CONSERVATION REFERENCE SERIES NO.12

Conserving India's Gentle Giants

Whale Shark Conservation Project 2002-2025

Eds: B C Choudhury, Sajan John, Saymanti B,
Arinita Sandilya and Vivek Menon

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TCSRD Tata Chemicals Society for Rural Development

Forest Department Gujarat

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Wildlife Trust of India (WTI) is a leading Indian nature conservation organisation committed to the service of nature. Its mission is to conserve wildlife and its habitat and to work for the welfare of individual wild animals, in partnership with communities and governments. WTI's team of 170 dedicated professionals work towards achieving its vision of a secure natural heritage of India.

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INVESTING IN COASTAL ECOSYSTEMS

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Principal Chief Conservator of Forests &
Head of Forest Force,
Gujarat State.

Foreword

Despite its size, wide-ranging distribution and the ease of identification, Whale Shark sightings are infrequently reported worldwide. The rarity of Whale Shark sightings, clubbed with other anthropogenic threats, has thus resulted in global concern regarding the health of its population. This led to the whale shark being classified as "Endangered" under IUCN categories. The whale shark was granted legal protection under The Wildlife (Protection) Act, 1972 in the year 2001 and the whale shark listed as Schedule- I fish species. Surveys have confirmed that the Gujarat coast is one of the major aggregation sites for whale sharks; however, it has now become evident that other whale shark aggregation areas also exist along both the East and West coasts of India. Despite this, public awareness remains low, necessitating targeted campaigns to make the people aware of the whale shark's protected status and to shift perceptions about this species.

It is a matter of pride that the Gujarat Forest Department, in collaboration with the Wildlife Trust of India (WTI) and Tata Chemicals Ltd., spearheaded whale shark conservation efforts in the country two decades ago. Today, this successful 'Gujarat Model' of whale shark conservation has slowly expanded to other coastal states as well. This visionary conservation initiative has brought about unprecedented change in the mindset of the people of Gujarat towards the whale shark. Fishermen now voluntarily release whale sharks accidentally entangled in their nets, and the fish once colloquially called "barrel", due to its sheer size has come to be affectionately called *Vhali* – "the dear one." The campaign has successfully transformed the whale shark from a hunted species into a cultural icon.

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I understand that similar changes are being observed in other coastal states where the project is operational, resulting in the successful rescue and release of more than 1000 whale sharks by the fishermen of Gujarat. The activities carried out have not only helped save whale sharks in Gujarat but have also become a role model for the conservation of this species across the country. I am pleased that the success of this project has received global recognition, most notably through the UNDP award presented to the initiative in Gujarat. While there is still a long way to go—particularly in empowering more fishermen to participate in whale shark conservation. I am confident that with the Gujarat Forest Department's commitment to facilitate the initiative, this goal shall soon be achieved.

The first successful satellite tagging of a whale shark in India has also paved the way forward to better understand the species' movement in Indian waters. Additionally, more cutting-edge molecular and hormonal assay studies need to be undertaken to gain a deeper understanding of the whale sharks visiting our waters. There is undoubtedly, more work required to unravel the mysteries of this unique fish, also known as the gentle giants of the sea. As we reaffirm our commitment to the conservation of whale sharks in the country, we are proud to present this publication, which documents the collaborative efforts carried out over the past two decades.

(Dr. A.P. Singh, IFS)
PCCF & HoFF, Gujarat State

Dr. Rima Jabado
Deputy Chair | IUCN Species Survival Commission
Chair | IUCN Species Survival Commission Shark Specialist Group
Dubai, United Arab Emirates

Message

Few creatures on our planet inspire as much awe and humility as the Whale Shark (*Rhincodon typus*). These gentle giants — the largest fish in the ocean — glide through our seas with a quiet majesty that transcends borders and cultures. Yet their size and symbolism belie a fragile reality: like so many marine species, Whale Sharks face mounting threats from targeted fishing, accidental capture, vessel strikes, habitat loss, and a changing climate. Their rarity and vulnerability are stark reminders of how much remains unknown about our oceans, and how urgently they need our care.

In a world where the health of our oceans is increasingly under threat, the story of Whale Shark conservation in India embodies the power of collaboration, compassion, and persistence. It's a story of hope — of how people, science, and culture can come together to protect a species once on the brink. Just two decades ago, Whale Sharks were hunted in Indian waters and largely invisible in public discourse. Today, they are celebrated as a model for how community-led action can transform a species' fate. This remarkable shift was not achieved through enforcement alone, but through a tapestry of approaches that wove science with traditional knowledge, legal protection with local leadership, and policy with people's pride.

This journey began with a visionary campaign more than two decades ago, when government, civil society, industry, and spiritual leaders came together to reimagine India's relationship with the Whale Shark. National legal protection and India's leadership in listing the species under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) provided the foundation. But it was the human dimension — the transformation of public perception — that turned the tide. Fisherfolk, once fearful of net damage or dismissive of the species' value, became its greatest allies. Communities that had never spoken of Whale Sharks now celebrate them. And faith-based narratives, coupled with local ambassadors, turned the Whale Shark into a powerful symbol of coexistence.

This work, and its impact, have been extraordinary. Over 1,000 Whale Sharks have been released from fishing nets along India's coastline — not by law enforcement, but by fishers themselves. Many of these rescues were motivated by a growing sense of stewardship and pride among fishing communities. Surveys have mapped new aggregation hotspots beyond Gujarat — in Kerala, Karnataka, Maharashtra, Lakshadweep, and along the east coast — and awareness campaigns have reached thousands of people. This publication, Towards a New Horizon: Conserving India's Gentle Giants, brings together this impressive body of work — the science, the community stories, the policy milestones, and the lessons learned. It is both a reflection of how far we have come and a roadmap for the challenges ahead. It shows how Traditional Ecological Knowledge (TEK) and Indigenous Technical Knowledge (ITK), when valued alongside formal science, can fill crucial gaps in our understanding of a highly migratory species. It reminds us that awareness, when rooted in cultural identity, can be more powerful than enforcement. And it demonstrates that conservation succeeds when it is aligned with livelihoods — when protecting a species does not compete with human needs but becomes part of them.

Yet, the road ahead is not without obstacles. Incidental entanglement remains the greatest threat to whale sharks in Indian waters, with gillnets accounting for the majority of reported captures. Awareness of legal protections is uneven, and perceptions of the species vary widely from state to state. In some areas, targeted capture still occurs, and the shadow of the fin trade persists. Moreover, populations of many other shark and ray species — equally vital to ocean health — continue to decline, sometimes unnoticed and unprotected. These challenges remind us that conservation is a continuous process, a commitment, not a single victory.

But if this story tells us anything, it is that change is possible and it is already happening. The willingness of communities to release entangled Whale Sharks, even when awareness is low, speaks to the deep human capacity for empathy. The fact that nearly 80% of citizens surveyed expressed willingness to support future conservation efforts suggests that the appetite for engagement is strong. And the success of the Gujarat model shows that, with the right mix of science, storytelling, and shared ownership, conservation can transcend regions, cultures, and generations.

As we look to the future, the task before us is clear. We must scale up what works; expanding community engagement programs, strengthening partnerships with fisheries, and integrating local knowledge into policy. We must invest in long-term monitoring, not only to better understand whale shark migrations but also to anticipate and mitigate emerging threats. We must continue to innovate, exploring new ways to align conservation with livelihoods and ensure that coastal communities are empowered, not burdened, by their role as stewards of the sea. Most importantly, we must keep telling stories like this one: stories that remind us that conservation is not an abstract ideal but a deeply human endeavour, driven by hope, respect, and responsibility. The Whale Shark's journey in India shows that species once hunted can become symbols of pride, that fear can give way to familiarity, and that exploitation can evolve into empathy.

These gentle giants have much to teach us about resilience, connection, and our shared future. Protecting them is about more than saving a species; it is about redefining our relationship with the ocean itself and ensuring it remains a source of life, wonder, and possibility for generations to come.

Dr Rima Jabado
September 2025

Message

At Tata Chemicals, our philosophy has always been to integrate care forcommunities, biodiversity, and sustainability as core to our well being. It was thisbelief that inspired us to take the first steps towards conserving the Whale Sharkalong the Gujarat coast. What began as a pioneering effort in partnership with theWildlife Trust of India, the Forest Department, and coastal communities has todaygrown into one of the most successful marine conservation programmes in thecountry.

The Whale Shark Conservation Project has shown us the power of collective action.From fishermen voluntarily releasing whale sharks caught in their nets, to schoolchildren carrying the message of conservation home, every stakeholder has played avital role in safeguarding this gentle giant — the world's largest fish. The release ofmore than a thousand Whale Sharks, once hunted for oil and meat, is a testament tothe fact that awareness, community participation, and science-led action cancollectively bring about meaningful change.

As we bring out this Publication, it is not just a documentation of efforts but also areminder of what is possible when business, government, science, and society cometogether for a shared cause. The Whale Shark conservation project continues toinspire us at Tata Chemicals to look beyond and work for a sustainable future wherepeople and nature thrive together.I am proud that this journey, which started on the Gujarat coast, is now recognised

globally as a model for marine conservation. Let this pioneering project of WTI,Gujarat Forest Department and Tata Chemicals serve as a model for public-privatecooperation and an inspiration for the next generation of conservation initiatives.

R. Mukundan

R. Mukundan
Managing Director & CEO
25th September 2025

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Preface

As someone born to the rhythms of the Malayalam language but raised across the diverse landscapes of India, my connection to Kerala has always been rooted in a deeper cultural memory—of stories carried by sea winds, of a people closely entwined with their coasts, and of an enduring reverence for nature. Among the many marine giants that roam our waters, the whale shark—or *Pulli Sravu* as it is locally known (or *Thimingala Sravu*)—has long stood out as a symbol of mystery, gentleness, and the quiet resilience of our oceans.

Two decades ago, we stood at the edge of a crisis. The hunt of these gentle giants, was documented first by the film maker Mike Pandey when he brought it to me, WTI took a bold step forward—urging the Government of India to list the whale shark under Schedule I of the Wild Life (Protection) Act, 1972. The campaign we led at the Wildlife Trust of India (WTI), in partnership with the Gujarat Forest Department, IFAW, and Tata Chemicals, not only secured this legal protection but also catalyzed India's successful push to include the whale shark under Appendix II of CITES.

Yet protection on paper is never enough. It is only when communities internalize conservation values that real change occurs. I am proud to say that, through consistent engagement, over 1,000 whale sharks have been rescued from accidental entanglement in fishing nets and released back into the wild in Gujarat and Kerala– each one a story of transformation, from fear to familiarity, from exploitation to empathy.

Across India, public discourse on wildlife often centres around charismatic terrestrial megafauna—elephants, tigers, and rhinos. Marine megafauna, despite their ecological significance and vulnerability, remain largely invisible in our

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collective consciousness. If conservation is to be truly inclusive, we must bring these species into the mainstream of public awareness.

To protect the whale shark, we must tailor our approach to local languages, traditions, and livelihoods. We must work with fishers—not against them—by offering not just recognition, but real incentives and support. We must engage schools, faith-based groups, fishers unions, fishery cooperative society (FCS) and harbour committees. It's equally important to remind every citizen that conservation is not a burden, but a shared responsibility to a species that graces our waters with quiet majesty.

In the end, conservation is a collective act of hope. Let this report be our shared starting point—one that guides, provokes, and ultimately leads us to protect the whale shark, not just as a species, but as a symbol of coexistence.

Vivek Menon, FLS
Founder and Executive Director
Wildlife Trust of India

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Executive Summary

The whale shark (*Rhincodon typus*), the world's largest living fish, is both an icon of the oceans and a vulnerable species facing escalating threats. Despite legal protection in India since 2001, its survival continues to be challenged by incidental capture, declining sightings, and limited awareness among coastal communities. *Conserving India's Gentle Giants: Whale Shark Conservation project 2002-2025* brings together findings from extensive surveys, conservation campaigns and scientific interventions along the west coast and east coast of India to provide a consolidated picture of the species' status and chart a roadmap for its recovery.

Whale sharks live up to 70 years and grow up to 18 meters long.

Whale sharks are elusive and highly migratory, making long-term scientific monitoring difficult. To address this gap, the project relied heavily on the Traditional Ecological Knowledge (TEK) and Indigenous Technical Knowledge (ITK) of fisherfolk. Between 2012 and 2013, surveys covering 1,703 respondents across 118 landing sites documented historical and recent encounters, incidental catch patterns, and new aggregation hotspots. These surveys confirmed that whale sharks are sighted across India's coastline, with five previously unrecorded aggregation sites identified beyond Gujarat, where the country's first and most successful whale shark conservation campaign was pioneered.

The whale shark occurrence survey along Gujarat was carried out with the funding support of TCL and GFD (2002-2005), Maharashtra, Goa, Karnataka, Kerala, Lakshadweep (2012-2013), Odisha and West Bengal (2016-2017) was carried out with the funding support of IUCN-MFF. The Andhra survey was carried out with the support of AP forest Department and EGREE Foundation (2015-2016). WTIs Rapid Action Project (RAP) Proponent did the survey along TN coast (2012-2013). The findings highlights important trends. Sightings were highest in Lakshadweep, followed by Maharashtra, Karnataka, and Kerala, with peak encounters between November and April when sardines and mackerel are most abundant. Incidental entanglement emerged as the greatest threat, with gillnets accounting for nearly three-fourths of all reported cases. Although direct hunting has sharply declined, occasional targeted captures and fin trade were reported from Kerala. Encouragingly, many fishers reported voluntarily releasing entangled whale sharks, though motivations were largely practical—avoiding net damage and loss of fishing time—rather than conservation-driven. Awareness of the 2001 fishing ban varied significantly between states: it was higher in Karnataka and Kerala but not always linked to release behaviour, while in Goa fishers with low awareness on whale sharks or their conservation status.

Socio-economic surveys in Kerala further revealed striking gaps in public knowledge and perception. While nearly 60 percent of citizens had heard of whale sharks, fewer than one-fourth could correctly identify them, and only 11 percent were aware of their legal protection. Among fishers, 62 percent reported encounters, but perceptions ranged from dismissing the whale shark as a "useless fish" to recognising it as a harmless creature that should not be caught. Notably, 78 percent of citizens expressed willingness to support future conservation efforts, underscoring the potential for community-led initiatives.

The Gujarat campaign, launched in 2004 through a unique partnership of government, civil society, industry, and spiritual leadership, demonstrated how awareness and pride could transform attitudes. Within a decade, it succeeded in eliminating whale shark landings in the state. Replicating such success along the rest of India's coastline required tailored approaches that combine legal enforcement with cultural outreach and livelihood-sensitive solutions. Building on this model, WTI extended campaigns to Kerala and Lakshadweep, where fishing intersects with major aggregation sites. Over the past seven years, these campaigns have successfully facilitated the release of 50 whale sharks along the Kerala coastline. Scaling such efforts across the remaining coastal states is essential to strengthen compliance, foster stewardship, and harmonise conservation with livelihoods.

This publication highlights that conserving India's gentle giants requires more than legal protection. It demands integrating indigenous knowledge with scientific research, aligning conservation with community livelihoods, and fostering reverence for the species. The successful model from Gujarat demonstrates that cultural pride, awareness campaigns, and inclusive stakeholder engagement can yield tangible results. By expanding these approaches nationally, India can ensure whale sharks are safeguarded by law and celebrated as symbols of harmony between people and the sea.

Impacts of the Project

Legal Protection Milestone: Whale sharks were brought under the Wildlife (Protection) Act, 2001, making them the first marine fish in India to receive legal protection. This landmark recognition criminalised hunting and trade, establishing the legal foundation for all conservation efforts that followed and placing marine biodiversity firmly within India's wildlife protection framework.

Global Leadership through CITES: In 2002, India supported the international protection of whale sharks under CITES, aligning with global conservation commitments. This elevated India's role in safeguarding migratory marine species that cross-national boundaries and showcased the country's leadership in marine conservation on the world stage.

1,000+ Whale Sharks Released: Over the past two decades, the project has facilitated the rescue and release of more than 1,000 whale sharks entangled in fishing nets across India's coastline. This remarkable achievement reflects both the scale of conservation success and a shift in fisher behaviour—from exploitation to stewardship.

Gujarat Whale Shark Day: The launch of a dedicated Whale Shark Day in Gujarat turned the species into a symbol of cultural pride. Once hunted, the whale shark is now celebrated as the daughter of the sea, embedding conservation into the cultural and emotional fabric of the state.

Ambassadors and Spiritual Leadership: The campaign's strategic engagement of spiritual leader and community ambassadors created mass awareness and influenced behavioural change at scale. By framing the whale shark within cultural and ethical narratives, the project reached audiences far beyond conventional conservation messaging, inspiring reverence and empathy for the species.

Additionally, the survey underscores the importance of:

- Continuous monitoring and reporting of sightings to understand migration patterns.
- Targeted outreach in high-risk zones such as Kerala and Lakshadweep, Malvan, Sindhudurg, and Kakinada to reduce entanglement.
- Strengthening community engagement programs that combine conservation education with practical incentives.
- Leveraging TEK and ITK alongside scientific studies to inform policy and management decisions.
- Expanding partnerships with local fisheries, civil society, and government agencies to sustain long-term conservation outcomes.

This consolidated reference series provides an actionable roadmap to guide policymakers, conservation practitioners, and local communities in ensuring that India's whale sharks are not only protected but thrive along its coastline for generations to come.

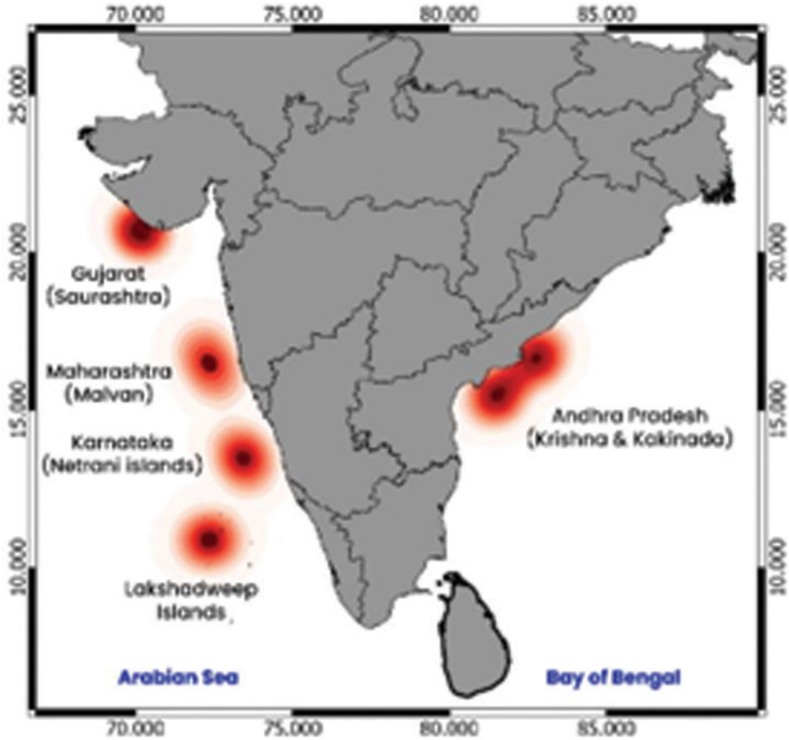
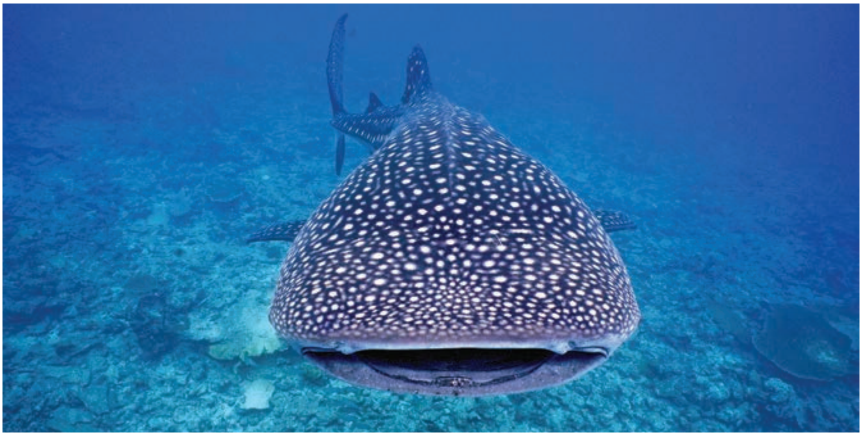


Fig. 1: Whale Shark aggregation site along the Indian coast

INTRODUCTION

Marine megafauna are large or relatively large species found in a marine ecosystem. This group includes a diverse range of taxa, such as sharks, polar bears, otters, rays, whales, cephalopods, pinnipeds, cetaceans, dolphins, porpoises, turtles, large marine birds (Fig 1). These species are key components of marine ecosystems, however, due to their long spans and low reproductive rates, they are often the first to suffer from human-induced pressures (Barnosky et al., 2004). In the past few decades, unprecedented die-offs among these species have heightened existing concerns about the overall health of the ocean.

Most of these marine megafauna play critical roles in maintaining healthy marine ecosystems, often acting as flagship, keystone, or umbrella species. Hunting poses a significant threat to both terrestrial and marine megafauna across continents, contributing to continuous megafaunal loss today in both terrestrial and marine ecosystems (Lewison et al., 2004). The recent decline in marine megafauna species, particularly those with little or no commercial value, such as sea turtles, seabirds and marine mammals, is largely attributed to incidental catch or bycatch,



Whale Sharks are largest filter feeders, using gill rakers to extract plankton from water.

in global fisheries (Lewison et al., 2004). With approximately 20%–30% of these species classified as endangered or threatened, there is growing concern about the adverse effects of human activities on marine megafauna.

As early as 15,000 years ago, intense hunting pressure coupled with habitat loss, led to the rapid extinction of large mammal genera in North America and New Zealand, Madagascar and Hawaii (Anthony 1991). In each case, megafaunal species were extirpated within a relatively short period of 100–1000 years (Lewison et al., 2004). Paleohistoric megafauna likely had life-history strategies similar to those of extant megafauna: low (and uncertain) recruitment rates over a long lifetime, and low mortality rates among older individuals. While these strategies provided a buffer against annual environmental and demographic fluctuations, they also made populations particularly vulnerable to extinction when faced with intense hunting pressure on older individuals.

India is one of the 12 mega-biodiversity countries and 25 hotspots of the world's richest and highly endangered eco-regions. Around 40 species (120 globally) are estimated to occur in the Indian Ocean Region (IOR). Marine resources, which have traditionally been of significant economic value, have seen a dramatic increase in commercial exploitation over recent decades. In addition to commercial exploitation, marine species are also significantly impacted by fishery-related injuries (incidental capture in fishing gears), and disorientation (and even mortality) due to naval exercises and oil drilling.

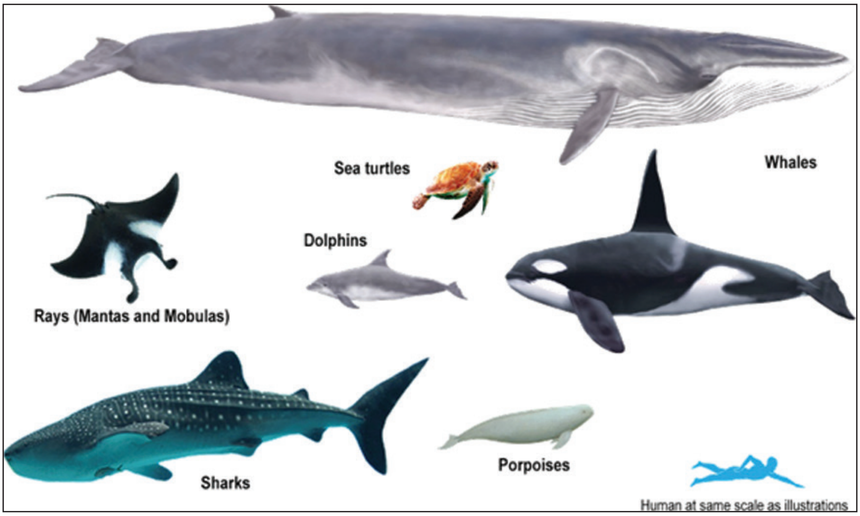


Fig 2. Tropical marine megafauna species

Commercial Shipping: India's fisheries sector is a major and ever-expanding industry. Reports indicate that fish production in the country has increased more than tenfold since it gained independence in 1947. According to the Food and Agriculture Organization (FAO) of the United Nations, fish output in India doubled between 1990 and 2010. With its extensive marine coastline and numerous fish landing centers, India is a major supplier of fish in the world. Increased traffic in the IOR has thus resulted in many incidents of marine megafauna stranding, caused by hunting, boat strikes, fishing gear entanglement, and habitat degradation.

Whale Shark: The Whale Shark (*Rhincodon typus Smith,* 1829) classified in the order Orectolobiformes, is a monotypic taxon in the family Rhincodontidae. A slow-moving filter feeder, it is the largest known extant fish species in the wild. Whale Sharks are distributed all along the tropical and warm-temperate seas except the Mediterranean. It is thought to be primarily pelagic (preferring an open-ocean habitat) but seasonal feeding aggregations do occur at several coastal sites throughout the tropics. The Whale Shark is known to occur in the waters of over 130 countries (Turnbull and Randell, 2006) and some of the most well-documented sites of its occurrence are in the Gulf of Mexico, the Gulf of California, Belize, Honduras, Western Australia, the Galapagos, New Zealand, Philippines, Indonesia, Madagascar, Mozambique, Kenya, India, Pakistan, Maldives, Seychelles, Indonesia, and Thailand (Fig 3).

Whale Sharks generally hold limited value to fisheries. However, increasing demand, during the early 1990s, for their flesh and fins in some Southeast Asian countries, (especially Taiwan) led to an increase in targeted catch of the species in countries like the Philippines, India and Taiwan. Artisanal fishing for Whale Sharks has existed in a number of countries, such as Indonesia, the Philippines, Iran, Maldives, India and Pakistan (Anderson and Ahmed, 1993; Hanfee, 2001; Compagno, 2002; Rowat, 2007; White and Cavanagh, 2007). Additionally, the surface swimming behavior of Whale Sharks has led to mortality from collisions with boats; these incidences are not often reported but are presumably a regular occurrence in some areas (Rowat, 2010).

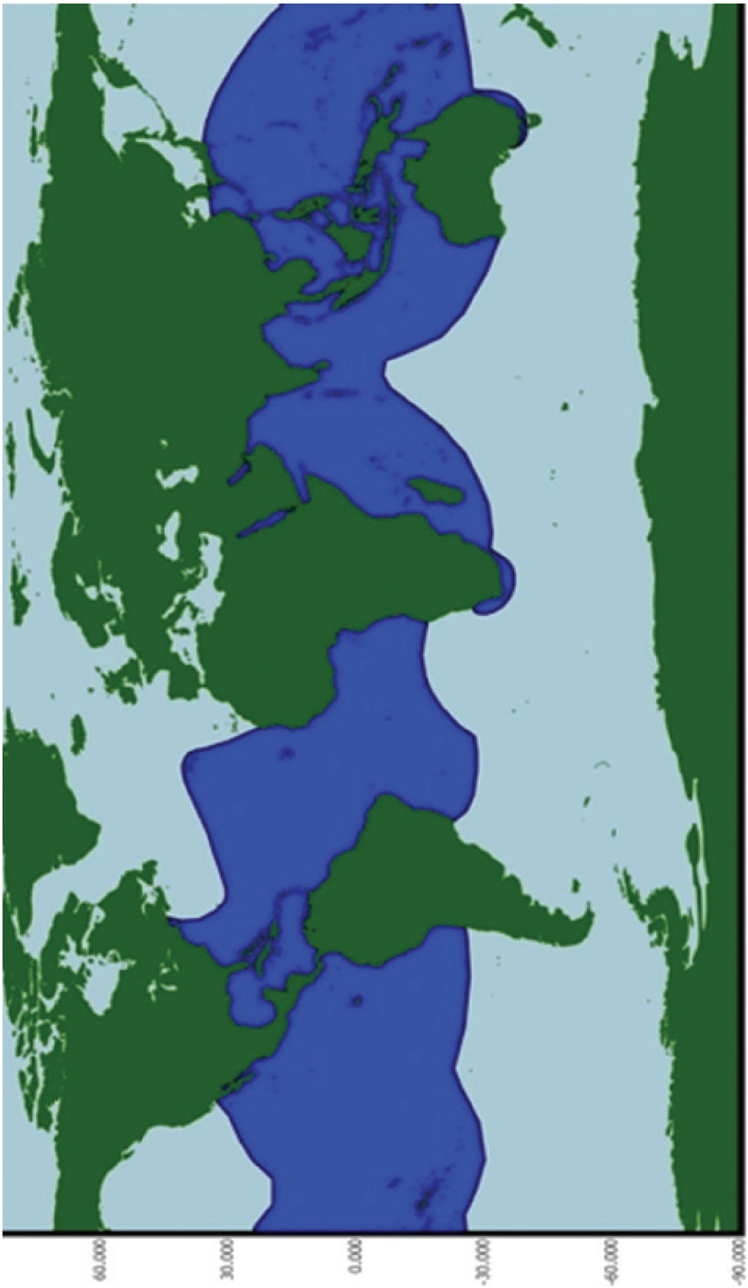


Fig 3. Whale Shark distribution across the globe (dark blue shades represent the Whale Shark distribution range)

International legislation aimed at the conservation and protection of Whale Sharks includes their listing in *Appendix II* of the Convention for the Conservation of Migratory Species (CMS) of Wild Animals in 1999 (CMS, 1999), *Appendix II* of the Convention on International Trade in Endangered Species (CITES) (Fowler, 2000; CITES, 2002), Annex 1 (Highly Migratory Species) of the United Nations Convention on the Law of the Sea (UNCLOS) and the Convention on Biological Diversity (CBD). Despite their legal protection in many countries, illegal and incidental capture of the species continues to be reported (Kasinathan *et. al.,* 2006; Riley *et. al.,* 2009) worldwide.

Although a ban on fishing, killing and possession of Whale Shark products in India has been in place since 2001, incidental catch of the species continues to occur along the Indian coast (Romanov, 2002; Choudhary et. al., 2008; Sajeela et. al., 2010) with many incidents likely going unreported along the extensive coastline of India. This is partly due to a lack of awareness of the imposed legislation, the vulnerability of the species, and the high cost involved in the rescue and release of accidentally entangled Whale Sharks.

Occurrence of Whale Sharks and other Megafauna in Indian Ocean

Marine megafauna species can be considered as umbrella species (Zacharias and Roff, 2001; Branton and Richardson, 2011) as their effective conservation should incorporate the conservation of a suite of lower trophic level species and associated ecosystem services. As top predators in the marine ecosystem, marine megafauna play a crucial role in maintaining biodiversity patterns through mechanisms such as top-down control or behaviorally mediated effects (Heithaus et al., 2008).

Marine megafauna in the Indian Ocean include sea birds marine mammals, sea turtles, and large elasmobranchs (Laran *et al.,* 2017). Among these, Odontocetes– comprising toothed whales, dolphins, porpoises, etc., which represent the majority of marine megafauna are more diverse in waters from 30oN–30oS (Kaschner *et al.,* 2011). A few major conservation initiatives such as the Indian Ocean Whale Sanctuary established by the IWC (International Whaling Commission), regional cooperation for the conservation of cetaceans and dugongs supported by the Indian Ocean Commission [consisting of Comoros, La Réunion (France), Madagascar, Mauritius, and the Seychelles], and the IOSEA Marine Turtles (MoU on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia etc., have already been implemented in this area (Laran *et al.,* 2017).

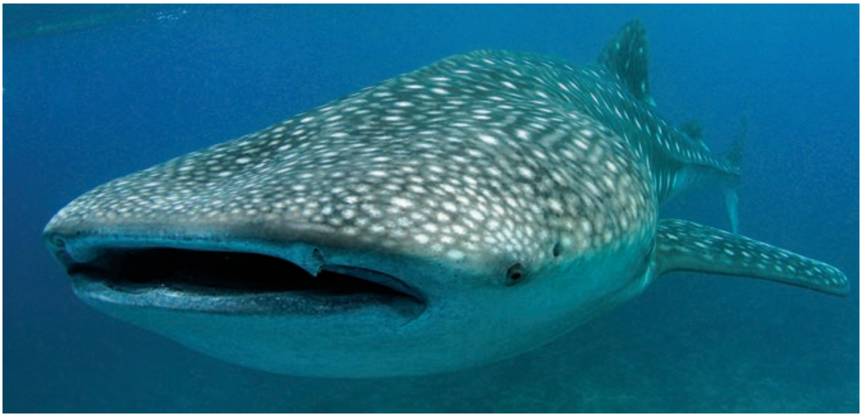
The Whale Shark is a migratory species found in warm and temperate waters around the globe (Sequeira *et al.* 2014; Bailly 2008). As a broad-ranging species, it has been observed in areas with surface seawater temperatures ranging from 18–30°C (Fowler, 2000). However, it has also been recorded in latitudes with far cooler temperatures as far as 41° N and 36.5° S Wolfson, 1986). Whale Sharks have been hunted for their skin, fin, meat and liver oil, which have a commercial market in some parts of Asia. In terms of their spatial distribution, Whale Sharks occur in Western Australia, Bangladesh, Djibouti, India, Indonesia, Kenya, Madagascar, Malaysia, the Maldives, Mauritius, Mozambique, Seychelles, Somalia, South Africa, Sri Lanka, Tanzania and Thailand (Irvine and Keesing, 2007; Norman, unpublished).

Occurrence of Whale Sharks and other Megafauna along Indian Coast

India is a major maritime nation and one of the leading marine fisheries exporting countries in the world. Its ever-expanding fisheries play a crucial role in both the ecology and economy of the nation, with India ranking second in global fish production. Having nearly 8,000 Km of coastline, it supports the livelihood of more than 14 million people.

Marine megafauna aggregate in large numbers along the off-shore waters (seasonally) as part of their breeding and feeding requirement (Eg. Olive Ridley turtles *Lepidochelys olivacea*). According to CMFRI, the occurrence of more than 160 species of elasmobranchs has been recorded along India's commercial fishing zones. In India, Gahirmatha and Rushikulya, along the Odisha coast are renowned for their mass nesting of Olive ridley turtles.

Along with other megafauna, Whale Sharks are also known to aggregate spatially. In India, records of Whale Shark landings date back to 1889, with documented occurrences appearing in published literature for nearly a century. Early records include those by Pillai (1929), Prater (1941), Kulkarni (1948) and Chacko & Mathew (1954). Much of the information about Whale Sharks in India is available from reports of beached or stranded individuals. Most of the published records have been based on single landings at various fish landing sites along the Indian coast. Whale Sharks have been reported along the entire Indian coastline extending from Gujarat on the west to West Bengal on the east (Silas, 1986; Pravin, 2000; John, 2010). In recent decades, sightings of Whale Sharks have been reported from nearly all maritime states of India, including Gujarat (Hanfee, 2001), Maharashtra (Jadhav *et. al.,* 2005), Karnataka (Kemparaju *et. al.,* 2002), Kerala (Paul, 2006), Tamil Nadu (Rajapackiam *et. al.,* 2006), Andhra Pradesh (Rao, 1992), West Bengal, Odisha (John, 2010, Patro, 2017) and Goa (Pravin, 2000; Choudhary, 2008; Choudhury *et al,* 2013).



Each whale shark has a unique spot pattern, like a human fingerprint.

Whale Shark Exploitation In India

Whale Sharks were not commercially exploited until the early 1880s with most landings being incidental and either discarded or thrown back into the sea (Pravin, 2000). However, the mid-1980s saw the world's largest fish become a target for fisheries for their liver, which was used to extract oil for coating fishing vessels (Pravin, 2000; Choudhary, 2008; Vivekanandan and Zala, 1994). The demand for their meat, fins, liver, skin and cartilage grew in countries like Taiwan (Chen and Phipps, 2002), Japan, Singapore and Hong Kong, especially after the ban on Whale Shark hunting in countries such as Maldives in 1995 and the Philippines in 1998.

Whale Shark hunting became a targeted and specialized fishery, with these gentle giants being hunted for nearly every part of their body (Fig 4). This resulted in an extremely large and unsustainable number of Whale Sharks being caught, with the maximum recorded landings of 279 sharks in December 1999 alone in Gujarat, India (CITES, 2002.). Hanfee (2001) reported as many as 40 Whale Shark landings recorded in a single day (September 15, 2001) along the Gujarat Coast. It is estimated that approximately 1,000 Whale Sharks were caught off the Gujarat coast in 1998 alone (CITES, 2002).

Cured Whale Shark meat and liver oil had a good market in India, while fins, frozen meat and skins were highly valued in Singapore, Korea and Taiwan (White and Cavanah, 2007). Between 1999 and 2000, an export of 465,000 kg of Whale Shark meat from Veraval in Gujarat brought in approximately INR 218,000 (Hanfee, 2001). The Whale Shark fishery was thus a source of economic profit and provided a sizeable income to fishers who were dependent solely on fishing for their livelihood. Hanfee (2001) described two predominant methods of Whale Shark capture. The first involved mechanized trawler boats fitted with large hooks or harpoons. The second predominant method involved artisanal fishermen using small wooden dugouts or fibre canoes fitted with outboard motors. These hooks were tied to large empty PVC barrels for buoyancy, leading locals to nickname the fish "Barel" after the barrels. This strongly indicates that Whale Shark hunting was a targeted fishery practice across all the fishing communities on Saurashtra Coast in Gujarat.

Fig 4: Whale Shark landings have been recorded along the Kakinada coast, Andhra Pradesh in recent years.

India has seen only one long-term research and conservation project dedicated to Whale Sharks, initiated by the Wildlife Trust of India (WTI) in 2003 in collaboration with the Gujarat Forest Department and TATA Chemicals Limited (TCL). This ongoing project focuses on raising awareness about the plight of the species (Fig 5), rescuing and releasing incidentally captured Whale Sharks, and understanding their biology through rescue operations. In 2008, WTI conducted a survey along the 1600 km coast of Gujarat to understand the past and present status of the whale shark. The survey identified the offshore waters of Veraval, Sutrapada and Dhamlej as the primarly aggregation areas for Whale Sharks along the Gujarat coast (Praveen Kumar et. al., 2008 unpublished report). Additionally, satellite tagging of Whale Sharks along the Gujarat coast yielded some firsthand information on the long-distance movement of Whale Sharks from Gujarat to other coastal territories.

WTI's efforts over the last 23 years have not only identified large aggregations of Whale Sharks along the Gujarat coastlines but have also put an end to the indiscriminate slaughter of these species. To effectively halt the hunting and landings of accidentally entangled Whale Sharks in Indian waters, additional data is needed from maritime states beyond Gujarat, including information on fishing activities, beachings, and temporal presence. These surveys are crucial for developing Whale Shark Conservation Action Plans for each Indian maritime state, which will form a part of the National Action Plan for Whale Shark conservation. Supported by the IUCN-India and Mangroves for Future (MFF), WTI conducted a survey along the west coast of India resulting in the identification of four major Whale Shark aggregation areas in the Arabian Sea (Choudhury et al, 2013). Additionally, with the support of the East Godavari Riverine Estuarine Ecosystem (EGREE) Foundation, WTI surveyed the Andhra coast which led to the identification of two more Whale Shark aggregating sites (Choudhury et al, 2016) (Appendix-3 (VII)).

WTI's efforts over the last 23 years have not only identified large aggregations of Whale Sharks along the Gujarat coast but have also put an end to the indiscriminate slaughter of these species. The fishers of Gujarat have so far rescued and released more than 986 whale sharks. To effectively halt the hunting and landings of accidentally entangled Whale Sharks in other maritime states of India (other than Gujarat), WTI have started whale shark conservation projects in Kerala, Lakshadweep and in Goa. These projects are also yielding results and fishers of Kerala have so far rescued and released 50 accidentally entangled whale sharks from Kerala waters.

While we recognize that there is more work required to unravel the mysteries of this unique fish in this region, this document will function as a reference guide on who, how, when and what were done to save the gentle giants along the Indian coastline.

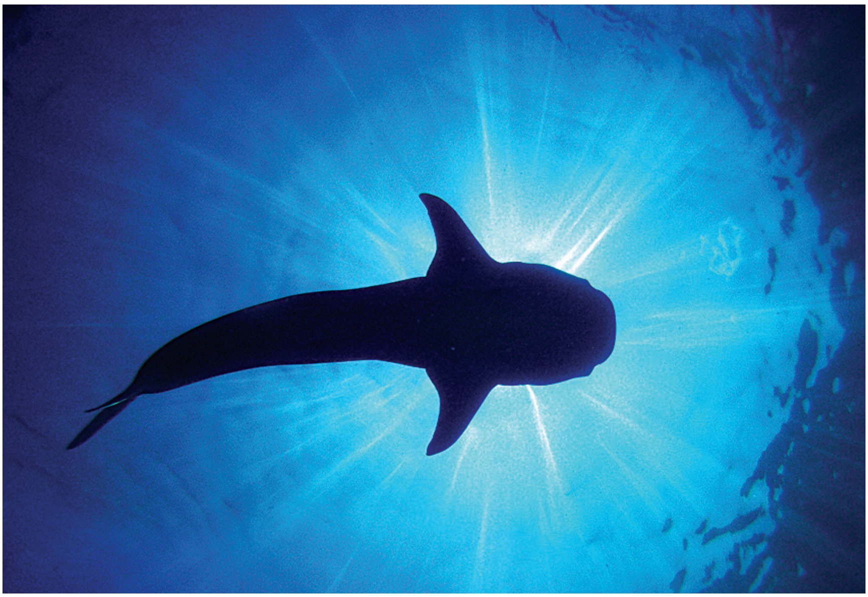
Fig 5. Awareness programs of WTI, TCL and Gujarat Forest Department collaborative Gujarat Whale Shark conservation project targeted school children to fishers has helped stop killing of Whale Sharks along Gujarat waters.

CHAPTER 1

Rationale, Objectives, Study Areas and Methodology

As a highly mobile species, Whale Sharks spend much of their lives beyond human reach, making long-term observation of their behaviour in the wild challenging and demanding. It is, therefore, understandable that science needs a greater understanding of their life history. Fisherfolk across the world possess valuable Indigenous Technical knowledge (ITK) about marine megafauna through their Traditional Ecological Knowledge (TEK). This Indigenous knowledge has been used by marine researchers, conservationists and management scientists globally (Drew, 2005; Stacey *et. al.*, 2008; Swathi *et. al.*, 2007 and Rinkevich *et. al.*, 2011.)

This project used the TEK and ITK (pertaining to the marine environment and other resources including Whale Sharks) of the fishers operating in the two Large



Whale Sharks are generally solitary, migrating long distances to feed and breed.

Marine Ecosystem (LME) of the Arabian Sea along the West Coast and the Bay of Bengal along the East coast of India, to understand the past and present status of Whale Sharks, their aggregation hotspots and other aspects such as fishing pressure and other threats. The rationale for contemplating the survey is to address the information gap about Whale Sharks along the west and east coasts of India.

The survey conducted along the coastal states of India aims to enhance our understanding of the hotspots of Whale Shark sighting locations, seasonal timing, frequency, and the areas with the most sightings. Additionally, it seeks to assess the frequency and abundance of Whale Shark encounters during fishing activities. By analyzing current and past Whale Shark landing data alongside the survey outputs, we can identify the Whale Shark aggregation hotspots[1] along our coastline requiring immediate conservation action.

Objectives

- To understand Whale Shark distribution along the Indian coastline and the range of threats they face,
- To analyze past and present distribution trends of Whale Sharks along the Indian coastline
- To develop a Whale Shark conservation strategy and action plan for implementation based on the mined information.

Study Area

India's coastline stretches approximately 11,099 km, with Whale Sharks reported along its entire length. The survey was conducted all along the nine maritime states and one island territory viz Gujarat, Maharashtra, Goa, Karnataka, Kerala and Lakshadweep islands on the west coast, as well as West Bengal, Odisha, Andhra Pradesh and Tamil Nadu on the east coast.

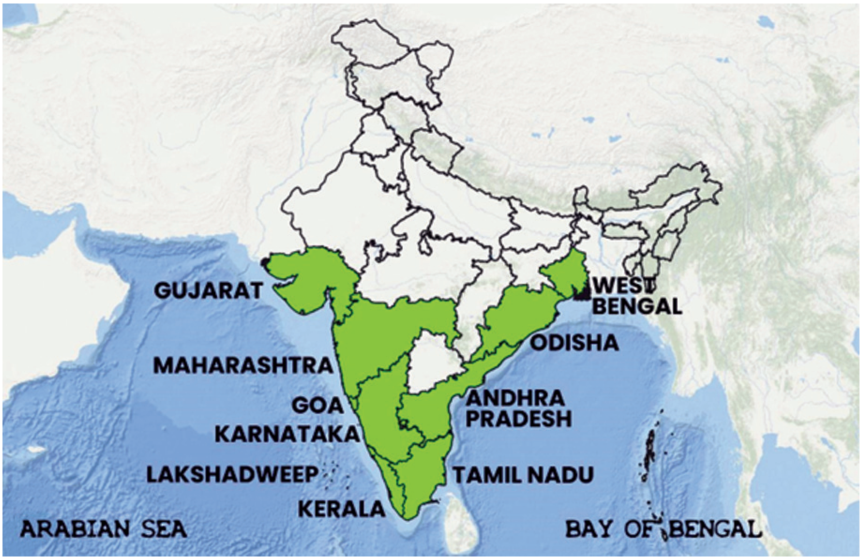


Fig. 5: Whale Shark distribution areas in India

Survey Design And Methodology:

Literature Review

The first phase of the survey involved a review of existing Whale Shark information:

- Published literature: to understand scientific information on Whale Sharks along the coast of India.
- Grey literature: to understand the past and present status of Whale Sharks along the Indian coast and media reports providing threat information were also reviewed.

These reviews encompassed various disciplines related to Whale Shark science, including conservation biology, anthropology, marine ecology and conservation. Sources of information comprised both published and unpublished literature, gathered through library searchers, databases and the internet. The results were summarized according to the key themes relating to Whale Shark ecology and migration, their uses, threats, traditional and technical knowledge across geographic regions and cultural perspectives. The literature review was primarily a desktop textual analysis of information, identifying topics and analyzing themes as well as establishing a framework for the ground study.

Consultation with professional institutions and organizations

In the second phase of the project, the survey team started collecting existing information on Whale Shark landing, stranding and sighting records from different scientific institutions, and governmental and Non-Governmental Organizations (NGOs) working along the coastline.

Developing the TEK and ITK-based survey questionnaires

By refining the existing TEK of Whale Shark survey questionnaire used in eastern Indonesia and the ITK questionnaire developed by CMFRI for their marine mammal field survey, a new structural questionnaire was developed (see Appendix-1).

Questions and topics in the questionnaire related broadly to the following themes:

i. Understanding Whale Shark distribution across the Indian coastline

ii. Range of threats experienced by Whale Sharks along the coast

Planning and finalizing the fish landing sites and villages for the survey

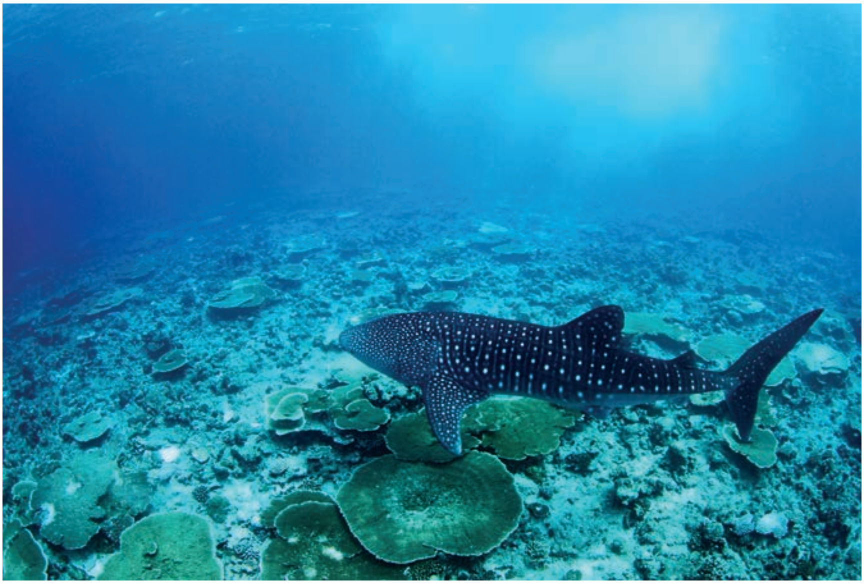
Details on major and minor fish landing centers along the coast were collected from CMFRI and the State Fisheries Office. Villages for the survey were selected based on the number of fishing crafts and proximity to major fish landing centers.

Planning the surveys

Fishing is predominantly a male-dominated occupation, hence the questionnaire survey was primarily targeted male fishers. We categorized them into two groups i.e., retired fishermen (>55 age) and active fishermen (<55 age). The importance of focusing the questionnaire survey on retired fishermen was to gather historical information about the Whale Sharks in their area of operation, while the survey of active fishermen sought to gather the present information about the Whale Sharks in the area of operation.

Conducting the questionnaire survey

The results of the literature review were used to define the field survey design, including the key topics and questions for the interview. The questionnaire was translated into regional languages. In addition to the translated questionnaires,



Whale Sharks though belong to the shark family; the whale is termed for their enormous size.

the interviewer also carried resource materials such as Whale Shark pictures and scale models which were shown to the target audience for accurate identification. Each questionnaire survey with a single respondent lasted between 30-45 minutes. Public gathering locations such as fish landing centres and local fishermen societies were targeted to facilitate easier access to the fisherfolk.

Data Analysis

The results from the literature review and field interviews were analyzed qualitatively. Data analysis was conducted using Microsoft Excel, while maps were prepared using QGIS.

The report summarizes the findings from these surveys, documenting Whale Shark distribution, and highlighting the Traditional Ecological Knowledge and conservation efforts across multiple states. The report provides recommendations for effective conservation measures, public and policy awareness, and support for sustainable livelihoods to ensure the long-term survival of Whale Shark populations.

CHAPTER 2

WEST COAST SURVEY

An assessment of the past and present distribution status of the Whale Shark along the West Coast of India

Choudury. B.C, Kaul. R, Premjothi. P.V.R, Subburaman. S, Matwal. M, Joshi. D, and Louise. J

Wildlife Trust of India

1. Rationale of the survey

Whale Sharks are highly mobile animals spending most of their lives out of reach of humans, making any long-term observation of their behavior in the wild exceedingly difficult and prohibitively expensive. It is, therefore, understandable that science has little understanding of Whale Shark life history. However, fisherfolk across the world through their Traditional Ecological Knowledge (TEK) possess a fairly adequate Indigenous Technical Knowledge (ITK) about Whale Sharks in the marine environment. Such indigenous knowledge has been used by marine research, conservation and management scientists worldwide (Drew, 2005; Stacey et al., 2008; Swathi et al., 2007; Rinkevich et al., 2011). The present project, therefore, aims to use the TEK and ITK of fisherfolk operating in the Arabian Sea along the west coast of India, including the maritime states of Maharashtra, Goa, Karnataka, Kerala and Lakshadweep Islands to understand the past and present status of Whale

Whale Sharks are ovoviviparous: eggs hatch inside the mother, giving birth to live young.

Sharks, identify their aggregation hotspots and other aspects of their off-take in the Arabian Sea.

The rationale for this project is to address the information gap regarding Whale Sharks along the west coast of India, except for the state of Gujarat (where a similar type of fishermen survey was conducted by WTI in 2008). Through questionnaire surveys in the coastal villages along the west coast of India, the project aims to gain a better understanding of the hotspots of Whale Shark sighting locations, and the season and frequency of sightings. Additionally, the surveys will provide insights into areas with a higher number of encounters during fishing activities, and the frequency as well as possible locations of other marine mammal sightings in association with Whale Sharks.

Based on past and current Whale Shark landing information as well as the present west coast survey outputs, we can single out their aggregation hotspots on the west coast of India that require immediate conservation action. Aggregation hotspots refer to the geographic locations where Whale Sharks have been sighted, or where they are believed to aggregate or migrate. This information formed the basis of a Conservation Action plan for Whale Shark Recovery along the west coast of India and the entire coastline.

2. Objectives of the survey

The objectives of the survey were:

1. To understand Whale Shark distribution across the west coast of India and the range of threats they face.
2. To develop draft recovery plans for the Whale Sharks in collaboration with the respective Indian range states.

3. Survey area

The west coast of India spans five maritime states and one archipelago, stretching 3,300 km from Gujarat to Kerala. Along this coastline, there are 846 fishing villages where approx. 8,99,332 fisherfolk (excluding Gujarat) are actively engaged in fishing in the Arabian Sea (FSI information, 2011). Fishing activities are undertaken using motorized and mechanized fishing boats. The fishing grounds off the west coast of India extend up to an average depth of 80 meters and the continental shelf extends up to 50 nautical miles from the coast. Notably, the fishing grounds off the Maharashtra coast reach depths of 91 meters and extend up to nearly 100 Nautical Miles from the coast. Heavy fishing activity is observed during the post-monsoon period (October to December). A fishing ban has been imposed by the Govt. of India for a period of nearly two months during the monsoons which varies from state to state, as given below, every year. However, traditional and artisanal fishing boats are permitted to carry out fishing during the ban period.

Table 1. Seasonal fishing ban or holiday along maritime states in the west coast of India

State/Union Territory	Year of Intro-duction	Notified Period	Days	Type of Fishing ban	Type of fishing permitted
Maharashtra	1990	10 June – 15 August	67	All Craft	Nil
Goa	1989	10 June – 15 August	67	All Craft	Nil
Karnataka	1989	15 June – 29 July	45	All except motorized OBM/IBM vessels up to 25 hp engine	Motorized up to 25 hp engine
Kerala	1988	15 June – 31 July	47	Mechanized vessels/ motorized craft > 10 hp engine	All traditional and motorized crafts of OBM/ IBM up to 10 hp engine

Source: Vivekananda et al., 2010, Marine Fishery Policy Brief - 2

The climatic condition in the Arabian Sea is characterized by the two monsoons – the South-West and the North-East. The South-West monsoon lasts from May to September and the latter from September to May. The best time for regular fishing is during the winter months when oceanographic conditions are relatively stable. The currents are slow and the waters above the continental shelf experience minimal fluctuations in temperature and other physical or chemical factors. The present questionnaire survey was conducted in all the states of the west coast of India (except Gujarat), including the Lakshadweep Islands between May 2012 and March 2013.

3.1 Maharashtra coast

Maharashtra has a 720-km long coastline with a continental shelf of 1,12,000 km^2 and 406 fishing villages in five coastal districts. Overall, there are 152 fish landing centers supporting a total of 23,508 fishing crafts of which 13,053 are mechanized, 3382 are motorized and 7073 are traditional crafts. According to the 2011 state fisheries statistics, Maharashtra has a total of 3,19,397 fisherfolk. Based on the reviewed records of historical Whale Shark landings as well as data from CMFRI and the State Fisheries Department's fishermen census, the project selected 21 major landing centers near fishing villages in the state for conducting the questionnaire-based survey to document their TEK and ITK on whale sharks (Fig. 6).

3.2 Goa coast

Goa has a 104-km long coastline with a continental shelf of 10,000 km^2 and 39 fishing villages in two coastal districts. Within the state, there are 34 fish landing centers supporting a total of 2,551 fishing crafts of which 1,087 are mechanized, 932 are motorized and 532 are traditional crafts. As per the 2011 state fisheries statistics, Goa has a total of 10,668 fisherfolk. Based on the reviewed records of historical Whale Shark landings as well as data from CMFRI and the State Fisheries Department's fishermen census, the project selected 12 major landing centers near fishing villages in Goa for conducting the questionnaire-based survey to document their TEK and ITK on Whale Sharks (Fig. 7).

3.3 Karnataka coast

Karnataka has a 300-km long coastline with a continental shelf of 27,000 km^2 and 156 fishing villages in three coastal districts. There are 88 fish landing centers supporting 15,655 fishing crafts of which 4,373 are mechanized, 3,705 are motorized and 7,577 are traditional crafts. According to 2011 state fisheries statistics, Karnataka has a total of 1,70,914 fisherfolk. Based on the reviewed records of historical Whale Shark landings as well as data from CMFRI and the State Fisheries Department's fishermen census, WTI selected 23 major landing centers near fishing villages for conducting the questionnaire-based survey to document the occurrence and distribution of Whale Sharks in the Karnataka coast (Fig. 8).

3.4 Kerala coast

Kerala has a 590-km long coastline with a continental shelf of 40,000 km^2 and 222 fishing villages in nine coastal districts. Within the state, there are 178 fish landing centers supporting 29,177 fishing crafts of which 5,504 are mechanized, 14,151 are motorized and 9,522 are traditional crafts. According to 2011 state fisheries statistics, Kerala has a total of 6,02,234 fisherfolk. Based on the reviewed records of historical Whale Shark landings as well as data from CMFRI and the State Fisheries Department's district-wise census, we selected 57 major landing centers near fishing villages for conducting the questionnaire-based survey to document their TEK and ITK on Whale Sharks (Fig. 9).

3.5 Lakshadweep (Union Territory)

Lakshadweep has a 132 km coastline with a continental shelf of 4,000 km^2 and 20 fishing villages in 10 inhabited islands. There are 19 fish landing centers within the state which support 2,384 fishing crafts, of which 667 are mechanized, 376 are motorized and 1,341 are traditional crafts. As per the 2011 state fisheries statistics, there are 40,328 fisherfolk in Lakshadweep. Based on the reviewed records of historical Whale Shark information and Agatti Forest Department data, WTI selected 5 important islands in Lakshadweep for conducting the questionnaire-based fishermen survey to document their TEK and ITK on Whale Sharks (Fig. 10)

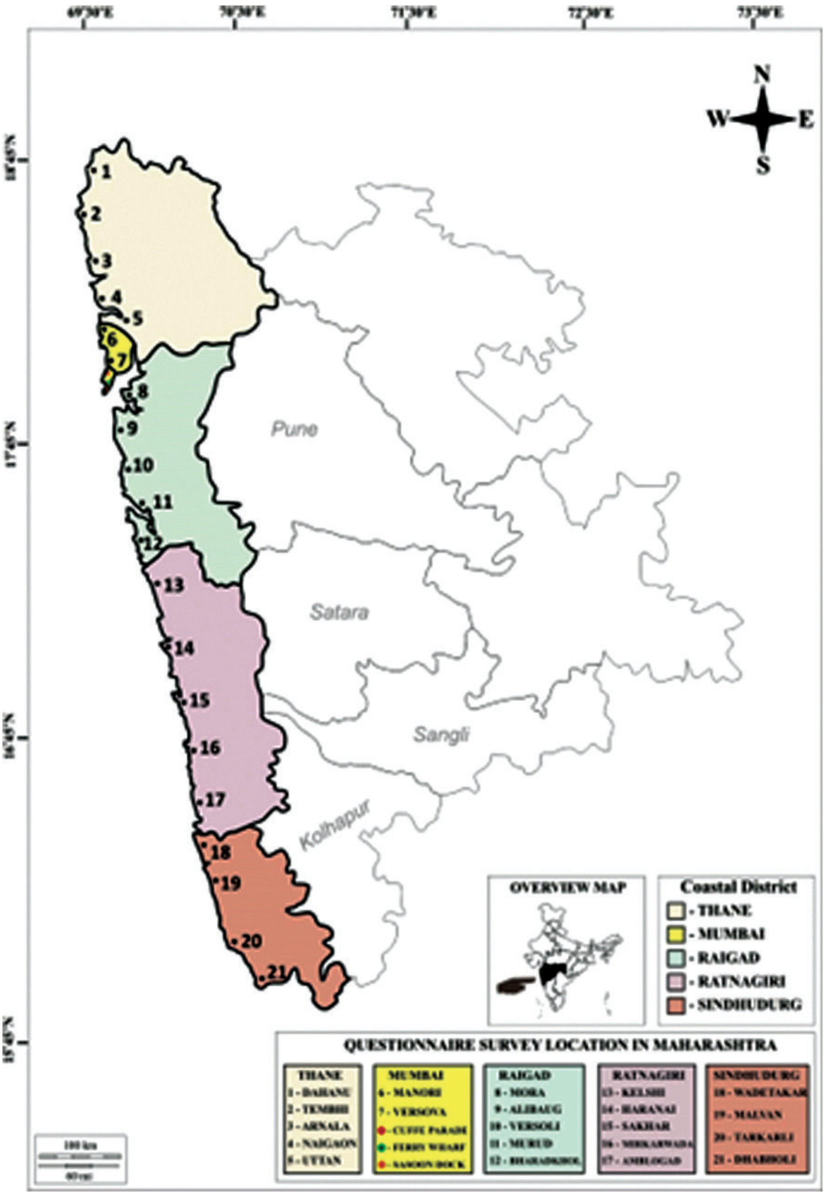


Fig.6: Location of communities visited in Maharashtra for questionnaire survey

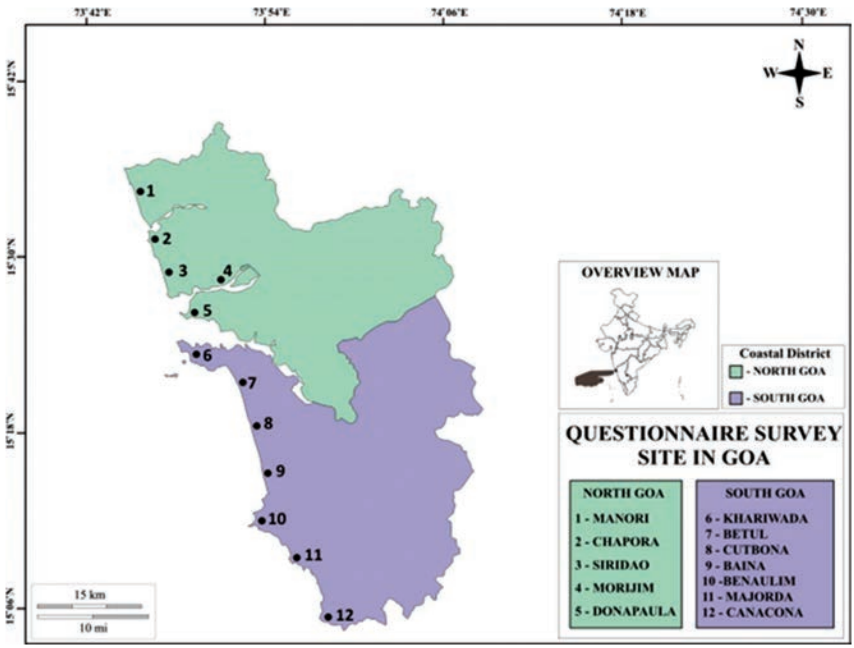


Fig.7: Location of communities visited in Goa for questionnaire survey

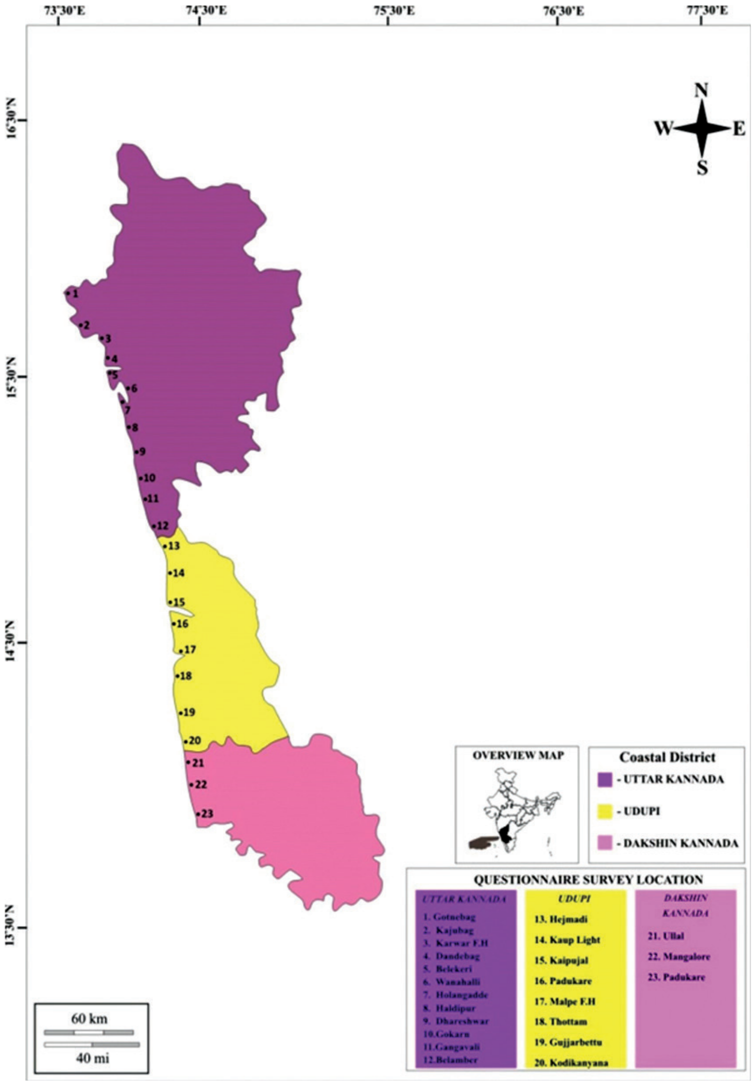


Fig.8: Location of communities visited in Karnataka for questionnaire survey

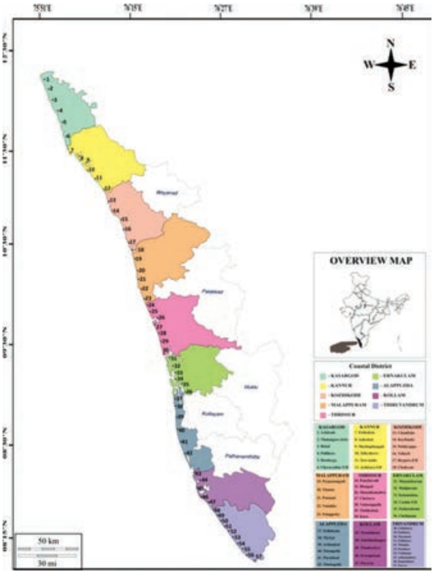


Fig. 9: Location of communities visited in Kerala for questionnaire survey

Fig. 10: Location of communities visited in Lakshadweep Island for questionnaire survey

4. Survey design

4.1 Literature Review

The first phase of the survey involved a review of existing Whale Shark information in 2 major areas of interest:

- Published literature to understand scientific information on Whale Sharks along the west coast of India.
- Grey literature on the past and present status of Whale Sharks along the west coast of India. Media reports that provide information about the threat to Whale Sharks in the individual states were also reviewed.

These desktop reviews covered various disciplines of Whale Shark science which includes conservation biology, anthropology, marine ecology, and conservation. The reviews covered a wider scope in geographical coverage than the west coast of India along with the Maldives and Qatar regions. Sources included published and unpublished literature gathered through library searches via catalogues, databases, and the internet. The results of the literature review have been summarized according to key themes relating to Whale Shark ecology and migration, uses, threats, and traditional and technical knowledge across geographic regions and cultural perspectives. The literature review was primarily a desktop textual analysis of information, identifying topics, and analyzing themes as well as establishing a framework for the study.

4.2 Consultation with professional institutions and organizations

In the second phase of the project, the survey team started collecting existing information on Whale Shark landing, stranding, and sighting records on the west coast of India from different scientific institutions, government and Non-Governmental Organizations (NGOs) working in the coastal states along the west coast.

4.3. Developing the TEK and ITK based survey questionnaires

Refining the existing Traditional Ecological Knowledge (TEK) of the Whale Shark survey questionnaire used in eastern Indonesia by Stacey et al., (2008) and the Indigenous Technical Knowledge (ITK) questionnaire by CMFRI for their marine mammal field survey by Vivekanandan et al., (2012), a new structural questionnaire was developed (see appendix 2). Questions and topics in the questionnaire related broadly to the following themes:

i. Understanding of Whale Shark distribution across the west coast of India

ii. Range of threats experienced by Whale Sharks along the west coast of India

4.4. Planning and finalizing the fish landing sites and villages for the survey

The Central Marine Fisheries Research Institute (CMFRI) provided information on major and minor fish landing centers along the west coast of India. These landing centers were categorized into 3 stratums by CMFRI, the details are provided in the table below:

Stratum No.	Title	Details, Boat type
Stratum 1	Major Landing centres	Centres with Jetty construction, Trawlers and Mechanized boats
Stratum 2	Minor Landing centres	Mechanized boats and traditional fishing boats
Stratum 3	Lesser minor landing centres	Traditions fishing boats only

Additional information on Whale Shark landings was collected from the Marine Fishery Information Service (MFIS) website. The respective state fisheries department provided the project team with the coastal village data along with hand-drawn maps. These sources were carefully reviewed, and the villages were selected on the following criteria.

- All Major landing fishing centers in the state (based on CMFRI data)
- Landing centers with previous records of Whale Shark landings or sightings
- Minor landing centers surrounding the major landing centers and landing centers with records of Whale Shark sightings.

The present study was carried out in all the states along the west coast of India except Gujarat. The total length of the study area covered approximately 1,846 km which also includes 5 major Lakshadweep Islands. Based on the CMFRI district-wise fish landing centers and fisheries department data, the project selected 118 major fish landing centers near villages for the questionnaire survey along the west coast and Lakshadweep Islands (see Appendix 1).

4.5. Stratifying possible interviewees

The questionnaire survey primarily targeted male fisherfolks who were categorized into 2 groups i.e., Retired Fishermen (>55 age) and Active Fishermen (<55 age). The importance of focusing the questionnaire survey on retired fishermen was to gather previous historical information about Whale Sharks in their area of operation, while the active fishermen were surveyed to obtain current information about Whale Sharks in their area of operation.

4.6. Conducting the questionnaire survey

The findings from the literature review were used to define the key topics and interview questions for field survey design. Each village had 2 survey team members responsible for conducting the questionnaire survey. The questionnaire was translated into 5 different languages i.e., Marathi, Kannada, Malayalam, Hindi and English, to cater specifically to each maritime state where the survey was conducted (Appendix 1 (II)). WTI also brought along resource materials such as miniature rubber models of Whale Sharks, and pictures of Whale Sharks taken from different angles which were shown to the target audience for basic identification. The questionnaire survey with a single respondent lasted between 30-45 min. Public gathering spots such as fish landing centers, local fishermen societies, and local tea shops were primarily chosen as convenient locations to reach out to fisherfolk (see Appendix 1 (III)).

4.7. Data analysis

The results of the literature review and field interviews were analyzed qualitatively and written up as records of conversations in the datasheet, as well as literal translations of interviews recorded digitally. Data were analyzed using SPSS version 16.0 and Excel.

5. Results

5.1 Literature review of Whale Sharks

Based on the published journals (35), grey articles (5) and media reports (7) the project tabulated the following information on Whale Shark sightings, landing and scientific studies along the west coast of India.

Table: 2. Details of published literature and media reports reviewed for co-ordinating the questionnaire survey by the WTI project.

Location of Whale Shark Sighting Information	Date	Source of Information
PUBLISHED JOURNALS		
Near Trivandrum, Kerala	1938	Pillai R.S., (1929).
Bombay, Maharashtra	1941	Prater, S. H., (1941).
Mumbai, India	1948	Kulkarni C.V., (1948)
Malabar Coast, Kerala	1954	Chacko PI, Mathew M.J., (1954)
Suratkal, 16 km north of Mangalore, Karnataka	1959	Kaikini, A. S. *et al.*, (1959)

Location of Whale Shark Sighting Information	Date	Source of Information
Vizhinjam, Kerala	1960	Silas (1986) *Mar. Fish. Infor.*Sen)., *T and E* Sen, No. 66
Off Cannanore, landed at Thayyil, Kerala	1963	Thomas, M. M. and K.Kartha, (1964)
Calicut, Kerala	1970	Seshappa, G. et al., (1972)
Vizhinjam, Kerala	1972	Kuthalingam, M. D. K. et al., (1973)
Cuffe Parade, Bombay, Maharashtra	1978	Pai M. V. et al., (1983)
Cuffe Parade, Bombay, Maharashtra	1980	Karbhari, J. P., (1986)
Hejmadi, Malpe, Mooloor, Kaup South Karnataka	1980	Satyanarayana Rao, K., (1986) Seven Whale Shark Landed from 8th November to 27th December, 1980.
Anjadiv Is., Karwar, Karnataka	1981	Pai M. V. et al., (1983)
Anjuna, Goa	1981	Doiphode, P. V., (1986)
Karwar, Karnataka	1983	Dhulkhed, M.H., (1983)
Cochin, Kerala	1984	Somasekharan Nair et al., (1986)
Cuffe Parade, Bombay, Maharashtra	1985	Karbhari, J. P. and C. J. Josekutty, (1986)
Cuffe Parade, Bombay Maharashtra	1985	Shriram, M. (1986)
Panathura, near Vizhinjam, Kerala	1988	Lazarus *et al.* (1988)
Makarabagh, Malvan	1992	Maikar (1992)
Cooperage, Mumbai	1993	Sriram *et al.* (1994)
Madaban, Ratnagiri	1995	Katkar (1986)
Dakti, Dhanu	1999	Kambleand Rane (2001)
Versova, Mumbai	2004	Jadhav et al., (2005)
Vizhinjam	2005	Marine fisheries information service 1128
Kollam	2006	Marine Fisheries Information Service CMFRI 1207

Location of Whale Shark Sighting Information	Date	Source of Information
Karwar, Karnataka	2007	Sreeram et al., CMFRI, Karwar
Kochi, Kerala	2008	Akhilesh et al., CMFRI
Thalassery, Kannur	2008	Sajeela et al., (2010)
Ankola, Karnataka	2009	Sreeram et al., CMFRI, Karwar
New Ferry Wharf, Maharashtra	2009	Das et al., (2009)
Kochi, Kerala	2010	Akhilesh et al., CMFRI
Kollam, Kerala	2010	P.T. Mani, (2010)
Kochi, Kerala	2011	Akhilesh et al., Four Whale Sharks landed from January to August 2011 in Kochi
GREY ARTICLES		
Gujarat Coast, India	2008	Praveen *et al.*, 2008 (Unpublished report)
Turning the Tides	2008	Wildlife Trust of India
Vizhinjam, Kerala	2007	Sabu, WTI
Calicut, Kerala	2007	Sabu, WTI
Niwati, Maharashtra	2008	Sarang Kulkarani
MEDIA REPORTS		
Vizhinjam, Kerala	2002	Media article: Hindu newspaper (26th January 2002)
Trivandrum, Kerala	2002	Media article: Times of India (26th January 2002)
Mumbai	2005	Deccan Herald News Paper
Pallithura, Kerala	2005	Malayala Manoroma
Kollam	2006	The Hindu newspaper
Kasargode	2007	Media article: Times of India
Khariwado, Goa	2007	Herald newspaper cutting

5.2. Range of information gathered from professional institutions and Non-Governmental Organizations

Table 3: Institutions and NGOs visited in the west coast of India for the Survey

Organization Visited	Kinds of information gathered
Central Marine Fisheries Research Institute, Cochin (CMFRI)	Fish landing centers across the west coast of India
Bombay Natural History Society, Mumbai (BNHS)	Reported information of Whale Shark landings along the Maharashtra coast
National Institute of Oceanography, Goa (NIO)	Whale Shark information from Goa
Goa University	Whale Shark information from Goa
Karwar University	Whale Shark information from Karnataka
State Fisheries Department	Names of the fishing villages and route maps in each state across the west coast of India

5.3. Results based on the Questionnaire Survey along the West Coast of India

A total of 1,703 interviews were conducted between May 2012 to November 2012 and March 2013 with the fisherfolk across four states (Maharashtra, Goa, Karnataka, and Kerala) and one Union Territory (Lakshadweep Islands) (Table 2). All analyses were carried out using SPSS 16.0 and Microsoft Excel 2007. The findings on similar aspects (such as Whale Shark sighting in their lifetime or time period of Whale Shark sighting) for 5 different survey regions were represented graphically for easy comparison and the subsequent formulation of a recovery plan for each state.

Table: 4 Number of surveyed villages and respondents along the west coast of India

Survey activities undertaken	Number of villages visited in each state	Number of fishermen interviewed in each state	Time-period when the survey was conducted
Maharashtra	21	424	10th May – 25thJune, 2012
Goa	12	178	2nd July – 25th July, 2012
Karnataka	23	400	1st August – 25th September, 2012

Survey activities undertaken	Number of villages visited in each state	Number of fishermen interviewed in each state	Time-period when the survey was conducted
Kerala	57	600	1st October – 25th November, 2012
Lakshadweep	5	101	1st March – 25th March, 2013

5.3.1. Whale Shark Sighting

Among (n=1703) the respondents interviewed along the west coast of India, 62% of respondents (n=1033) reported sighting Whale Sharks in the Arabian Sea during their fishing operation. The highest proportion of respondent fishermen who encountered Whale Sharks (Figure 1) were in Lakshadweep (28%, n= 91) followed by Maharashtra (20%, n= 274), Karnataka (19%, n= 236), Kerala (18%, n= 350) and Goa (15%, n= 82). The result indicated that the possibility of Whale Shark sighting was highest in the Lakshadweep during fishing operations. This is perhaps due to the proximity of the Lakshadweep archipelago to the Maldives, where Whale Shark tourism has been developed under a national-level research program, thereby, enhancing their conservation status and population numbers. (Rees et al., 2012). In Maharashtra, the majority of respondents in the northern region reported sighting Whale Sharks near the Saurashtra coast in Gujarat, where their fishing operations often extend. The other respondents reported sightings within 20 – 40 km offshore from the Malvan coast in Maharashtra.

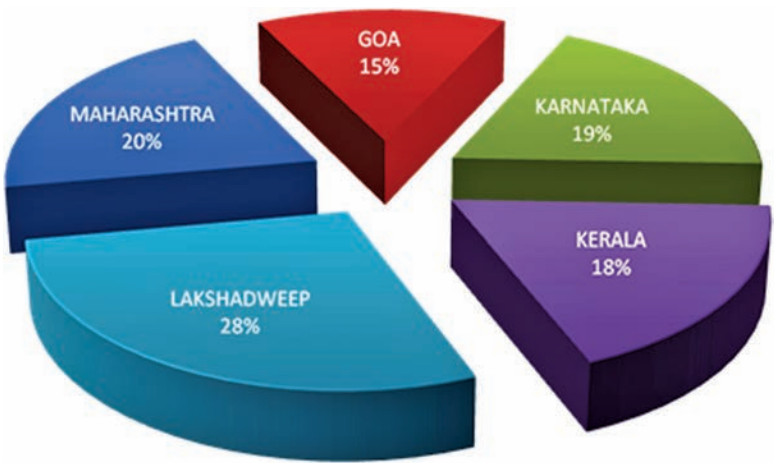


Fig.11: Percentage of interviewees who reported Whale Shark sighting

5.3.2. Time period of Whale Shark sightings by the respondents over the decades (from five survey regions)

For over a decade, Whale Sharks have been sighted or have landed along the west coast of India. All the responses collected from 5 survey regions were categorized into 4 time periods: as recent as 2011-12, (n= 184), comparatively recent as 2009-10, (n= 227), during the last decade 2000-2008, (n= 212) and in the decade up to 1999 (n= 410). To test the statistical significance of the differences among the number of fishermen who indicated different time periods of Whale Shark sightings over the decades, a non-parametric Kruskal-Wallis $\chi 2$ test (Sokal and Rohlf, 1981) was applied after testing the distribution (normality) of the data. The result depicted that the mean number of respondents (in each village) who had seen Whale Sharks before 1999 was significantly higher (Kruskal-Wallis $\chi 2$ 74.65, degrees of freedom 3, p= 0.00) than the mean number of respondents (in each village) who had seen the species in other time periods of later decades (Fig. 12).

However, when the data was analyzed using the responses of active fishermen (presently engaged in fishing) only (n=460) the mean number of respondents (in each village) who had encountered Whale Sharks 3-5 years ago was significantly higher (Kruskal-Wallis $\chi 2$ 204. 24, df 4, $p<0.05$) than the mean number of respondents (in each village) who has seen the species recently or decades ago (Fig. 13). This overall trend of Whale Shark sightings by active fishermen between 3-5 years ago was observed in each of the survey states except for Lakshadweep where the mean number of respondents who had encountered Whale Sharks recently or 1-2 years ago or 3-5 years back was similar (Fig. 14).

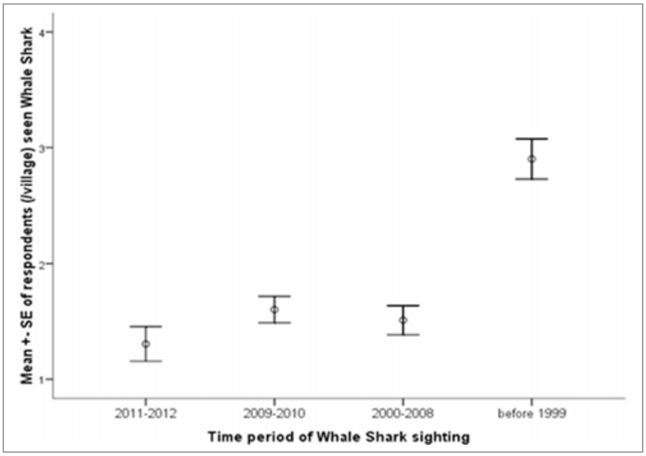


Fig. 12: Significant difference of Whale Shark sightings over the decades

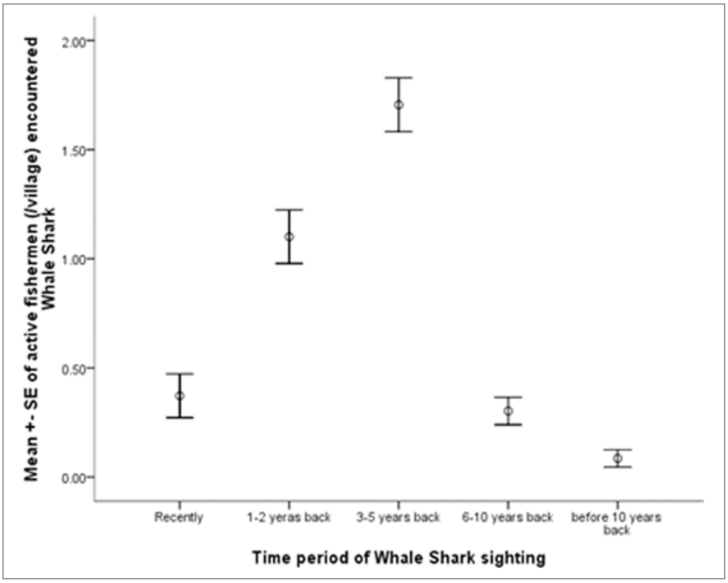


Fig. 13: Variation in the number of active fishermen/villages that encountered Whale Sharks across different time periods over a decade

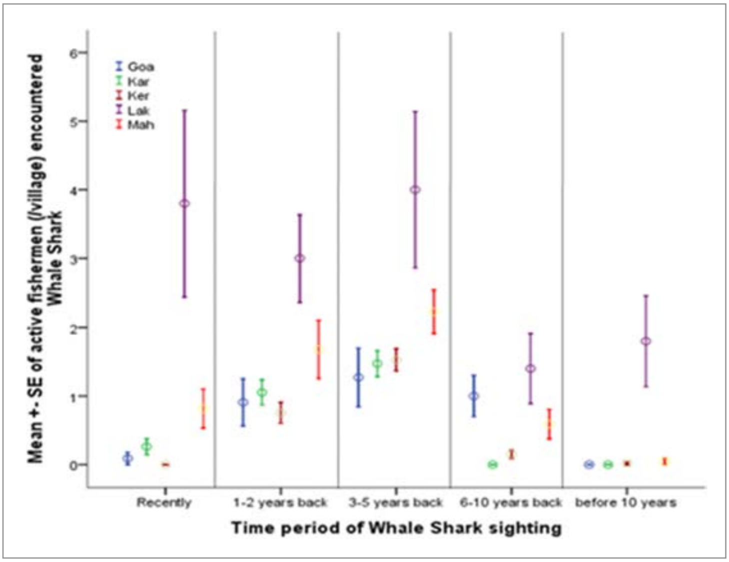


Fig. 14: Variation in the number of active fishermen/villages that encountered Whale Sharks across different time periods over a decade in different survey regions

5.3.3. Frequency in Whale Shark Sighting over a year

Throughout the year, fishermen have sighted hale sharks in the Arabian Sea across various months. Analysis was conducted to determine how sightings varied by month and to identify the peak season when fishermen most frequently encountered Whale Sharks in this region.

When asked about the season for Whale Shark sightings, the fishermen gave varied responses for various times of the year. To present this data more clearly, we calculated the cumulative number of respondents for each month and displayed it in Fig. 15.

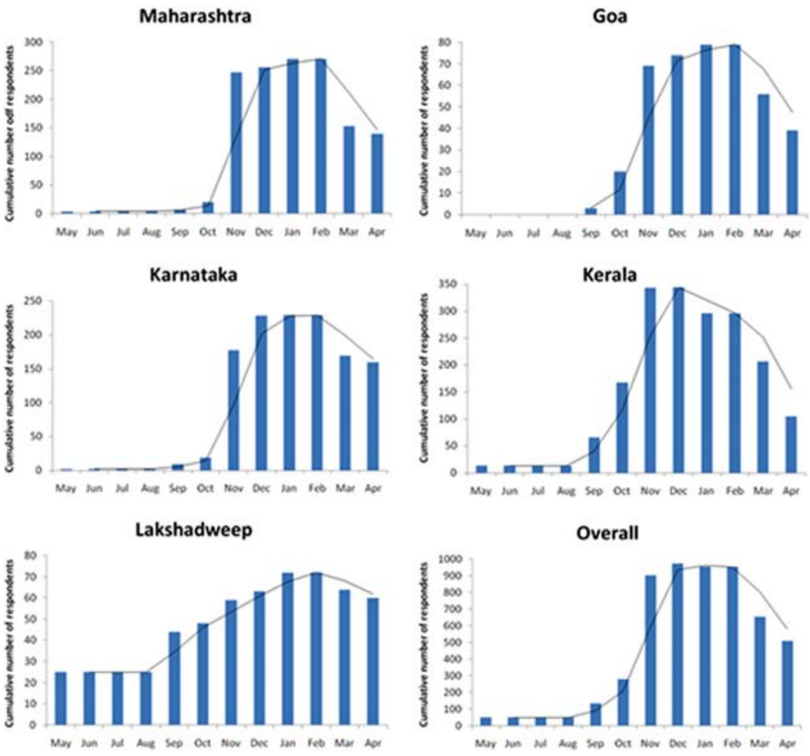


Fig.15: Frequency of Whale Shark sightings during different months of the year

When asked about the season for Whale Shark sightings, the fishermen provided varying responses for different segments of the year. To present the data more clearly, the cumulative number of respondents for each month of the year was calculated and represented (Fig. 15). The graph also depicted the state-wise variation in Whale Shark sightings throughout the year alongside the overall trend for the entire West Coast of India. Among all the 5 states, only Lakshadweep reported Whale Shark sightings year-round, while the other States indicated that winter months were the best time for Whale Shark sightings.

5.3.4. Number of Whale Sharks sighted in the lifetime of a fisherman

Based on the respondents' fishing experience and number of Whale Shark encounters in a lifetime, 6 encounter ranges were selected based on their data from each state; the ranges start from 1-5 and up to more than 21 encounters (Fig.. 16). To test the significance of the differences among the numbers of respondents within these categories, based on the number of Whale Sharks seen in their lifetime, a non-parametric Kruskal-Wallis $\chi 2$ test was applied after testing the distribution (normality) of the data. The results depicted that the mean number of respondents (in each village) who had seen 6-10 Whale Sharks in their lifetime was significantly higher (Kruskal-Wallis $\chi 2$ 336.61, df 5, $p <0.05$) than the mean number of respondents (in each village) who had seen more or less number of Whale Sharks in their lifetime.

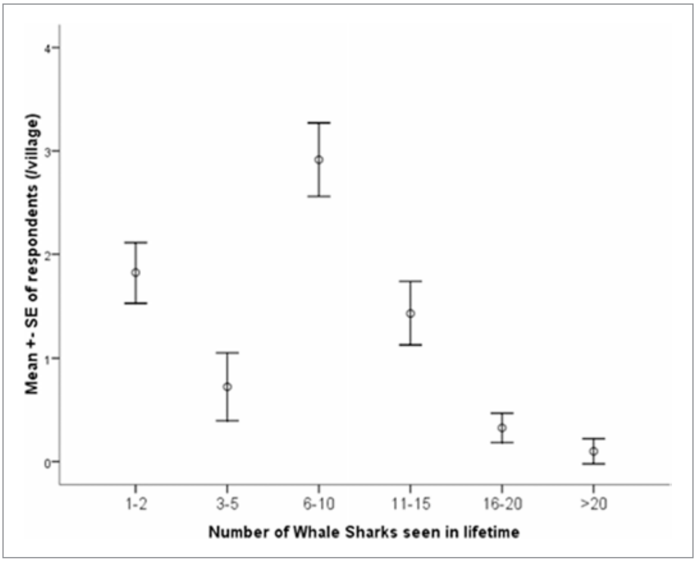


Fig. 16: Number of Whale Sharks sighted in a fisherman's lifetime

The graph (Fig.17) depicts the state-wise variation in the number of fishermen for different categories of the total number of Whale Sharks seen in their lifetime. Only in Lakshadweep, a considerable number of fishermen (n= 13) had seen more than 20 Whale Sharks in their lifetime.

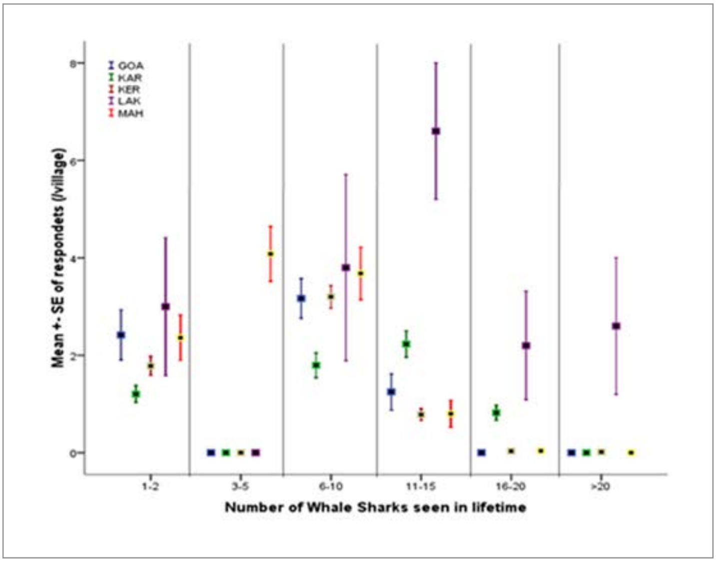


Fig. 17: State-wise number of Whale Shark sighted in a fisherman's lifetime

5.3.5. Whale Shark incidental catch

Incidental catch of Whale Sharks is a matter of concern worldwide as it is one of the major threats to their populations. Among several kinds of fishing gear used, gillnets and purse seines have been identified as the main cause of incidental catch along the west coast of India.

Based on the responses of fishermen on lifetime incidental catch of the whale shark, it was found that Maharashtra contributes 29% (n=196), Karnataka contributes 28% (n=180), Kerala contributes 26% (n=254) and Goa contributes 17% (n=47) [Fig. 18].

Of the (n=196) respondents who incidentally caught the Whale Sharks in Maharashtra, gill net was responsible in 122 cases, purse-seine was responsible in 71 cases and trawlers were responsible in just three cases. In Goa, out of the (n=47) respondents who incidentally caught Whale Sharks, gill net contributed (n=35) in a majority of the cases followed by purse-seine (n=9) and trawler (n=3).

In Karnataka, of the (n=180) respondents who incidentally caught Whale Sharks, gill net was responsible in 124 cases, purse-seine was responsible in 40 cases and trawlers were responsible in 16 cases. In Kerala, of the (n=254) respondents, gill net contributed in most of the cases (n=208) followed by purse-seine (n=33) and trawler (n=13). Overall, gill net contributed 72% (n= 489), purse-seine 23% (n= 153) and trawler contributed 5% (n= 35) of incidental Whale Shark catches all along the west coast of India. Of the 101 respondents interviewed in Lakshadweep, not even a single fisherman had come across any incidental Whale Shark catch in their lifetime. This is mainly because of their use of traditional fishing methods, including rowing crafts and fishing gears such as hand lines, cast nets, wounding gears, and harpoons. However, it is to be noted that a few mechanized boats, primarily used for tuna fishing were also operating in the Lakshadweep seas.

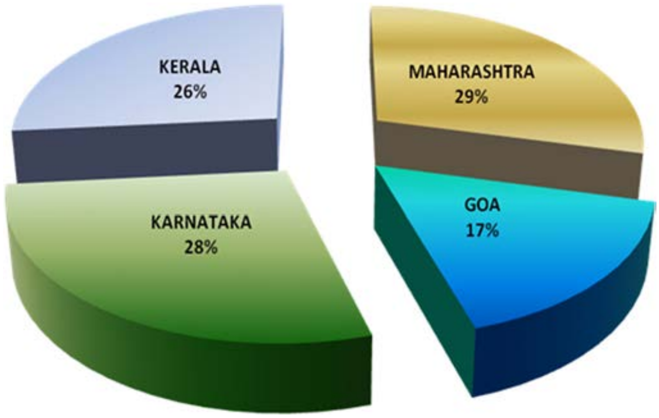


Fig. 18: Percentage of Whale Shark incidental catch

To depict the significance of the difference among the number of respondents who had incidentally caught Whale Sharks by using three different types of nets (Gill net, Purse- seine and Trawl net), the non-parametric Kruskal-Wallis $\chi2$ test (Sokal and Rohlf 1981) was applied after testing the distribution (normality) of the data. The results depicted that the mean number of respondents (in each village) who had caught Whale Sharks using Gill net was significantly higher (Kruskal-Wallis $\chi2$ 218.56, df 2, $p < 0.05$) than the mean number of respondents (in each village) who had caught them using either Purse-seine or Trawl net (Fig. 19).

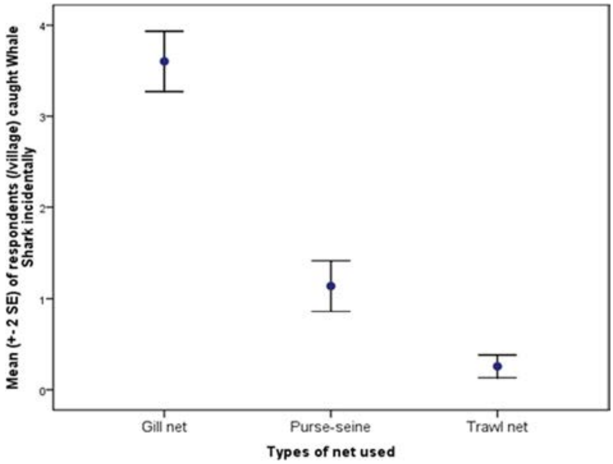


Fig. 19: Differences in the mean of respondents who caught Whale Sharks incidentally using different types of net

5.3.6. Voluntary release of Whale Shark by fishermen

Based on the incidental catch data, the question of disposal of the entangled Whale Sharks was raised to the fishermen. It was found that 677 respondents who caught Whale Sharks, incidentally, released them voluntarily. State-wise comparison (Fig. 20) of this data revealed that fishermen in Goa contributed 50% (n=40) of the voluntary release followed by Maharashtra with 21% (n=69), Kerala with 17% (n=72) and Karnataka with 12% (n= 36). This voluntary release was largely to avoid damage to the nets and to save fishing time and space, which would otherwise be lost if a large Whale Shark remained entangled in the net.

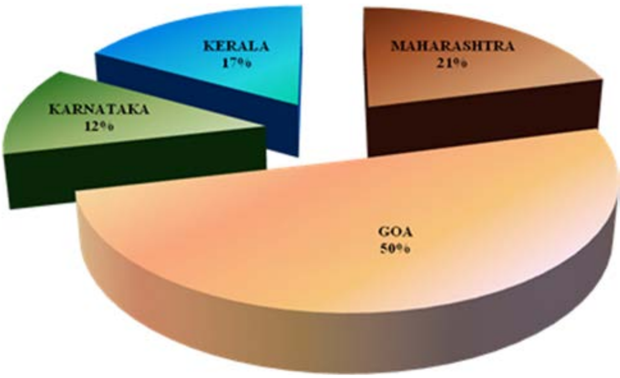


Fig. 20: Percentage of Whale Shark release

5.3.7. Correlation between the number of fishermen who released Whale Sharks and the number of fishermen aware of the ban on Whale Sharks

Spearman rank correlation (Sokal and Rohlf, 1981) coefficient (rho, for non-normal data) was computed to assess the relationship between the number of fishermen who release Whale Sharks (incidentally caught) and the number of fishermen who are aware of the ban on Whale Shark fishing. In the case of Goa, there was a positive correlation between these two variables (rho= 0.76, p=0.004, n=12). However, in the case of Maharashtra, Karnataka and Kerala no significant correlation was present between these two variables (rho= 0.31, p= 0.13, n= 25; rho= 0.19, p=0.24, n= 39 and rho= -0.15, p= 0.24, n= 59 respectively).

5.3.8. Village-level comparison of states in terms of effectiveness of the awareness regarding ban on Whale Shark fishing

To assess the awareness among fishermen across each village (state-wise) regarding the ban on Whale Shark fishing and corresponding action taken when one is incidentally caught, two indices were derived from the data on action taken in such instances and awareness of the ban. The first one, "release index" was calculated by standardizing the percentage of Whale Sharks dragged to the shore and subtracting it from the percentage released for each village. The second one, "Awareness index" included a standardized value of the percentage of villagers unaware subtracted from the percentage aware of the ban on Whale Shark fishing. A scatter plot (Fig. 21) summarizes the result.

The plot can be divided into 4 quadrates (1. +ve release index and +ve awareness index, 2. +ve release index and –ve awareness index, 3. –ve release index and –ve awareness index, 4. –ve release index and +ve awareness index). Fishermen of the villages in Karnataka and Kerala were largely aware of the ban, however, they were reluctant to release the whale shark. On the other hand, the fishermen of Goa were largely unaware of the ban but had released the Whale Shark on most occasions. Data of fishermen in Lakshadweep were not included in the analysis as no incidental catch of Whale Sharks was reported from this Union Territory. In Maharashtra, the scatter plot did not show a clear trend as the awareness level of most of the villages was negative and the fishermen had either released or dragged the incidentally caught Whale Shark to the shore in almost equal proportion.

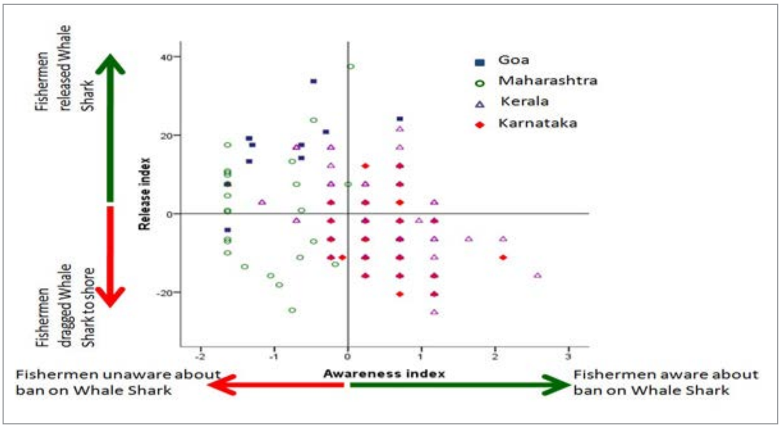


Fig. 21: Scatter plot showing the distribution of villages (of four different states of west coast of India) with respect to release of incidentally caught Whale Shark

5.3.9. Human-induced threats to Whale Sharks on the west coast of india

As far as threats to shale sharks on the west coast of India are concerned, there is no conclusive evidence confirming hunting or target fishing. Threats are mainly due to incidental catch and the rate of incidental catch was found to be higher in three types of fishing gears, gill net contributing 72% (n= 489), purse-seine contributing 23% (n= 153) and Trawler contributing 5% (n= 35) of incidental capture of Whale Shark all along the west coast of India (Fig. 20).

5.3.10. Indigenous knowledge of Whale Sharks along the west coast of india as compared to global scientific information

Based on the indigenous knowledge of fisherfolk on the west coast of India about Whale Sharks and global scientific information, we generated the following comparison.

Table: 5 Indigenous knowledge of Whale Shark along the west coast of India and global scientific information

Fisher folk Indigenous Knowledge about Whale Shark	Scientific information about Whale Shark
During fishing operations, the Whale Shark is often found swimming on the surface of the sea	Whale Sharks live in all tropic and warm-temperate seas except evidently the Mediterranean. It is thought to be primarily pelagic and to occur in the waters of over 130 countries (Turnbull and Randell, 2006)

	primarily pelagic and to occur in the waters of over 130 countries (Turnbull and Randell, 2006)
Whale Shark while swimming in the open sea suck large quantities of water through the mouth	Water flows over the gills of the Whale Shark simply by opening its mouth and swimming forward, a process termed Ram Filter Feeding (Heyman et al., 2001). Whale Sharks extract oxygen from the water which flows over five pairs of gills. Water flows from the brachial cavity to these gills through filtering pads.
Whale Sharks are often found along with the bloom of Paste Shrimp on the west coast of India.	Whale Sharks are versatile filter feeders, filtering large amounts of water over their specially adapted gills, catching planktonic and nektonic organisms (Jarman and Wilson, 2004).

5.3.11. Geographic locations where Whale Sharks have been sighted, or are believed to aggregate

One of the outcomes from the west coast fishermen survey is that at least 4 Whale Shark aggregation sites along the west coast of India including the Lakshadweep Islands have been identified for the first time (Fig. 22). Out of the 274 respondents who reported sighting Whale Sharks during fishing operations, 83 respondents from Mumbai, Thane, Raigad reported to have sighted them s off the Gujarat coast, particularly near the Saurashtra coast. Additionally, 55 respondents from Raigad, Ratnagiri and Sindhudurg reported to have sighted them off the Malvan coast of Maharashtra.

Out of the 236 respondents who reported having sighted Whale Sharks during fishing operations in Karnataka, 115 respondents from Uttar Kannada, Udupi and Dakshin Kannada reported having sighted them close to Netrani Island in Karnataka and 25 respondents from Uttar Kannada reported having sighted them off the Malvan coast at Maharashtra.

Based on the observations of fishermen in Kerala and Lakshadweep Whale Shark sightings were reportedly more in the islands of Androth, Pitti, Suheli, Chinnapara, Periyapara Bangaram and Minicoy. According to reports by the interviewees, most of the Whale Sharks that landed on the Kerala coast were from Lakshadweep waters.

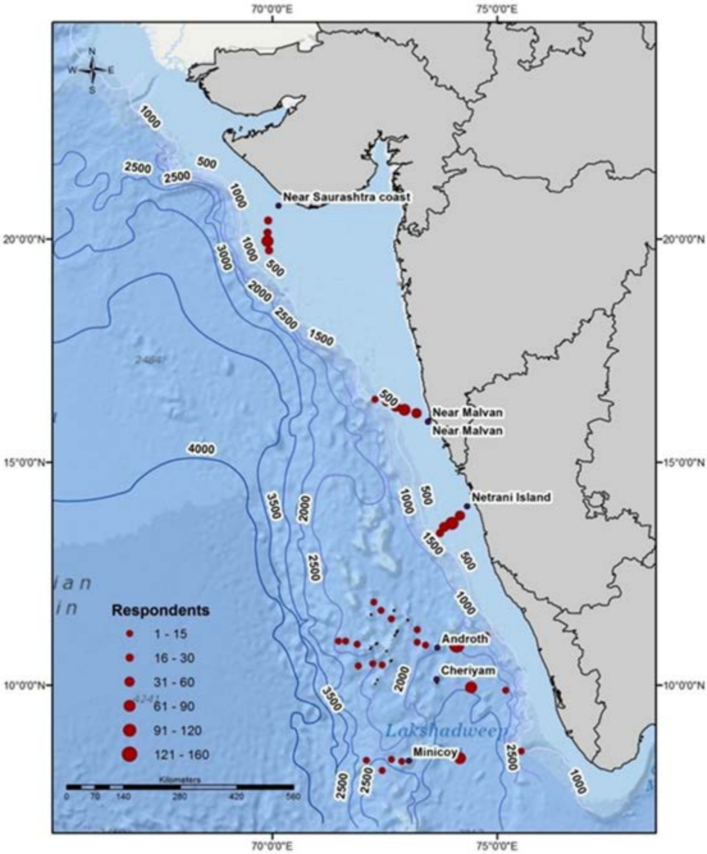


Fig. 22: Geographic locations where Whale Sharks have been sighted, or where they are believed to aggregate

8. Discussion

The Whale Shark survey was executed primarily to understand the past and present distribution of the species along the west coast of India, solely based on the Indigenous Technical Knowledge (ITK) of the fisherfolk in their concerned fishing zones. This survey is part of a larger initiative to expand the Whale Shark conservation strategy and action plan to other parts of the west coast which are presently confined to the state of Gujarat. A cumulative number of 1,602 interviews have been conducted in 113 fishing villages along the 1,714 km long coastal line of Maharashtra, Goa, Karnataka, and Kerala (North to South) between the period of May (2012) and November (2012) and 101 interviews had been conducted at 5 islands of the Lakshadweep Archipelago (towards the western side) during March (2013). Thus, a total of 1,703 individual fishermen have been interviewed over a period of 8 months along the west coast of India, including Lakshadweep. The result revealed that the percentage of Whale Shark sightings was high in Lakshadweep (28%) and low in Goa (15%). With reference to the sample size, the fishermen interviewed (n=600) in Kerala belonging to 57 villages were higher compared to the fishermen interviewed in Lakshadweep (n=101) belonging to the five islands. However, the number of sightings in Kerala (350) was relatively low in number compared to Lakshadweep (28%), Maharashtra (20%), and Karnataka (19%) thereby reducing the overall percentage (18%). Arguably, most of these Whale Shark sightings by Kerala fishermen were in Lakshadweep waters.

Whale Sharks are globally threatened by fin/meat trade, fishing nets, and vessel strikes.

Occurrences of Whale Sharks from west coast of India and the Lakshadweep Islands have been reported in the published literature for almost a century, with early records of Whale Sharks in Maharashtra by Prater, S. H., 1941, Goa by Doiphode, P. V., 1986, Karnataka by Kaikini, A. S., et al., 1959, Kerala by Pillai R.S., 1929 and Lakshadweep Islands by Burton, 1940 (Silas, 1986). According to Akhilesh et al., 2012, in the last 10 years, Whale Shark landings were high in Kerala followed by Maharashtra and Karnataka, which matches our survey results. He has further provided information on 6 small juvenile Whale Sharks ranging in length from 95 to 260 cm TL, found in by-catch of gill nets off the Arabian Sea, landed on the Kerala coast between 2008 and 2011. Among 600 respondents in Kerala, 350 had sighted shale sharks and a majority of respondents either sighted or incidentally caught them in Lakshadweep Islands. Earlier, Silas (1986) had provided information on Whale Sharks sighted in the Lakshadweep Islands. Ali Manikfan, formerly of the Central Marine Fisheries Research Institute, who hails from Minicoy Island in the Lakshadweep Archipelago, reports observing

Whale Sharks caught in Minocy on at least 3 occasions. However, none of these specimens measured longer than 8 feet. The occurrence of Whale Sharks is rare, but the local fishermen are well aware of their passive and harmless disposition, and call them 'Vori mas meer'. The name' Vori mass' is used by them to refer to the Siganusstellatus (Forskal) species which has a blotched colour pattern. It is likely that the name of the shark is derived from this characteristic (Silas, 1986). Based on the responses of active fishermen (n=460), who encountered Whale Sharks during their fishing operations, there has been a confirmed gradual decline in their sightings from 2010 to 2011 onwards along the west coast of India. However, that frequency has been sustained in the Lakshadweep Islands. The gradual decline in Whale Shark sighting frequency (Fig. 16) along the west coast is mainly due to the continuous changes and up-gradation of existing fishing technologies and the increase in the efficiency of craft and gear. In recent years, there has been a considerable increase in activity in the motorized sector, especially the ring seine and mini-trawl fishery, causing concern for certain exploited species. There have also been dimensional changes in the gear and the time spent fishing in the mechanized sector by undertaking voyage fishing and the use of sophisticated electronic devices for fish finding has resulted in increased fishing pressure and fishing efficiency (Bindu, 2011).

According to the fishermen respondents who also operate traditional fishing boats, the decline in Whale Shark sightings was mainly due to the sound emitted from the mechanized fishing vessels. This noise causes larger fish species like the Whale Shark to move away from their native sighting grounds in the Arabian Sea. Unlike cetaceans, sharks do not use sound to communicate with each other, however, they do sense sound as pressure through their lateral line system, and it is likely that high-decibel sounds may negatively impact them. Experiments have demonstrated that sharks can hear sounds with frequencies ranging from about 10 Hertz to about 800 Hertz (Martin, 2004). The effects of very loud sounds on shark behavior are not well documented, however, it is possible that they could potentially disrupt normal behaviors such as feeding, mating, or migrating from one place to another (Whale Shark recovery plan, Australia, 2005). According to the Whale Shark recovery plan submitted to the Common Wealth of Australia (2005), the global Whale Shark population decline has been attributed to the fishing pressure in International waters esp., India, Taiwan and the Philippines. Interestingly, they are not hunted around the Lakshadweep Islands. Moreover, traditional fishing practices such as rowing boats and non-destructive fishing gear like hand lines, cast nets, wounding gears, and harpoons possibly result in increased sightings in the region. Only a few numbers of mechanized boats operate in Lakshadweep which are mainly for tuna fishing.

Maximum number of Interviewees (≤ 900) reported that Whale Sharks were frequently sighted along the west coast of India, between November and April each year. During this period, sardines and mackerel are abundant in the coastal waters of the west coast of India, coinciding with the presence of Whale Sharks in these waters. This is also the period when schools of bonitos, frigate mackerels, skiperels, skipjack and yellow-fin tunas visit the coastal waters along the west coast of India. It will be worth finding whether any such associations between these larger fish and Whale Sharks exist in our waters (Silas, 1986). In fact, along the California coast in San Diego, whenever Whale Sharks are sighted, fishermen know that they will be invariably surrounded by yellow-fin tuna and head for them (Gudger, 1941).

Using questionnaire-based fishermen surveys and historical Whale Shark information from published journals along the west coast of India, we assessed the level of threats faced by Whale Sharks across the Arabian Sea coastline. There is no conclusive evidence to confirm hunting or targeted fishing. Our knowledge today is confined mainly to incidental captures, stranding or ramming by ships or boats which can be considered as present major threats. Many respondents (n=677) have reported having found Whale Sharks entangled incidentally in their fishing gear, specifically in Gill nets, Purse-seine and Trawl nets. Among the 3 fishing gears, the gill net (n=483) was found to be the most predominant gear responsible for Whale Shark entanglement followed by Purse-seine (n=153), Trawl and other nets. While comparing the survey data with data from the last ten years from published journals and articles on Whale Shark incidental catches, gill nets are consistently reported as the primary gear used. Despite, the protected status of Whale Sharks since 2001, reports of stranding due to human interactions (e.g. vessel collisions, releasing netted and injured sharks), incidental landings (by-catch) and stranding/beaching are still being recorded (Akhilesh et al., 2012). At the same time, sightings or captures of Whale Sharks measuring less than 2.5 m or 3 m may be going unreported.

Over the past 5 years, Whale Shark landings have been reported in various states of the west coast of India except in Gujarat primarily due to the level of awareness among fishermen. In Gujarat, the level of awareness increased up to 69%, after WTI and IFAW (International Fund for Animal Welfare) launched the Whale Shark Campaign in January 2004 in collaboration with the Gujarat Forest Department, Tata Chemicals and Gujarat Heavy Chemicals Ltd. Well-known religious leader, Shri Morari Bapu supported the initiative leading to the grand success of the campaign. This effort garnered positive responses from civilians, fisherfolk and the Government. Today, the Whale Shark is a source of pride in the state and many cities have adopted this species as their official mascot. Presently, the Gujarat fisher community is actively involved in conservation efforts through the newly introduced scheme by WTI in collaboration with the Gujarat Forest Department, Tata Chemicals and David Shepherd Foundation for self-documenting incidental catch rescues. Photos taken by the fishermen of released Whale Sharks aid in receiving compensation for damaged fishing nets from the Gujarat Government. The awareness campaign, along with the compensation program and self-documentation scheme for releasing net-caught Whale Sharks is currently restricted to Gujarat. This approach has had a positive impact and if such a program is extended to all coastal states, it would be a great support to fishers, especially in Kerala and Karnataka where reports indicate entangled Whale Sharks are often dragged ashore for sale instead of being released. Due to their protection status in the Indian Wildlife (Protection) Act, 1972, the dragged Whale Sharks do not attract buyers, ultimately leading to the fishermen discarding the dead animal. At the same time, most fishers are sympathetic towards net-caught Whale Sharks, however, cutting the net to release the animal comes at a financial cost. Increasing the level of cooperation between the 5 coastal states along the west coast of India will result in a range of state agreements to reduce the pressure on the Whale Shark in their waters.

Geographic locations on Whale Shark sightings or probable aggregation based on the fisherfolk response have been plotted on a bathymetric map, as a result of which 4 aggregation sites were identified in the Arabian Sea, i.e. Minicoy in Lakshadweep, Netrani in Karnataka, Malvan in Maharashtra and Saurashtra Coast in Gujarat. Furthermore, in-depth research and the frequent cruise surveys in these aggregation sites may provide valuable insight into the Whale Shark lifecycle. Previous reports of schooling behavior in 1998, where 16 juveniles of about 1m were reported to be swimming with a Whale Shark of 5.5m in Vizhinjam, India (Krishnapillai, 1998) further authenticate these findings. Other records of Whale Shark aggregation in Gujarat are based on the rescue data maintained by WTI in collaboration with the Gujarat Forest Department and Tata Chemicals from 2005 onwards. During this period, fishermen rescued a total of 372 Whale Sharks along the Saurashtra Coast of Gujarat (Veraval, Sutrapada and Dhamlej) and fishermen were surveyed to document their TEK and ITK on Whale Shark in the Gujarat Coast (Praveen et al., 2008 unpublished). Occurrences of Whale Sharks along the west coast of India and Lakshadweep Islands appear to show some seasonality according to published reports and our survey results. Whale Sharks occur off the Gujarat coast in the winter monsoon period, i.e. February to March (Rao, 1986; Silas,1986; Pravin, 2000; Hanfee, 2001) which is correlated with the winter cooling and high productivity of the northeastern Arabian Sea (Haq et al., 1973; Paulinose and Aravindakshan, 1977). During the winter monsoon, seasonal cooling and convective mixing in the northern Arabian Sea inject nutrients into surface layers, triggering primary production and a phytoplankton bloom (Bhattathiri et al., 1996; Prasanna Kumar and Prasad, 1996). Predictable aggregations have been reported in other parts of the Indian Ocean, e.g. Djibouti (Rowat et al., 2006), Kwa-Zulu Natal coast and Mozambique (Cliff et al., 2007), Seychelles (Rowat et al., 2009), Ningaloo Reef in Western Australia and Andaman Sea off the west coast of Thailand (Colman,1997) and the Maldives (Riley et al., 2010). The largest aggregations of Whale Sharks have been reported from Mexican coastal waters (de la Parra Venegas et al., 2011). The Whale Shark aggregations, rescues, awareness, and involvement of the corporate sector in conservation are all positive responses to marine species conservation.

Remoras attach to Whale Sharks, feeding on leftovers and parasites.

The present west coast survey has given us information about the status of Whale Sharks in the Arabian Sea, which is one of the Large Marine Ecosystems (LME) in the world. However, we have virtually little and no information about the status and threats to this species in the Bay of Bengal which is the other LME. There is an urgent need to initiate a survey along the east coast of India and the Andaman and Nicobar Islands in the Bay of Bengal to obtain a comprehensive understanding of Whale Sharks in the Indian water.

In the Asian region, such detailed information on Whale Sharks and a model conservation program has been in operation in India. This will pave the way for other Northern Indian Ocean countries to consider collaborating and initiating a regional Whale Shark conservation program with the active participation of fishing communities. Marine species and habitat conservation is possible only with an inclusive management approach.

CHAPTER 3

EAST COAST SURVEY

Occurrence survey of Whale Shark along Tamil Nadu Coastline

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[1,2,3,4,5,6]RAP Proponents and [7] Wildlife Trust of India

Rationale of the Survey

Tamil Nadu's extensive coastline along the Bay of Bengal, Palk Bay, and the Gulf of Mannar comprises a biologically rich seascape. However, knowledge about the whale shark (*Rhincodon typus*) in these waters remains scarce and fragmented. Unlike Gujarat, where conservation models and monitoring frameworks exist, Tamil Nadu lacks baseline data on the occurrence, movement, and ecological role of the species.

Traditional Ecological Knowledge (TEK) from artisanal fishing communities suggests that whale sharks were once more common in nearshore waters and were occasionally entangled in nets; however, sightings have declined over recent decades. These accounts remain anecdotal and unvalidated by systematic science. This data-poor situation undermines both conservation and policy action, leaving the species largely invisible in management plans for the state.

The survey was therefore initiated to document TEK, perceptions, and historical interactions between coastal communities and whale sharks. It also aims to identify sighting hotspots, seasonality, and threats in Tamil Nadu waters. By integrating fisher knowledge with scientific methods, the survey seeks to generate the first evidence base for whale sharks in the state. This foundational data will support awareness campaigns, reduce accidental entanglements, and facilitate the adaptation of Gujarat's successful conservation model in Tamil Nadu. In essence, the survey marks a pioneering step from anecdote to evidence, filling critical knowledge gaps while empowering coastal communities to play an active role in protecting this globally endangered species.

1. Study Area

1.1. Coastal Districts of Tamil Nadu

There are 13 coastal districts in Tamil Nadu which has the second longest coastline (1,076 km) with 3 major Ports and 17 non-major Ports (Fig. 1). The first Indian state that has the longest coastline is Gujarat (1,600 km). Tamil Nadu is one of the oldest business coasts having records dating back to 200 BCE – 200 CE. Among the Ports in Tamil Nadu, Poompuhar is one of the main Ports for foreign exchange. Poompuhar, in ancient times, was the Port capital of the Cholas. Other major and minor Ports in Tamil Nadu were largely used by the British during the colonial era.

1.2. Ecological Importance of the Coast

Tamil Nadu, situated in the southeast of Peninsular India is about 1,30,000 Sq.km. The length of its Coastline is about 1,050 km with its significant portion on the east coast bordering the Bay of Bengal. The coastline starts from Pulicat along the east coast and extends up to Erayamanthurai in Kanniyakumari District and consists of Estuaries of ecological importance, Major and Minor Ports, Fishing harbors, Monuments of international heritage, Tourist locations, Pilgrimage centers, etc. The ecological importance of the coastal area has been identified and details of Ports are listed below.

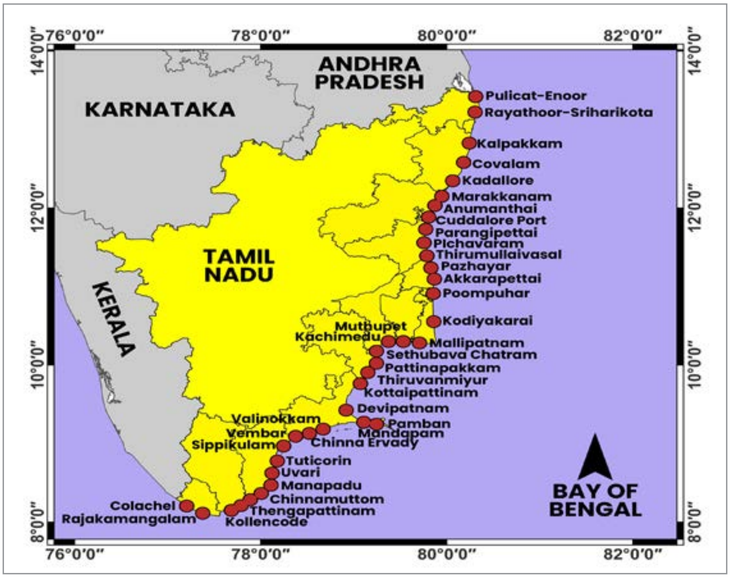


Fig. 23: Map for Tamil Nadu Coastal villages

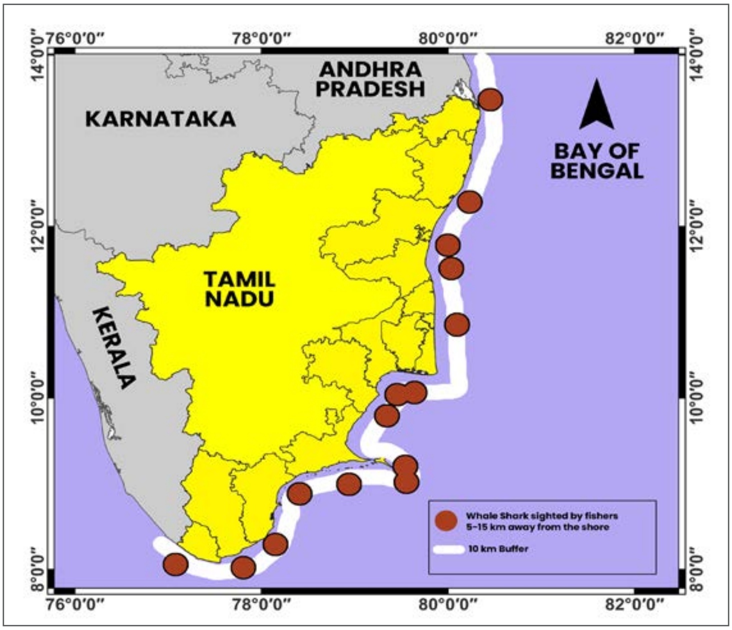


Fig. 24: Map for Whale Shark Sighting Area

Whale Sharks possess filter pads in cheeks to sieve food from large volumes of water.

Ports and Harbors

Major Ports
- Chennai
- Tuticorin
- Ennore

Minor Ports
- Cuddalore
- Nagapattinam
- Valinokkam

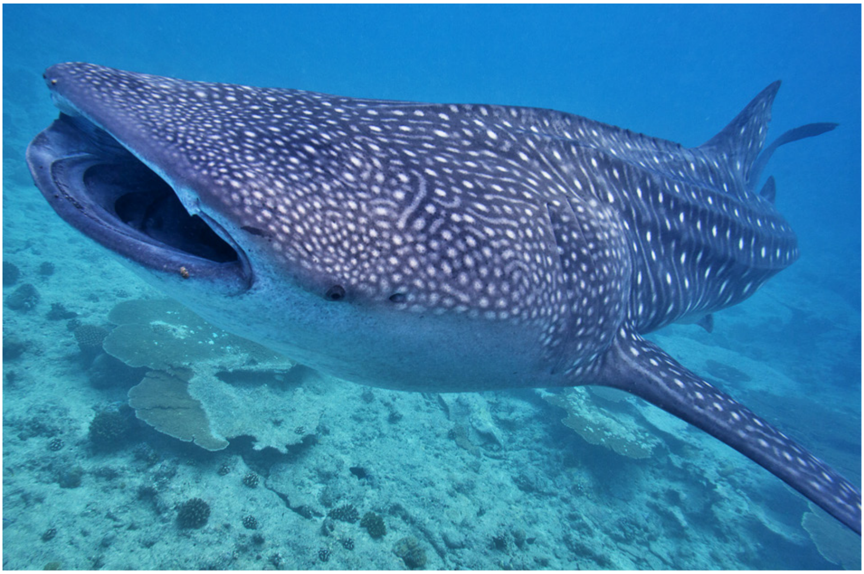
Fishing harbours
- Chennai
- Tuticorin
- Chinnamuttam

Future projects
- Colachel
- Poompuhar fishing harbor
- Thengapattinam fishing harbor
- Veera pandi pattinam
- Rameswaram

Kanyakumari harbour where fishers bring in their catch at the confluence.

Table 6. Ecologically Important Coastal Areas Identified along Tamil Nadu Coast

District	Site	Ecological Importance	Area In km2
Ramnadu	Gulf of Mannar (Islands between Rameswaram -Tuticorin)	Coral Reef	63.226
Nagapattinam	Vedaranniyam, Muthupettai	Mangroves	24.53
Cuddalore	Pichavaram	Mangroves	10.61
Thiruvallur	Pulicat Lake	Lagoon	252.04



Whale Sharks skin is up to 14 cm thick acts as armour against predators.

Study design and methodology

2.1. Survey Methodology

Methodology based on the results of the literature review was used to define the field survey design, key topics and interview questions. The methodology is based on simple random sampling method. The study should be done at all 13 coastal districts in Tamil Nadu from Thiruvallur to Kanniyakumari which consists of 8.92 lakhs marine fisher folk population in 591 fishing villages.

The interview questions are based on the Traditional Ecological Knowledge (TEK) about the Whale Shark to the fishermen communities in the state. The TEK questionnaire is based on the Whale Shark sightings, season and frequency of sightings, areas where most sightings have occurred, total number of Whale Shark encounters during their life at sea and also frequency and possible location of marine mammal sighting frequency. The survey is mainly focused on two groups —Retired Fishermen (Above 55 years) and Active Fishermen (Below 55 years).

Questions and topics are broadly related to the following themes:

- Customary practices and beliefs concerning Whale Sharks.

- Actual geographic locations where Whale Sharks have been sighted, or where they are believed to aggregate or migrate and seasonal patterns.
- Information relating to human-induced threats faced by Whale Sharks in their state (e.g. Subsistence or commercial fishing and trade of products).

2.2. Tamil Nadu and Survey sites

Tamil Nadu is one of the important coastal states on the east coast, having a coastline of 1,076 km with 13 coastal districts and 591 fishing villages. It ranks fourth in fish production in the country. It has a continental shelf of 41,412 sq. km. and an Exclusive Economic Zone spreading over 0.19 million sq. km. The marine sector dominates the entire fishery sector and the Tamil Nadu coastline is divided into four zones.

- The surf-beaten Coromandel Coast extending to 357.2 km from Pulicat to Point Calimere.
- The Palk Bay extending to 293.9 km from Point Calimere to Dhanushkodi.
- The Gulf of Mannar, rich in biodiversity and hosting a variety of marine species is a Marine National park, extending to 364.9 km from Dhanushkodi to Kanniyakumari.
- The Western sector with 60 km of coastline is on the Arabian Sea, from Kanniyakumari to Neerodi.

2.3. Survey Plan

- Met the State Fisheries Department in the District & Taluk office and get information about all the villages by Taluk (administrative district) before conducting a survey in a district.
- Meet the survey staff in the FRAD division in all the CMFRI centers in Tamil Nadu and get the information about the survey spot and landing center names in Tamil Nadu.

Fig. 25: Field Officer interacting with fishermen settlement of Thoothukudi

Fig. 26: Field officer surveying the fishing village of Nagapattinam

Fig. 26: Ongoing survey in Kanniyakumari District

Fig. 27: Survey ongoing at Pazhaiyar fishing port, Nagapattinam district

Fig. 28: A glimps of regular fishing on a motor boat

Fig. 29: Thoothukudi coastal village

Table 7. Activities undertaken start and finish date and month

Name of the Districts	Major port	Important fishing village	Starting month	Finishing Month
Tiruvallur	Pulicut	Thiruvallaivail and Sriharkotta	11th August2012	August
Kancheepuram	Chennai	Neelankarai	August	Do
Vizhuppuram		Marakkanam	August	Do
Cuddalore	Cuddalore	Annankoil	August	Do
Kanniyakumari and Thirunellveli	Kanniyakumari	Chinnamuttom	August	20th August2012
Ramanathapuram	Rameshwaram	Keelakarai and, Mandapam	28th September	1st October
Puthukottai and Thanjavur	Meenmesalo	Sethubavachatram and Vembar	14th October	
Thiruvarur	Muthupettai	Adirampattinam		17th October
Thoothukudi	Thoothukudi	Tharuvaikulam	5th January2013	
Thirunelveli		Ovari Paravarmatta	January	
Nagapattinam	Nagapattinam	Nagore,Pazhaiyar, Poombuhar		20th January2013

Standard ethnographic qualitative survey techniques were used. 8 larger themes and 40 questions were asked during informant interviews (from 15-30 minutes to 1-2 hours) with respected elders and holders of traditional knowledge.Informal group discussions with other groups of fishermen living in the villages of all districts were alsoconducted. The selection of key informants was based on the investigator's (J. Gokulakrishnan) past experience, contacts and the availability of these informants. During visits to villages, the team also approached as many fishers as possible to ask about Whale Sharks. These discussions were much more informal and opportunistic, based on whoever was around/available at the time.

The team was also surprised by the low numbers of fishermen living in the area where the effect of the Tsunami is believed to be lesser. The reason for the decrease in population of the fishers is directly related to the large number of people in the Thoothukudi Fishing zone over the last decade for conformed fish catch. Hence, there were boat apprehensions in certain districts. A questionnaire was developed in English but translated to Tamil and some of them in Malayalam and Telugu. The questionnaire was used as a guide for semi-structured interviews.

The field interviews were largely conducted on the Tamil Nadu coast. 2 teams, Thandapani and Bharanitharan, and Ruban Prabakaran and Muthukumarasamy conducted interviews in different districts enabling greater detailed information on the ecology of Whale Sharks to be explored with fishers. 2 extended interviews with fishermen were recorded electronically and transcribed into English. To assist with discussions with fishermen, a Whale Shark photograph, a postcard to get sighting information and a poster with important information about Whale Sharks and their legal status were prepared and available for fishers and their families to peruse for future conservation.

2.4. Data Analysis

The results of the literature review and field interviews were analyzed qualitatively and written up as records of conversations in notebooks, as well as literal translations of interviews recorded digitally. Within the limitations of this brief pilot study, the information was cross-checked between fishermen from various settlements and information and identification of emerging common themes developed into summary results.

3. Results

3.1. Ethnographic assessment

The results of the literature review were used to define the field survey design key topics and interview questions. A field team of field investigators; U. Thandapani,

M. Bharanitharan, P. Muthukumarasamy and M. Ruban Prabakaran from the Zoology Research Department undertook a four-day field trip (11 August 2012 to 20 January 2013) to interview fishers in selected villages in the Tamil Nadu coast covering all 13 coastal districts. Questions and topics related broadly to the following themes: professional experience, awareness of the species, and awareness about its whereabouts in the sea, sighting information, oceanographic parameters, hunting practices/threat to Whale Sharks, awareness about the legal status of Whale Shark and marine mammals sighting/bycatch information.

3.2. Professional experience

A total of 461 fishers were interviewed in 46 fishermen villages including major and minor ports on the Tamil Nadu coast. Among the fishers, 82% of them were Hindus, 14% Christians and 4% Muslims. All informants are not well educated only 2% of the fishermen studied up to the undergraduate level and have been educated up to the 5th standard.

Fishers participating in the study ranged in age from 19 to 67 years. The age group most active in fishing was between 29 and 34. The majority of the respondents interviewed were aged 34 to 39 years (Fig. 30). Not all fishermen in each village owned fishing boats; 49.7% did not, while 50.3% did. The average fishing experience of the target group was 28 years, with the highest being 55 years and the lowest being 8 years. The majority of respondents interviewed had fishing experience ranging from 23 to 29 years (Fig. 31). This analysis primarily aimed to gather comprehensive information on Whale Sharks.

Fig. 30: Age class survey distribution of fishermen interviewed during the survey

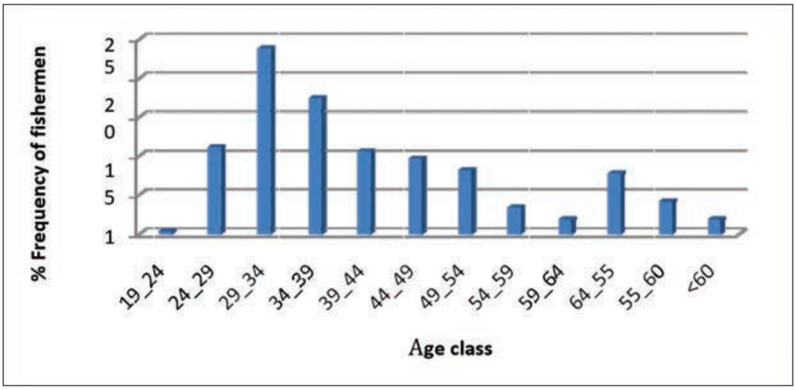
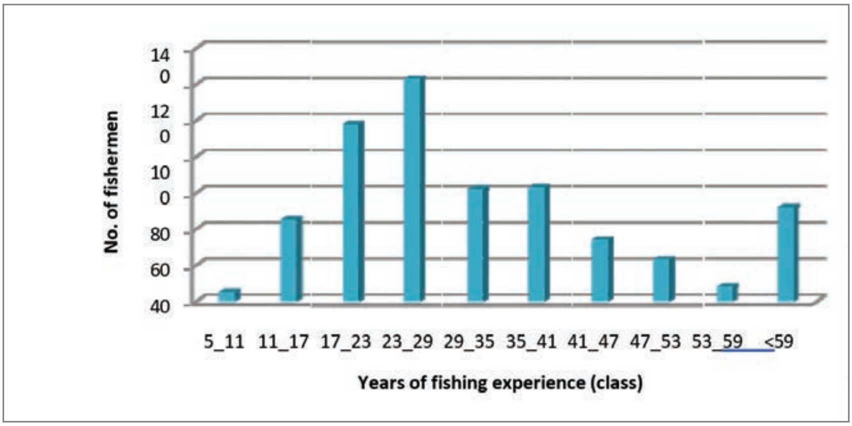


Fig. 31. Fishing experience of the respondents interviewed



Most of the fishers were aware of GPS and 84% of the boats had GPS while the rest of the 16% did not have GPS (Fig. 31)

Fig. 31. Usage of GPS in fishing boats in the villages of Tamil Nadu

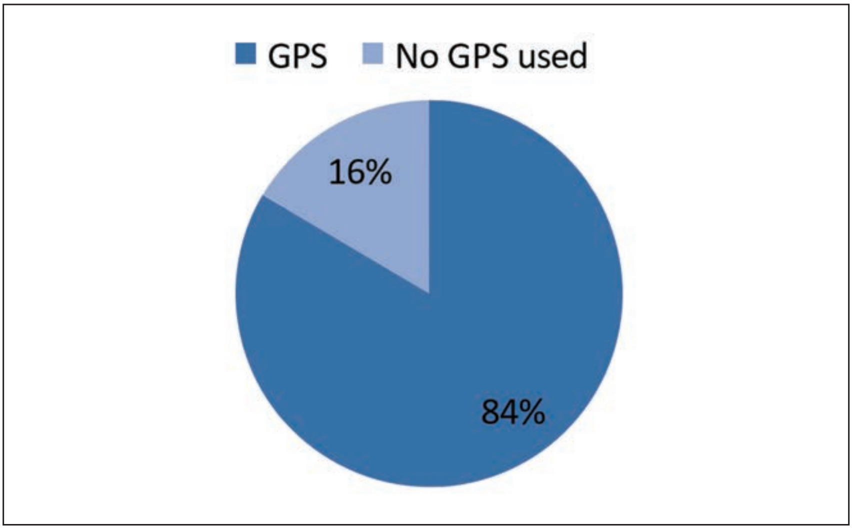
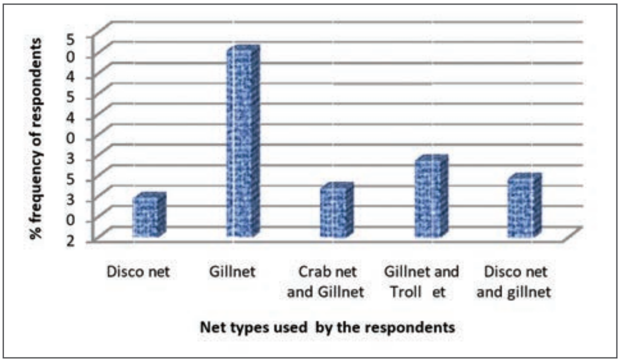


Fig. 32. Various Net respondents for Whale Shark

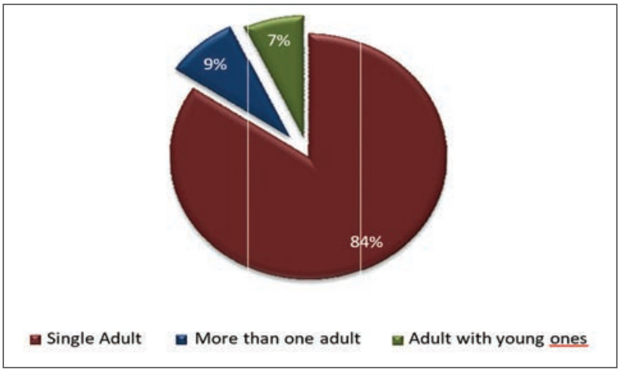


In Tamil Nadu, fishers utilized four types of nets for fishing: troll nets, gill nets, disco nets, and crab nets. Among these, 45.5% of fishers used gill nets followed by 18.6% using both gill nets and troll nets. Both crab nets and gill nets were used by 11.9% of the fishers. Disco nets and gill nets were used by 14.3% and only 9.5% of fishers employed disco nets for fishing. Notably, Whale Sharks are often caught in troll and gill nets in Tamil Nadu.

3.3. Traditional Ecological Knowledge of Whale Sharks

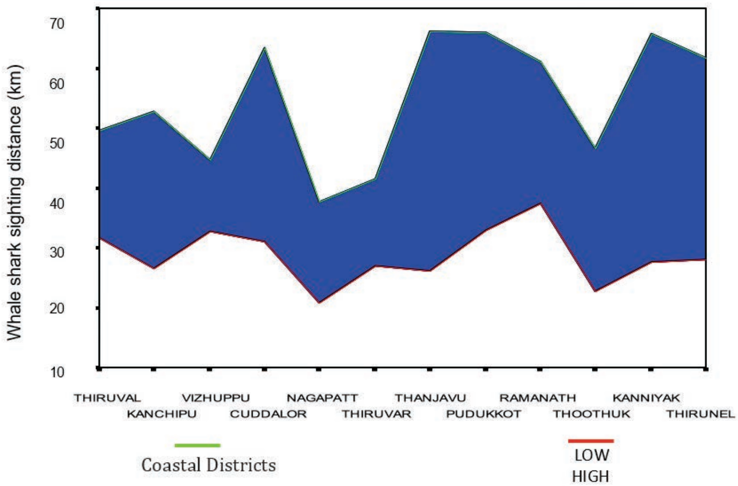
Irrespective of age and experience, every fisherman interviewed reported sightings of Whale Sharks during their fishing activities. The majority (84%) had seen a single whale shark, while 9% had encountered more than one adult, and 7% had observed adults with young ones (Fig. 34). Whale Sharks were frequently sighted between July and October.

Fig. 33. Composition of Whale Sharks sighted by the informant



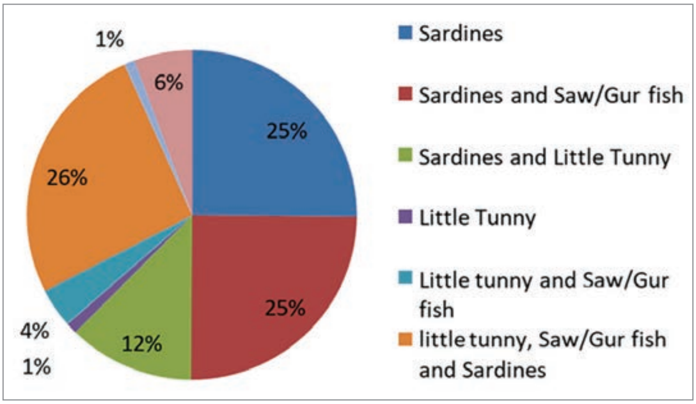
Whale Shark groups were observed in Thiruvallur, Kanchipuram, Thiruvarur, Thoothukudi and Thirunelveli. Fishers from Cuddalore and Kanniyakumari reported sighting adults with their young. Both solitary Whale Sharks and groups were observed in Cuddalore, Poodhukotai, Kanniyakumari and Thirunelveli districts. The distance from the shore at which they were observed varied from district to district. There is a pattern in the sighting distance range which may reflect the depth of the sea as well as the pollution and other disturbances in the ocean (Fig 34). Whale Sharks were sighted (mean distance) below 25 km in Nagapattinam and Thoothukudi districts which have major fishing ports. The closest sighting recorded was 10 km from the shore.

Fig. 34. Distance range Whale Sharks sighted during fishing by fishermen interviewed in Tamil Nadu



Most of the fishers in Tamil Nadu use Kattumaram boats fitted with engines capable of travelling up to 50 km from the shore. The other group of fishers who use small-liner boats catch regular fish species between 10 to 50 km offshore. Commonly caught fish species include sardines, little tunny and gur fishes. During their fishing activities, fishermen have closely observed the feeding behavior of Whale Sharks. About 25% observed Whale Sharks feeding on sardines while 25% observed them feeding on sardines and sawfish species. Around 26% of the fishermen observed them feeding on little tunny and fish species whereas, 12% observed them feeding on sardines and little tunny (Fig. 35).

Fig. 13. Fishermen observation on the food species consumed by Whale Sharks on the Tamil Nadu coastFig. 13. Fishermen observation on the food species consumed by Whale Sharks on the Tamil Nadu coast



Fishing is regular among the fishermen interviewed in Tamil Nadu. Overall 93% of the fishermen were aware of the government order to stop fishing from April to May). Only a few were unaware of the ban on fishing during fish reproduction season. Small-scale fishers were not following any orders of the government and when required they would go fishing.

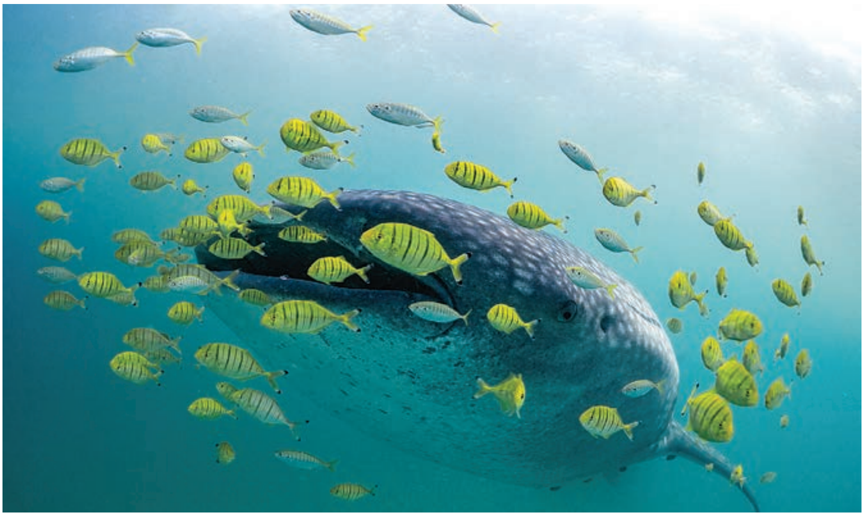
3.3.1. Common names of Whale Shark

Fishers across 12 coastal districts use approximately eighteen local names to refer to the whale shark. Among the most frequently used names are Uluva, Puli sura (Leopard Shark), and Pulli sura (Dotted Shark). In Nagapattinam district, fishers refer to this fish as Banai fish or Banavam, while in Ramanathapuram, it is called Kurangu sura (Monkey Shark). In Thoothukudi, fishermen commonly call the Whale Shark Panavayan (Palm mouthed). These various local names for the Whale Shark are listed in Table 8.

Table 8. Local names used for Whale Shark in the Tamil Nadu coast

No.	Local name in use	Districts
1	Ammuni Uluva	Kanyakumari, Pudukottai, Thanjavor, Ramanathapuram, Thiruvallur
2	Aranai sura	Kanchipuram
3	Banai fish	Nagapattinam
4	Banavam	Nagapattinam

5	Pulli sura	Thiruvallur, Kanchipuram, Ramanathapuram, Cudalore, Thoothukudi
6	Flachchi meen	Thiruvallur and Kanchipuram
7	Koma sura	Cudalore
8	Komarasi	Nagapattinam
9	Kommu sura	Ramanathapuram
10	Kurangu sura	Ramanathapuram
11	Panavayan	Thoothukudi
12	Pilaal	Ramanathapuram
13	Sura	Pudukottai
14	Puli sura	Thiruvalluvar, Kanchipuram, Cudalore, Ramanathapuram, Thoothukudi
15	Uluva/Uluvai	Thiruvalluvar, Kanchipuram, Kanyakumari, Pudukottai, Ramanathapuram,Thoothukudi.
16	Valuvam	Vizhuppuram, Kanchipuram, Thanjavor, Thiruvallur, Ramanathapuram
17	Velaameen	Thiruvalluvar and Kanchipuram
18	Thimingalam	Thiruvallur, Kanchipuram and Vizhuppuram
19	Thimingala sura	Thiruvallur, Kanchipuram and Ramanathapuram



Whale sharks have tiny tooth-like dermal denticles covering their eyes, providing protection against abrasions

3.3.2. Fisher's belief about Whale Sharks

Most of the informants (73%) think that the whale shark's presence is good. Their presence is a good indicator of fish availability in the location where they are sighted. However, 27% of the respondents consider them to be a nuisance since they get caught in fishing nets.

3.3.3. Whale Shark population reduction

Fishers (93%)in Tamil Nadu believe that the sighting frequency of Whale Sharks had reduced but the number is increasing now. About 7% of the people inferred that the population is normal (Fig. 36).

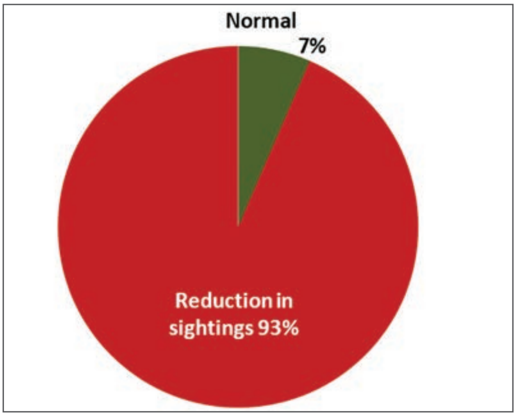


Fig. 36: Opinion of fishers on Whale Shark population trend

3.3.4 Other marine species

All fishermen reported sighting turtles along with Whale Sharks. During Whale Shark sightings, 56.97% of fishermen observed crabs and turtles, 3.69% observed only turtles, and 40.35% observed both turtles and sea birds (Fig. 37). Interestingly, crabs were seen aggregating to feed on plankton, while turtles and birds were observed feeding on small fishes during these encounters.

Overall, 76% of the fishermen interviewed in Tamil Nadu felt that Whale Sharks are not important for the sea. However, 24% considered them to be important for the sea. Since Whale Shark is a big fish, fishers assumed that they benefit other fishes and marine mammals. Some expressed that they indicate the presence of small fishes such as sardines, saw/gur fish, little tunny etc. which helps fishers locate fishing spots more easily. About 43% of the fishers were uncertain about where the Whale Sharks were coming from. Nevertheless, 57% assume that they come from the oceans.

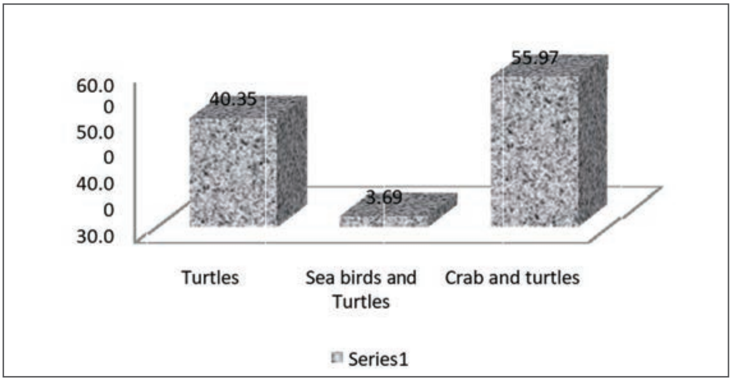


Fig. 37: Details of other marine species observed along with Whale Sharks

3.3.5. Accidental dash with Whale Sharks

In Tamil Nadu, Whale Shark sightings are not very common, however, all fishermen reported sighting the species. During fishing activities, 41% of the informants had never hit a Whale Shark with their boats, while 59% had dashed with them.

There are anecdotal records of Whale Shark catches in Tamil Nadu. On January 28th, 2013, fishermen in Injapakkam, Kanchipuram district, caught a sub-adult Whale Shark measuring 6.4 meters in length. (Fig. 38)

Fig. 38: Whale Shark caught in net dragged to death in Kanchipuram, 2013

In Tamil Nadu, 60% of fishermen reported dashes with Whale Sharks. During these accidental encounters, 83% of fishermen noted that neither the Whale Sharks nor their boats suffered any damage (Fig. 39). Only 9% of fishermen reported seeing injuries on the fins of Whale Sharks. Injuries to the snout were observed by 3% of fishermen, while injuries to the caudal fin were noted by 5%.

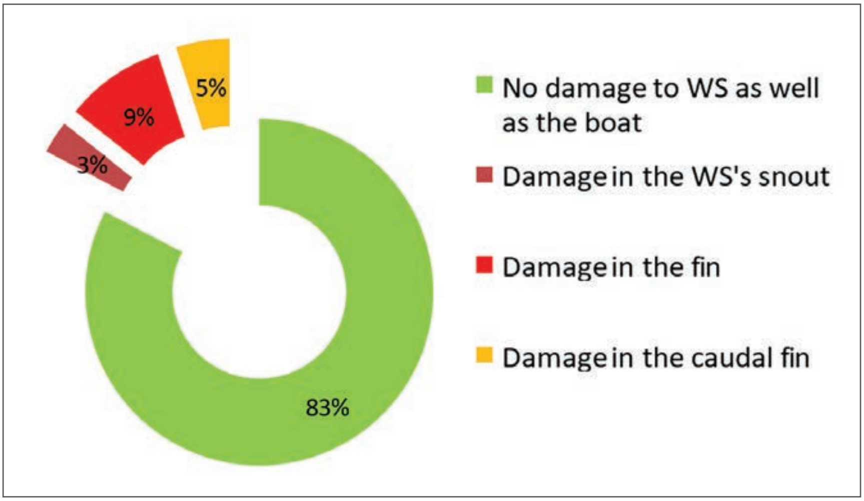


Fig. 39. Details of damage to the Whale Shark reported by the fishers during accidents

Most of the fishers interviewed (99.1%) have never caught a Whale Shark during fishing. There have been only 10 occasions where Whale Sharks were accidentally caught while fishing on the Tamil Nadu coast, all of which occurred in the Kanchipuram district. 1 fisherman caught a Whale Shark on 6 separate occasions, while 2 other fishers each caught 1 on 5 occasions, and another caught a Whale Shark on 3 occasions.

The trade of Whale Sharks in the markets of Tamil Nadu is not common, and there are very few brokers involved in such trade. Only 0.7% of the fishers sold Whale Sharks to brokers, and 0.2% directly put them up for sale in the markets.

3.3.6. Market value of Whale Shark

Fishers in Tamil Nadu generally lacked awareness regarding the domestic and international value of Whale Sharks. Out of 457 fishermen interviewed, all of whom had never caught a whale shark, none were aware of the specific market rates for this species.

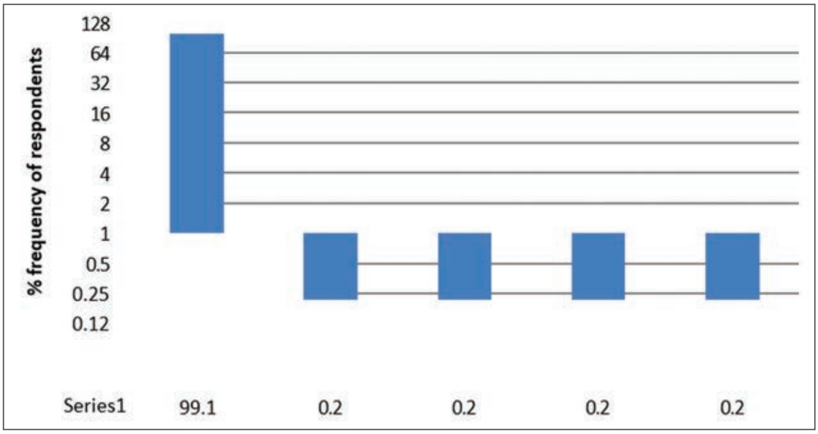


Fig. 17. Market rate for Whale Sharks reported by the fishers

However, the price they sold the Whale Sharks for and the assumptions are given in Fig. 17. As mentioned earlier 99.1% of the fishers were unaware of the market value of Whale Sharks.

Don't know the price	Rs. 2000/- 10000	Rs. 5000/- 10000	Rs. 5000/- 15000	Rs. 5000/- 20000

Only 2% of the fishers interviewed actively engaged in Whale Shark hunting, while the rest expressed no interest in this activity. Similarly, fishers in this region generally lacked awareness of Whale Shark hunting practices around the world. Only 4% of the fishers reported that they were aware of Whale Sharks being hunted for oil and meat. A majority (95%) of the fishers felt there was no demand for Whale Sharks in the region, however, there was a demand for their liver and fins in Tamil Nadu.

3.3.7. Pollution in the Tamil Nadu coast

Three major sources of pollution exist on the Tamil Nadu coast.

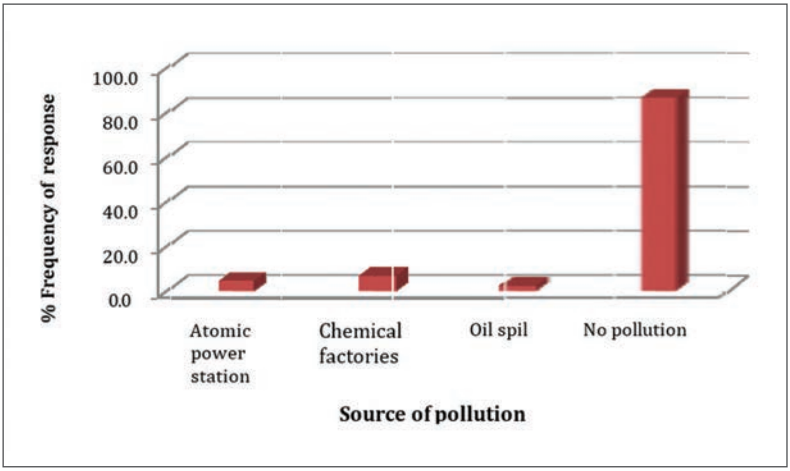


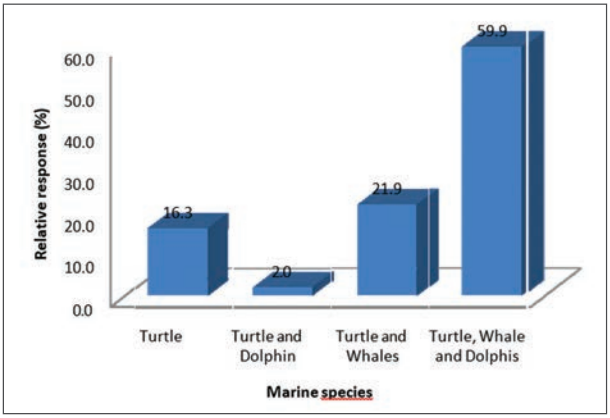
Figure 41. Pollution in Tamil Nadu for Whale Sharks reported

In districts like Thiruvallur, Thirunelveli, and Kanchipuram where there are atomic power stations, research conducted by SACON (unpublished data from 2004) indicated the presence of heavy metal residues in the sand along the Kanchipuram coast, likely stemming from these industrial activities. Additionally, chemical factories in Kanchipuram were releasing the effluents into the sea.

Oil spills from the major port are there in the Thiruvallur district but 86.8% of the fishers reported that there was no pollution in their area. However, dead Whale Sharks were recorded only in the Thiruvallur district. It was only recently that an adult female Whale Shark was caught in the net at Injappakkam in Kanchipuram district. Over the past 5 years, only 6 out of 461 fishers have recorded dead seeing Whale Sharks, mostly in a decomposed stage. A few fishers that were interviewed had encountered beached Whale Sharks. Overall, 59.9% of the fishers were aware that turtles, whales and dolphins are protected under the Wildlife (Protection) Act, 1972 (WPA). Interestingly, only 2 % of the respondents knew that turtles and dolphins are protected under WPA (Fig 42).

Ban on Whale Shark hunting is appreciated by 99% of the fishermen and only 1 % from Vizhuppuram district did not have any suggestions since they rarely sighted them in the ocean. However, they felt Whale Sharks were beneficial for good fish catches.

Figure 42. Fishermen's knowledge of marine species protection under Wildlife Protection Act



Whale Shark is among the deepest diving fish, recorded at depths up to 1,920 meters.

4. Review of secondary information

4.1. Introduction

The second phase of the study involved a review of published and unpublished literature pertaining to 2 major areas of interest: a) a review of Traditional Ecological Knowledge and information on Whale Sharks from the Indian region; and b) a review of documented traditional ecological knowledge of species with life histories to contribute to scientific research, impact assessment and ecological assessment of species.

The desktop review covered various disciplines including biology, anthropology, marine ecology and conservation. The review was wider than India in geographical coverage to include the Asia-Pacific and Indian Ocean regions. Sources included published and unpublished literature garnered through library searchers via catalogues, databases and the internet. The results of the literature review were summarized according to key themes relating to Whale Shark ecology and migration, uses, threats, and traditional ecological knowledge across geographic regions and cultural perspectives.

4.2. Ecology and Biology research abroad

The Whale Shark is known to occur in the waters of over 130 countries (Turnbull and Randell, 2006b). There have been a number of literature reviews describing their ecology and biology (Colman, 1997; Martin, 2007; Stevens, 2007) so, only a brief overview will be given here. Very little is known about the sex ratio and size at sexual maturity of Whale Sharks (Norman and Stevens, 2007). There is no definitive information about the age at maturity or maximum age of the species. Research at Ningaloo Reef, Western Australia found that about 50% of males were sexually mature at approximately 8m in length and were estimated to be around 30 years of age (Norman and Stevens, 2007). Unfortunately, it is not possible to determine female sexual maturity by simple external observation (Norman and Stevens, 2007).

Large females and small newborns are uncommon, therefore, it is possible that breeding occur in offshore waters where they are not easily observed (Bradshaw et al., 2007; Norman and Stevens, 2007). Much of what is known about their reproduction has come from a single female Whale Shark caught off the coast of Taiwan (Joung et al., 1996). This individual measured 10.6m in length and was found to contain over 300 embryos at various stages of development, the most ever found in any shark species. This catch confirmed that Whale Sharks are ovoviviparous, however, it is unknown whether their mating is opportunistic or occurs at specific sites on a seasonal basis (Martin, 2007).

Whale Sharks are versatile filter feeders, filtering large amounts of water over their specially adapted gills, catching planktonic and nektonic organisms (Jarman and Wilson, 2004). At Ningaloo Reef, Western Australia, Whale Sharks have been found to feed on different planktonic species (Taylor, 2007; Campagno, 1984). They are also known to eat small fishes such as sardines, anchovies, mackerels, small tunas, albacore and squids (Taylor, 2007). Aggregations of Whale Sharks appear to be related to food availability but the majority were observed at Ningaloo in the daytime and have not been engaged in feeding activities (Norman, 2000).

The population size and structure of Whale Sharks found in aggregations around the world are patchy, however, current photo-identification studies are helping to provide rough estimates. A lack of understanding of their migration patterns and limited knowledge of aggregation sizes makes it difficult to estimate the size of the global population. Population studies have only been site-specific and have not permitted inferences about the global population. Aggregations in various sites around the globe demonstrate ontogenetic and/or sexual segregation (Graham and Roberts, 2007). A high level of sex segregation has also been observed at Ningaloo Reef (Norman and Stevens, 2007) where approximately 85% of the individual Whale Sharks identified were male (Rowat and Gore, 2007).

All observed Whale Sharks that were greater than 9m in length were found to be male. Most females were in the 5-7m size range. Population estimates are made even more difficult because observations are generally made when they swim close to the surface. However, these surfacing episodes are generally brief, and it has been unclear what portion of an individual's time is spent at the surface (Taylor, 2007). Recent tagging studies in Australian waters have indicated that they spend >40% of their time in the top 15m of the water column (Wilson et al., 2006a), which suggests individuals being recorded are likely to be representative of the population in the area at the time.

Population numbers of Whale Sharks in the Andaman Sea, Thailand have been observed to be declining though from the data it is not clear if this is due to yearly variability in sea currents and plankton abundance or decreases in numbers are due to harvesting (Theberge and Dearden, 2006). Whale Shark harvesting in India increased dramatically during the 1990s and these may be the same population that visits the west coast of Thailand (Graham and Roberts, 2007).

It is reported that the Whale Sharks congregate in certain locations at a time corresponding with local coral spawning, however, the main aggregation site at Ningaloo Reef appears to vary between years, possibly in response to variations in this spawning (Cardenas-Torres et al., 2007). Whale Sharks are present in Bahia de Los Angeles for up to 7 months of the year from May to early December, though are most frequent and predictable between August and November, coinciding with periods of high plankton abundance (Norman and Stevens, 2007).

Segregation between Whale Shark sexes and age groups in many locations also suggests that aggregation is often related to feeding rather than reproduction (Graham and Roberts, 2007; Hayman et al., 2001).

Very little is known about their breeding grounds. Known aggregation sites are heavily biased as they are all inshore locations that are regularly frequented by humans. Whale Sharks do not have a biological need to remain at the surface to breathe, it is reported that they may only be observed for a small portion of their time when surfacing.

4.3. Whale Shark studies in the south Indian region

Most of the scientific information is from Whale Shark accidental catches (Table 9). Whale Sharks were reported from Ramanathapuram, Kanniyakumari and Kaveripompattinam (Kasinathan and Ramamoorthy, 1992; Jacob and Ebenezer, 1994; Radhakrishnan, 1996). An adult male measuring 8.1m in length was caught in Chennai, Masimedu (Rajapakiam and Mohan, 2006). A juvenile Whale Shark was caught while fishing in Vizhinjam in 2002 (Gopakumar et. al., 2003); Whale Shark catches have also been reported from Kerala; a 6.4m immature female was offshored in Kovalam beach, a 4.45m immature male was stranded in the net dragged to Sakthikulangara fishing harbor in 2006 and in Pallithurai near Vizhinjam (Paul, 2006; Pillai and Kingston, 2006). Kasinathan et al. (2006) reported accidental catching of a Whale Shark in the Gulf of Mannar. Pravin (2000) reported their occurrence on the Tamil Nadu coast from July – Oct. However, the recent news in the Hindu newspaper on Whale Shark catch confirms that this fish was observed up to January. Whale Sharks may occur throughout the year along the Indian coast.

Table 9: List of Whale Shark sightings in Tamil Nadu Coast

No	Sighting location	District name	Published literature
1	Ramanathapuram	Ramanathapuram	Kasinathan and Ramamoorthy 1992
2	Kanyakumari	Kanyakumari	Jacob and Ebenezer, 1994
3	Kaveripoompattinam	Nagapattinam	Radhakrisnan, 1996
4	Masimedu, Chennai	Kanchipuram	Rajapackiam and Mohan, 2006
5	Kaveripoompatiinam	Nagapattinam	Dhinamalar, News Paper
6	Gulf of Mannar	Thoothukudi and Ramanathapuram	Gandhi, 1996
7	Vizhijam	Kanyakumari	Gopakumar, 2003
8	Sakthikulangara	Kollam	Paul, 2006
9	Kovalam	Trivandram	Pillai and Kingston,2006
10	Gulf of Mannar	Thoothukudi and Ramanathapuram	Kasinathan et. al., 2006
11	Enjapakkam	Kanchipuram	Hindu newspaper, 2013

4.4. Migration and aggregation

It is known that Whale Sharks can travel over vast distances between aggregation sites. Studies reveal that they can travel longer distances. For example, one Whale Shark tagged in the Seychelles was relocated after 42 days having travelled 3,000 km south of Sri Lanka and then located again 4 months later, a further 5,000 km away in the waters of Thailand (Hsu et al., 2007a). Long-distance movement of Whale Sharks frequenting Seychelles has been found to be influenced by the prevailing geotropic currents (Hsu et al., 2007a).

4.5. Threats to Whale Sharks

There is very little conclusive evidence about the main threats to Whale Sharks (Colman, 1997). They appear to be very slow-growing and may take up to 30 years to reach sexual maturity (Rowat, 2007), which makes them highly vulnerable to human-induced mortality and probably not viable as a sustainable fisheries target species (Chen and Phipps, 2002). However, targeted fisheries could easily lead to a population collapse in the affected areas.

Estimates of vulnerability have often been highly speculative as seasonal and inter-annual variability of Whale Shark populations and abundance make it very difficult to determine long-term changes to populations or impacts of human activities (Graham and Roberts, 2007).

Research revealed that Whale Sharks in the Indian Ocean are subjected to targeted fisheries and population numbers appear to have declined rapidly in recent years (Norman and Stevens, 2007). Data from Taiwan's Harvest Reporting System show that all Whale Sharks caught around Taiwan between January 2001 and March 2002 were less than 7 meters in length, averaging 4.65m (Hsu et al., 2007b). This is well below the predicted size at maturity for Whale Sharks.

5. Discussion

The 7-month rapid action survey in 12 districts of Tamil Nadu registered the occurrence of Whale Sharks in the region. The survey has yielded qualitative information on the occurrence of this species. However, this survey failed to get photographs of live or dead Whale Sharks which was our personal interest. The whale shark, Rhincodon typus, is a long-lived migratory species inhabiting tropical and warm-temperate waters worldwide. Their seasonal aggregations in shallow coastal waters of many countries have led to the development of ecotourism industries (Stacey et al., 2012).

The highest records of Whale Shark observations were reported from the Gujarat coast and Tamil Nadu has the next highest sighting reports.

All fishermen informants have sighted Whale Sharks. These sightings have been reported from almost all maritime states of India including Gujarat (Hanfee., 2001), Maharashtra (Jadhav et al., 2005), Karnataka (Kemparaju et al., 2002), Kerala (Paul, 2006; Pillai and Kingston, 2006), Tamil Nadu (Rajapackiam et al., 2006), Andhra Pradesh (Rao, 1992), Orissa (Bar 1998) and Rao (2004), West Bengal and Goa (Pravin, 2000; Choudhary, 2008). Recently, there has been an increase in Whale Shark sightings on the Orissa coast, such as those documented by Bar (1998) and Rao (2004). Whale Shark catches are very rare and most of the time not reported to the scientific authorities.

All the historical records of Whale Sharks are from publications that have come from the Tamil Nadu coast through accidental catches and offshored dead individuals (Kasinathan and Ramamoorthy, 1992; Jacob and Ebenezer. 1994; Radhakrishnan 1996; Rajapakiam and Mohan, 2006; Gandhi, 1997).

In Tamil Nadu, Whale Sharks are referred to by at least 19 different local names. Among these, the most common names include Uluva, Puli sura (Leopard Shark), and Pulli sura (Dotted Shark). All the other names are exclusively used by fishers from different districts.

There is a pattern in the sighting distance range which might reflect the depth of the sea as well as the pollution and other disturbance in the ocean. Whale Sharks were sighted (mean distance) below 25 km in Nagapattinam and Thoothukudi districts which have major fishing ports. This suggests that these areas may have deeper waters near the shore, which could provide stable food sources for Whale Sharks. The closest sightings recorded were as close as 10 km from the shore.

Boat strikes involving Whale Sharks were well-documented during the early 19th century (Rowat and Gore, 2007), however, the current impact of mortalities from boat strikes is unknown. Informants along the Tamil Nadu coast reported that Whale Sharks have not died due to boat hits. However, boat strikes have been reported to be a major problem for Whale Sharks in the Indian Ocean (Johannes and Yeeting, 2001), though it seems unlikely that boat strikes by small vessels are contributing to mortalities (Martin, 2007).

In Tamil Nadu, the majority of the fishers interviewed feel that though Whale Sharks are good for fish catches yet it is not ideal since they get entangled in the fishing nets.

Globally, Whale Shark strandings are quite rare; and whilst it has the potential to affect some localized population numbers, it seems unlikely that this is a major threat to the global population. Stranding on the Tamil Nadu coast is not common. Over the past two years (2010-12) 1 juvenile (off-shored) and 4 adults have been stranded in Tamil Nadu. In contrast, only 2 Whale Sharks have been found stranded over the same period in Australia. However, these are the only confirmed records of stranding in Australia (Chen and Phipps, 2002). It is reported that Whale Shark strandings are relatively common in certain coastal areas of South Africa (Chen and Phipps, 2002), though the reasons for these strandings are largely unknown.

Whale Shark markets in India are few and in Tamil Nadu, there are specific locations where these markets exist. Typically, Whale Shark markets exist in Southeast Asia, but as the vulnerability of the Whale Sharks becomes better understood, some nations are making efforts to ban their sale. Despite an increasing number of countries banning the fishing of Whale Sharks, it is evident that they continue to be targeted, but this may not be reported.

A complete ban on the capture and trade of Whale Sharks in Taiwan came into effect in 2008, aimed at reducing the rate of population decline. Whale Sharks are not deliberately hunted in Mexico (Pravin, 2000). The species is known to the local community of Seychelles but has never been targeted as a food source (Pravin, 2000). In the waters around Madagascar, Whale Sharks are not a targeted fish species as they are not eaten and the fins do not fetch a high price, but there is no information available about incidental catch of the species (Pravin. 2000).

TRAFFIC report, shows that of all the world's nations, Indonesia caught the highest number of sharks in 2003, with a total of 14.1% of the world's shark catch. This represented an increase from a total of 73,000 tonnes caught in 1990 to more than 120,000 tonnes caught in 2003. Taiwan (7.87%) and India (7.38%) were the next two biggest shark fisheries.

Once again, this data is only available as a total for all shark species and does not indicate the number of Whale Sharks caught.

In recent decades, sightings of Whale Sharks have been reported from almost all maritime states of India including Gujarat (Hanfee, 2001), Maharashtra (Jadhav et al., 2005), Karnataka (Kemparaju et al., 2002), Kerala (Paul, 2006), Tamil Nadu (Rajapackiam et al., 2006), Andhra Pradesh (Rao., 1992), West Bengal and Goa (Pravin, 2000; Choudhary, 2008). Recently, there has been an increase in Whale Shark sightings on the Odisha coast, as documented by Bar (1998) and Rao (2004).

Up until the early 1980s, Whale Shark catches in India were mostly incidental but a large, targeted fishery began in the late 1980's. Prior to 1980, only the livers of Whale Sharks were used in India and the remainder of the carcass was discarded

(Pravin, 2000). It is estimated that approximately 1,000 Whale Sharks were caught off the Gujarat Coast of India during 1998 (CITES, 2002). Cured meat and liver oil have a good market in India and fins, frozen meat and skins from Whale Sharks caught in India have good markets in Singapore, Korea and Taiwan (White and Cavanagh, 2007). At present, the Whale Shark is protected under the Indian Wildlife (Protection) Act, 1972 (WPA).

Secondary information on Whale Sharks is scanty with much of it consisting of anecdotal records of catches in Tamil Nadu by the Central Marine Fisheries Research Institute (CMFRI). In general, targeted fishing of Whale Sharks is not ongoing in Tamil Nadu and awareness camps conducted by the Zoology Department, Poompuhar have had a significant impact on the conservation of this species.

Whale sharks often attract schools of smaller fish that swim close for protection, using the shark's massive body as a shield from predators.

6. Suggestion for conservations

Whale Sharks grow at a slow pace, mature late, produce few offsprings and live long. These features make them extremely vulnerable to overfishing. Despite the decline in major traditional fisheries, there is an emerging market in India for cured Whale Shark meat and liver oil, whereas, the fins, skin and frozen meat are exported to countries like Singapore, Korea and Taiwan. This trend towards increased exploitation of Whale Sharks is likely to continue and intensify further. Despite a considerable increase in the landings in recent years, the Whale Shark is one of the least-known among the large sharks along the Indian coast.

- It is realized that the Whale Shark is a highly vulnerable species and it is opined that an increase in any directed effort of capture may result in great imbalance.
- Recent fishing techniques and the launching of new ports on the Tamil Nadu coast in a decade have increased the fishing intensity offshore, affecting the movement of Whale Sharks.
- The IUCN lists the Whale Shark as an endangered species. These are naturally less abundant and are potentially at risk. One of the greatest challenges to the conservation of this species is overcoming the current poor state of our knowledge about the life history and biological parameters such as growth rate, reproduction potential, distribution movement and interaction with other species. Hence, complete research on the Whale Shark on the Indian coast is essential.
- It is imperative to conduct awareness camps among young fishermen.
- It is found that little attention is paid to the directed and incidental catches of Whale Sharks in Tamil Nadu.
- The fisheries are largely unregulated or unmonitored, and apart from what has been documented so far, the actual number of Whale Sharks captured may be less than that reported.
- The months of March to June observed the peak movement of Whale Sharks on the coast so the Govt. of Tamil Nadu has to declare the ban for deep sea fishing during this period.

CHAPTER 4

EAST COAST SURVEY

A Traditional Ecological Knowledge (TEK) based investigation of historical occurrence, distribution and population trend of Whale Shark along the Andhra Pradesh coast

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Rationale of the survey

Whale Sharks are a highly mobile fish species, making long-term observation of their behavior in the wild difficult and expensive. It is, therefore, understandable that science has little understanding of the whale shark's life history. However, with their Traditional Ecological Knowledge (TEK), fisherfolk across the world have a fairly adequate Indigenous Traditional Knowledge (ITK) about marine megafauna in the marine environment. Such indigenous knowledge of fisherfolk has been used by marine research, conservation and management scientists across the world .

The project along the Andhra Pradesh coast aimed to use the TEK and ITK (pertaining to the marine environment and other resources including Whale Sharks) of the fisherfolk operating in the Bay of Bengal along the east coast of India, to understand the past and present status of Whale Sharks, their aggregation hotspots and other aspects (like fishing pressure/threats) in the Bay of Bengal. The rationale for contemplating the project was to fill in the information gap about these gentle giants along the east coast of India.

Through questionnaire surveys conducted in the villages along the coastal Andhra Pradesh, it was expected that a better understanding would be gleaned on the hotspots of Whale Shark sighting locations, season and frequency of sightings, areas where most sightings have occurred, frequency and abundance of Whale Shark encounter during the fishing activity. Present and past Whale Shark landing information and the present survey outputs would enable us to single out the Whale Shark aggregation hotspots along Andhra Pradesh requiring immediate conservation action. Aggregation hotspots refer to geographic locations where a large number of Whale Sharks have been sighted, or where they are believed to aggregate.

Objectives

- To understand Whale Shark distribution along the Andhra Pradesh coast and the range of threats they face
- To analyze present and past distribution trends of Whale Sharks along the coast of Andhra Pradesh
- Based on the information generated, suggest a Whale Shark conservation strategy and action plan for implementation along the Andhra Pradesh coast.

Study Area

Andhra Pradesh is located at (16° 00' N& 80° 00' E) the Southern peninsula of India with a coastline of 980 km and a continental shelf area of 33,227 sq. km^2, spread over 9 districts. The state is bound on the north by Odisha and Chhattisgarh, on the west by Telangana and Karnataka, on the South by Tamil Nadu and on the east by the Bay of Bengal . There are 9 coastal districts of Andhra Pradesh: Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore (Fig. 43).

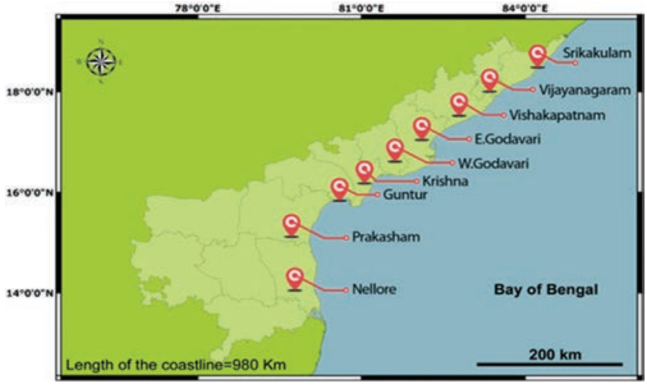


Fig 43. Map of Andhra Pradesh with coastal districts

The fishing grounds off the east coast of India extend up to a depth of 500 m, and the continental shelf extends up to 250 Nautical miles from the coast. Heavy fishing activity is observed during the post-monsoon season. The Government of Andhra Pradesh imposes a 45-day fishing ban, although traditional and artisanal fishing boats are permitted to carry out fishing during this period. Key demographic features of the Andhra Pradesh coast are given in Fig. 44.

The climatic condition along the eastern coast is characterized by monsoon season, which starts during July and continues till September. This period is marked by heavy tropical rains across Andhra Pradesh. The southwest monsoons play a crucial role in shaping the state's climate. Additionally, about one-third of the total rainfall in Andhra Pradesh is brought by the northeast monsoons around the month of October.

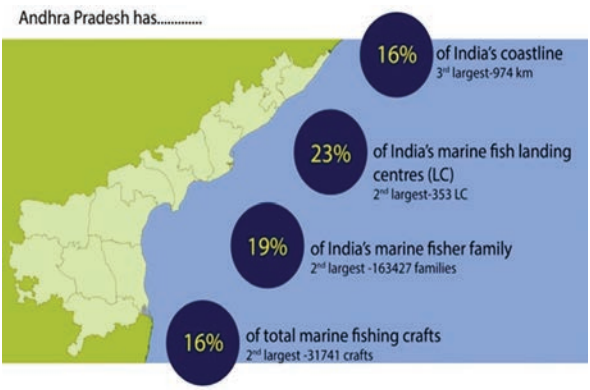


Fig 44. Key demographic features of the coast of Andhra Pradesh.

Table 10. Demographic details of coastal villages along Andhra Pradesh Coast

Sl. No	Districts	No. of Villages	Fishermen Families	Traditional fishermen families	Fisherfolk Population
1	Srikakulam	128	25579	25274	98450
2	Vijayanagaram	20	5138	5137	20812
3	Visakhapatnam	63	28779	28738	113632
4	East Godavri	97	44476	43800	165208
5	West Godavri	7	2451	2438	9188
6	Krishna	43	13073	13061	43005
7	Guntur	36	11771	10492	39333
8	Prakasam	67	15103	15055	51511
9	Nellore	94	17057	17044	64289
	TOTAL	**555**	**163427**	**161039**	**605428**

(source CMFRI, 2010)

There are 555 marine fishing villages with 1,63,427 fisher families, of which 98.5% belonged to traditional fishers. On average, each village had 294 families, with 1,091 persons per village (Table 10). The maximum number of villages are located in the Srikakulam district (128) and the minimum is in West Godavari district (7). The number of fishing villages in the remaining districts varied between 20 and 97.

The total number of landing centers in the state is 353 of which, 100 are in the Nellore district and the minimum number of landing centers are in the West Godavari district (CMFRI, 2010). There were 31,741 crafts in the fishery of which 3,167 were mechanized, 10,737 motorized and the rest were non-motorized. The mechanized sector predominantly comprised gillnetters (52%), trawlers (42%) and ring seiners (6%). The majority of the motorized crafts are operated in Nellore, Visakhapatnam and Prakasam districts, while non-motorized crafts are more in Visakhapatnam, Srikakulam and East Godavari districts.

Survey design and methodology:

Literature review

The first phase of the project involved a review of existing Whale Shark information:

- Published literature, to understand scientific information on Whale Sharks along the east coast of India.
- Grey literature on the past and present status of Whale Sharks along coastal Andhra Pradesh and media reports that provide threat information were also reviewed.

These reviews encompassed a range of disciplines in Whale Shark science, including conservation biology, anthropology, marine ecology and conservation. Sources of information included published and unpublished literature gathered through library searchers, databases and the internet. Results of the literature review were summarized according to key themes relating to Whale Shark ecology and migration, uses, threats, traditional and technical knowledge across geographic regions and cultural perspectives. The literature review was primarily a desktop textual analysis of information, identifying topics and analyzing themes as well as establishing a framework for the ground study.

Spot patterns over Whale Sharks allow non-invasive ID to track migration and behaviour.

Consultation with professional institutions and organizations

In the second phase of the project, the survey team started collecting existing information on Whale Shark landing, stranding and sighting records in coastal Andhra Pradesh from different scientific institutions, governmental and Non-Governmental Organizations (NGOs) working in the state.

Developing the TEK and ITK based survey questionnaires

Refining the existing TEK of the Whale Shark survey questionnaire used in eastern Indonesia and the ITK questionnaire developed by CMFRI for their marine mammal field survey, a new structural questionnaire was developed (see appendices).

Questions and topics in the questionnaire related broadly to the following themes:

i. Understanding Whale Shark distribution across the coast of Andhra Pradesh

ii. Range of threats experienced by Whale Sharks along the coast of Andhra Pradesh

Planning and finalizing the fish landing sites and villages for the survey

Details on the major and minor fish landing centers along the Andhra coast were collected from CMFRI. Villages for the survey were selected based on the number of fishing crafts and proximity to major fish landing centers.

Planning the surveys

The questionnaire survey was mainly targeted at male fishers. We categorized fishers into two groups i.e., retired Fishermen (>55 age) and active Fishermen (<55 age). The importance of focusing the questionnaire survey on retired fishermen was to gather historical information about the Whale Sharks in their area of operation. The active fishermen were to provide the present information about the Whale Sharks in the area of operation.

Range of information gathered from professional institutions and Non-Governmental Organizations (Table 2)

Conducting the questionnaire survey

Results of the literature review were used to define the field survey design, key topics and questions for the interview. The questionnaire was translated into Telugu (the native-speaking language). Along with the translated questionnaire, the interviewer also carried some resource materials like Whale Shark pictures and scale models which were shown to the target audience for correct identification. The questionnaire survey with a single respondent lasted between 30-45 min (Fig. 45). Public gathering locations such as fish landing centers and local fishermen societies were targeted as they facilitated easier outreach to fisherfolk.

Fig 45. Several informal interactions were conducted along the coast before kick-starting the actual field data collection to get firsthand knowledge of the coast and the fishing behavior of the community.

Suckerfish feed on leftovers from the Whale Sharks filter feeding

Data Analysis

The results of the literature review and field interviews were analyzed qualitatively. Data were analyzed using Microsoft Excel.

Results

Literature review of Whale Sharks

Based on the published journals (6), and media reports (4), the study tabulated the following information on Whale Shark sightings, landings and scientific studies along the coast of Andhra Pradesh (Table 11).

Table 11: Details of published literature and media reports reviewed for co-ordinating the questionnaire survey.

Location of Whale Shark sighting information	Date	Sources of Information
Dumalpeta, Iskalapalam, Kakinada, Kopirivamipeta, Kothapeta, Kothura, Perumalgramam, Srikakulam, Vadagangavada, Vizag, Yellaiepheta, Yerapeta, Yeeramukham, Yetimogan (Coastal Villages of AP)	1889-1998	P. Pravin (2000)
Visakhapatnam, AP	25.05.1965	E. G. Silas (1965)
Visakhapatnam, AP	08.06.1992	C.V.Seshagiri Rao, K. Narayana Rao (1992)
Kakinada, AP	24.09.1992	P.Ramalingam et al. (1993)
Kakinada, AP	07.02.1996	Ch. E. Thathayya (1996)
Vadagangavada, Srikakulam,AP	16.01.1997	V. Atchutha Rao (1997)
Iskalapalem Landing Centre, Srikakulam, AP	25.01.1997	V. Atchutha Rao (1997)
Kothuru, Srikakulam, AP	25.01.1997	V. Atchutha Rao (1997)
Iskalapalem Landing Centre, Srikakulam, AP	02.03.1997	V. Atchutha Rao (1997)
Kakinada	2014	K.N Murli Sankar (The Hindu)

Location of Whale Shark sighting information	Date	Sources of Information
Kakinada	2015	The Hindu
Kakinada Near Vakalapudi Shore	07.08.2015	K.N Murli Sankar (The Hindu)
Andhra Coast	2015	Vadrevu Srinivas (Deccan Chronicle)

Results based on questionnaire survey in coastal Andhra Pradesh

In total, 650 interviews were conducted between October 2015 and April 2016 with fishers from Srikakulam, Vijayanagaram, Visakhapatnam, East Godavari, Krishna, Guntur, Prakasham and Nellore districts (Fig. 46 and Table 12). Due to its small size and having only 7 coastal fishing villages, no formal interviews were conducted in the West Godavari district. Data analysis was carried out using Microsoft Excel 2007.

Table 12: Number of surveyed villages and respondents along the west coast of India.

Surveyed districts	No. of villages visited	No. of fishermen interviewed
Srikakulam	04	40
Vijaynagram	07	77
Visakhapatnam	11	157
East Godavari	11	90
West Godavari	0	0
Krishna	14	119
Guntur	06	40
Prakasham	14	17
Nellore	17	110
Total	**84**	**650**

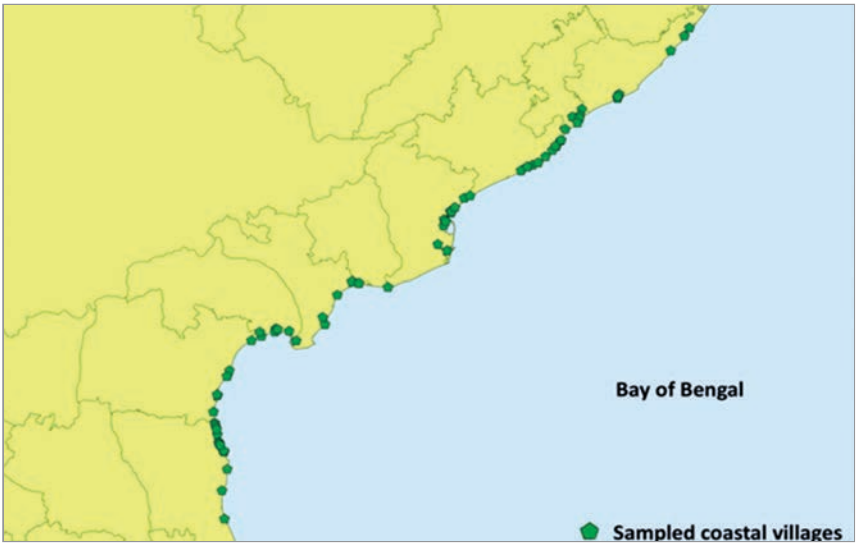


Fig 46. Locations of sampled villages along Andhra Pradesh Coast (Village details are given in Appendix 3 (II) of Chapter 4)

Whale Shark sightings

Among (n=650) the respondents interviewed, 48% (n=314) reported having sighted a Whale Shark in the Bay of Bengal during fishing (Fig. 47). The highest proportion of respondents who encountered Whale Sharks (Fig. 52) were from East Godavari (66%, n= 90) followed by Krishna (58%, n= 119), Guntur (55%, n= 40), Visakhapatnam (52%, n=157), Prakasham (50%, n=17), Srikakulam (45%, n=40), Vijayanagaram (44%, n=77) and Nellore (20%, n=110).

Thousands of tiny teeth, but no biting needed – the whale shark's gentle filter-feeding keeps it thriving on plankton

It can be inferred from the interviews, that the probability of Whale Shark sighting is highest in the offshore waters of East Godavari, Krishna and Guntur. Whale Sharks are largely planktonic feeders and their seasonal feeding aggregations are largely associated with productive areas. The Bay of Bengal becomes more productive with periodic phytoplankton and ciliate blooms, and these were mainly attributed to local coastal upwelling. In the Northern Gulf of Mexico, chlorophyll A and phytoplankton concentration have been used successfully to predict the seasonal occurrence of these Whale Sharks. The nutrient-loaded waters of Coringa and Krishna mangroves clubbed with coastal upwelling are hypothesized to be making the offshore waters of East Godavari, Krishna and Guntur nutrient-rich and a perfect place for Whale Shark aggregation.

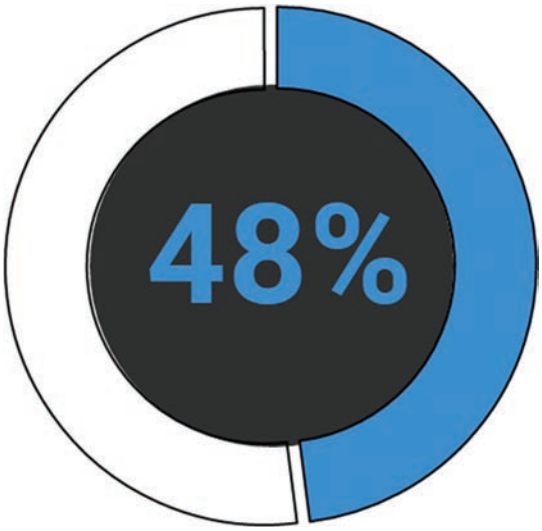


Fig 47. Percentage of respondents who have seen Whale Sharks during their fishing careers.

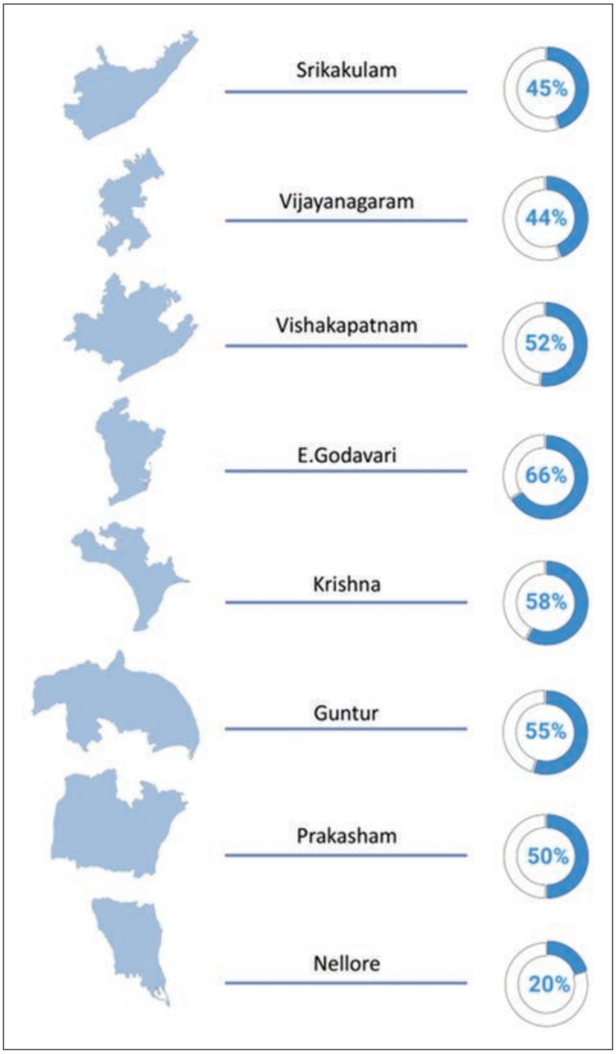


Fig 48. Percentage of fishermen who have encountered Whale Sharks during their fishing careers.

Whale Shark landing records from the East Godavari region collected by EGREE Foundation reported 79 Whale Sharks during 2013-2015 (Fig. 49); support this hypothesis.

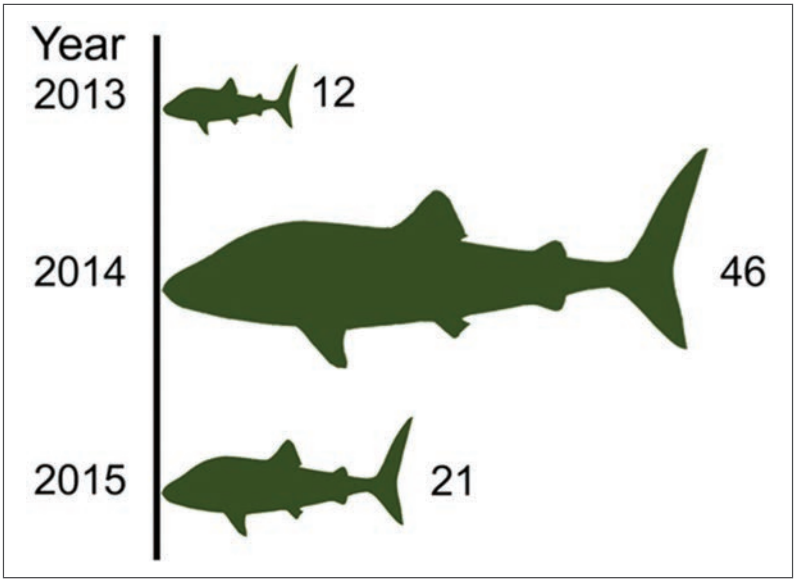


Fig 49 : Number of Whale Sharks landed at Kakinada during 2013-15 (Source: Sathiyaselvam et al 2016).

Time-period of Whale Shark sightings by respondents over the decades

Whale Sharks have been sighted or have landed along the east coast of India for over a decade. All the responses collected from the regions were categorized into 4 time periods, recent as 2011-16 (n= 116), comparatively recent as 2006-10 (n= 102), during the last decade 2000-2005, (n= 53) and in the decade up to 1999 (n= 43). The result shows that the mean number of respondents (in each village) who had seen Whale Sharks before 1999 was significantly less than the mean number of respondents (in each village) who had seen them in later decades (Fig. 50). There is consensus amongst the fishers that Whale Shark sightings have increased in the last 10 years. However, before 2005, the frequency of Whale Shark encounters was significantly lower along the Andhra Pradesh Coast.

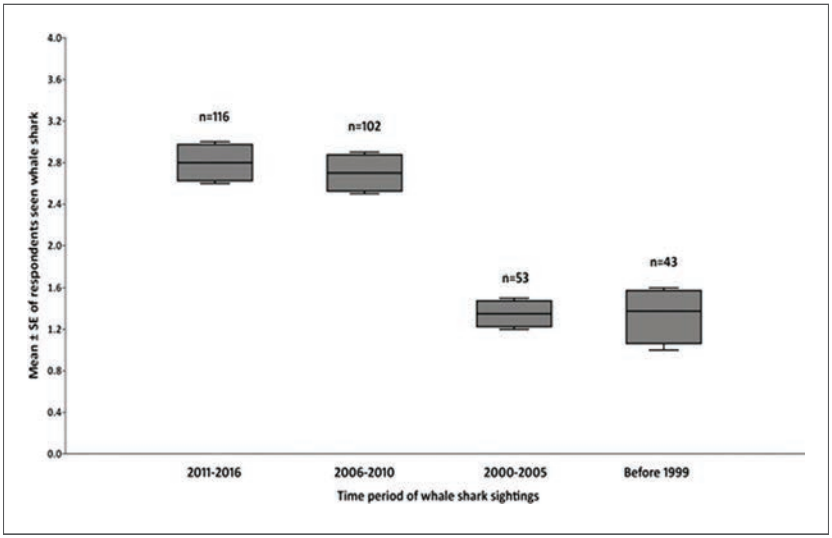


Fig 50: Number of active fishers/villages encountered Whale Sharks in different time periods over a decade.

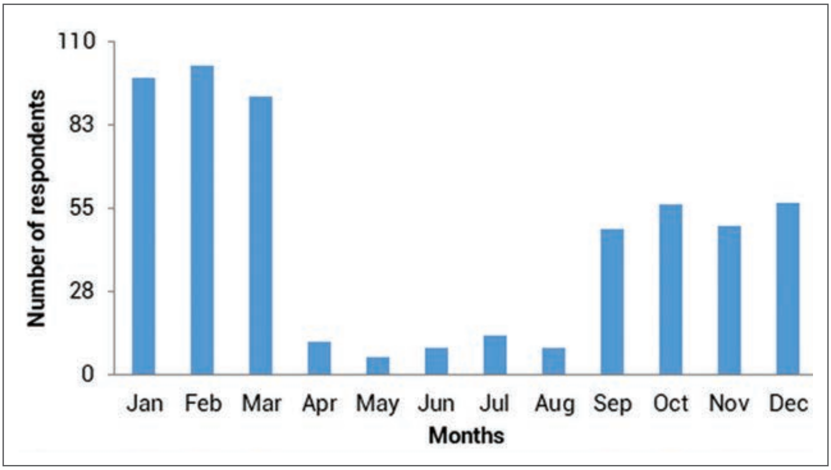


Fig 51. Whale Shark encounters during the calendar year.

Number of Whale Sharks sighted in the lifetime of a fisherman

Fishers were interviewed to understand the total Whale Shark sightings they had in their entire fishing career. These sightings were grouped into 6 categories based on the number observed, ranging from 1 to more than 20 sightings. The result depicted that the mean number of respondents (in each village) who had seen 3-5 Whale Sharks in their lifetime was significantly higher than the mean number of respondents (in each village) who had seen more or less number of Whale Sharks in their lifetime (Fig. 52).

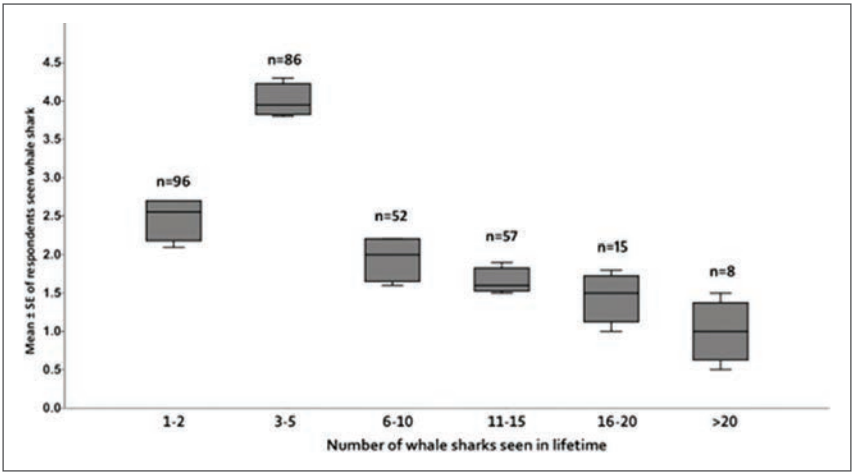


Fig 52. The number of Whale Sharks sighted in a fisherman's lifetime.

Whale Shark incidental catch

Incidental catch is one of the major threats to Whale Shark populations and is a global concern. Among various kinds of fishing gear used, gillnets and purse seines have been identified as the primary gears responsible for incidental catch along the west coast of India[10]

Overall, gill nets contributed to 80% (n= 384), trawl nets contributed to 15% (n= 72) and shore seines contributed to 5% (n=24) of incidental Whale Shark catches along the Andhra Pradesh coast (Fig. 53). It is both surprising and interesting that Whale Sharks get entangled in shore seines, considering their preference for deeper waters, although they occasionally come close to the shores.

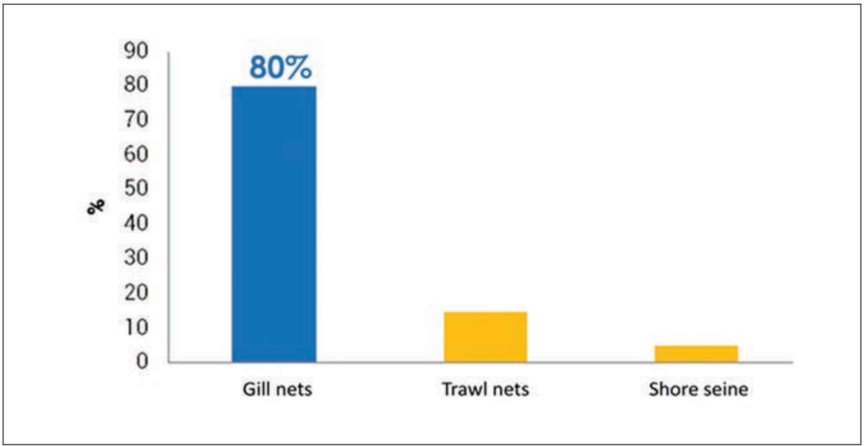


Fig 53. Percentage of Whale Shark entanglements in different fishing gears.

Fisher's awareness of Whale Sharks

The majority of fishers (94%) along the coast were aware of Whale Sharks. Since different local names were used for the species in different parts of the coast (Table 13), when pictures and props were shown, most fishers identified them correctly. (Fig. 54).

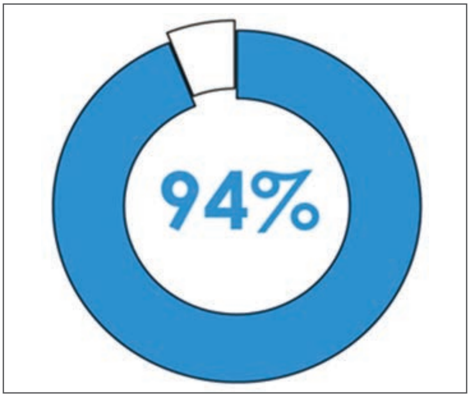


Figure 54. Awareness level of fishers on Whale Sharks along the Andhra Pradesh coast. 94% of the respondents are aware about Whale Sharks.

Table 5. Common names of Whale Sharks along the AP Coast

Common names of Whale Shark along the coast of AP	
1 Bokku Sora	7 Jaru Menu
2 Boka Sora	8 Kithalam Sora
3 Gunna Sora	9 Puli Sora
4 Machala Sora	10 Neru Sora
5 Rubber Sora	11 Puli Bokku Sora
6 Thimmiri Menu	12 Gali Sora

ETYMOLOGY

During the initial stages of conducting interviews with fisherfolk in the state of Andhra Pradesh, we were faced with difficulty in explaining to them about the whale shark. We later understood that this was because people use various names for this species across different places along the coast. Common names that are in use along the coast are given in Table 5. As we started investigating the etymology of these names, we came across a piece of interesting information: the names given to the species explain its behavior and biology. Explanations of some common names are given below in the interest of the reader.

Bokku sora:

In Telugu, *Sora* translates to shark, and *Bokku* means to "to feed voraciously". This name reflects the voracious feeding behavior of Whale Sharks, as they are frequently observed feeding with their mouths.

Rubber sora, Neeru sora:

Neeru in Telugu translates to "water". The flesh of the Whale Shark cannot retain water once slaughtered; it loses its texture and shrinks faster than any other animal. This distinct characteristic of Whale Shark flesh is reflected in the usage of these names.

Gunna Sora:

Gunna in Telugu translates to a young one of any animal but, popular usage of this word refers to a smaller elephant. Gunna sora thus refers to its large size.

Thimmiri menu:

While *menu/minu* in Dravidian languages translates to "fish", *Thimmiri* in Telugu translates to "numbness". This explains the thickness of the skin of a whale shark. (Refer to the next Box).

Puli sora:

Puli in Telugu translates to "Tiger". The name refers to the contrasting white stripes on its dark skin on the dorsal surface.

Machala sora:

This Telugu name directly translates to "Spotted shark".

Among the respondents interviewed along the Andhra Pradesh coast (n=650), 48% (n=314) reported having sighted a Whale Shark in the Bay of Bengal during their fishing career. Of which, 93% of fishers were able to identify a Whale Shark by its dorsal fin when it was out of the water. Few fishers saw the caudal fin out of water. However, none of the respondents recall witnessing any signs of feeding activity on any of the occasions (Fig. 55).

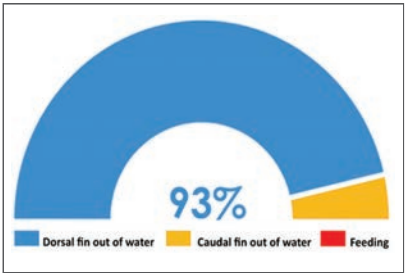


Fig 55. Most of the Whale Sharks were found on the water surface with the dorsal fin exposed.

Maximum Whale Shark sightings (86%) were between 10 and 20 km from the shore, where the water depth ranged from 20 to 200 m (Fig. 56). However, some fishers reported instances where Whale Sharks occasionally come near the shore and sometimes get entangled in shore seines.

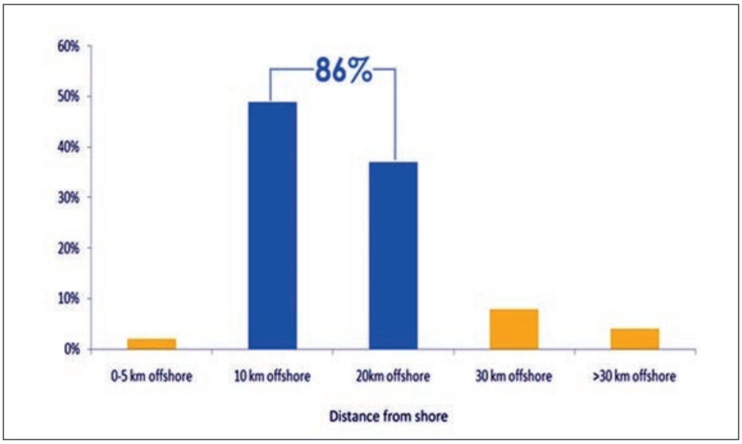


Fig 56: Maximum Whale Shark sightings in relation to distance from the shore.

Fishers had a neutral feeling about the sighting of Whale Sharks during fishing operations. None of them considered these sightings as a good/bad omen. However, few fishers of Guntur and Visakhapatnam felt that sighting a Whale Shark during a fishing operation brings bad luck (Fig. 57). This perception may have been correlated with their voracious feeding behavior, leading fishers to view them as competitors.

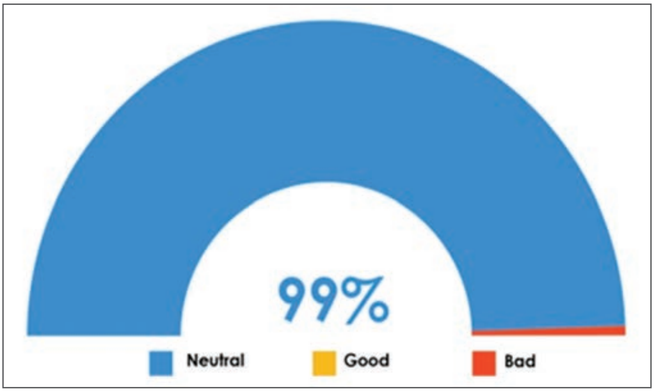


Fig. 57: Fishers' feeling on seeing Whale Sharks during fishing operation

The majority of fishers (90%) considered Whale Sharks to be harmless. However, few fishers of east Godavari, Krishna, Prakasham and Vishakhapatnam consider them to be dangerous owing to their size (Fig. 58).

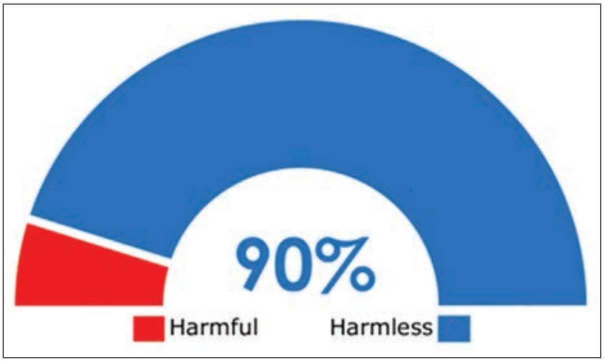


Fig. 58: Majority of fishers (90%) considered Whale Sharks as a harmless fish.

76% of fishers believed that Whale Shark feeds on shrimps and small fishes. However, the rest were unaware of what these giant fishes feed on (Fig. 59).

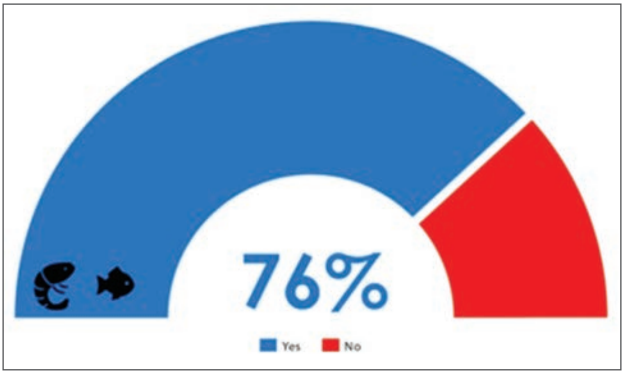


Fig. 59: According to fishers, Whale Shark feeds on shrimps and small fishes.

Some unusual behavioural patterns of Whale Shark as reported by the fishers of Andhra Pradesh

Unlike fishermen of other coastal states of India, AP fishermen reported some unusual behavioral patterns of Whale Sharks during fishing operations.

Basking:

Fishermen who reported to have encountered Whale Sharks during their fishing careers shared an interesting observation that they tend to bask under the shade of the boat to escape from excess heat of the sun when near the surface for extended periods. They reported instances where Whale Shark often came to rest under the boats while they were moored after deploying their gill nets.

Scratching:

We were also informed that Whale Sharks have a very itchy skin, which leads them to scratch against boats that are moored after deploying their boats. Some fishermen also expressed doubts, suggesting that due to numbness of their skin (refer to Etymology : Thimmiri Menu), the Whale Sharks did not probably realize that they were scratching against the boats.

This is particularly interesting as these interactions were never reported from Gujarat where WTI has had an ongoing project on Whale Shark conservation for the past 12 years.

If this is to be believed, these interactions with Whale Sharks explain the risk of frequent entanglements. More in-depth scientific understanding can shed more light while designing further conservation strategies for this species.

Whale Shark pups/sub-adults from Andhra Pradesh waters

Understanding the Whale Sharks reproductive behavior is key to formulating appropriate conservation plans across their global range. Whale Sharks are ovo-viviparous (aplacental viviparity), giving birth to live young ones that hatch from egg cases within the uterus of the female. The pre-natal development of the Whale

Shark is described by Joung et al., (1996) from a single pregnant female caught in Taiwan in 1995. Most records of neonatal free-swimming Whale Sharks are from open ocean habitats, and given their limited swimming abilities, researchers speculate that they may have been born close to where they were captured/ recorded.

During the survey, 11% (n=650) of fishers claimed to have seen Whale Shark pups ranging from 80-150 cm while fishing and have landed them as well. However, none of the fishers had photographic evidence of these sightings, leading to doubts about whether these were indeed Whale Shark pups.

Fishers claim that 65% of the pups were between the size class of 80-100 cm (Fig. 60) and most of the sightings were from 10-20 km offshore (Fig. 61) in the month of October to March (Fig. 63).

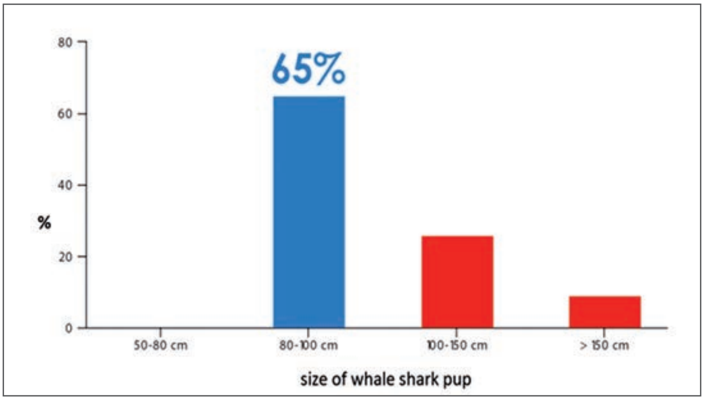


Fig. 60: Size class of encountered Whale Shark pups by fishers

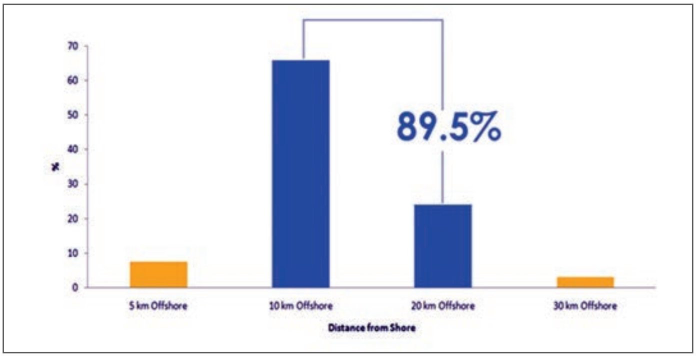


Fig. 61: Distance from shore at which Whale Shark pups were encountered.

Whale Shark pups or Bow-mouth guitarfish?

Bow-mouth guitarfish (*Rhina ancylostoma*) are often misidentified as Whale Sharks amongst amateur biologists/non-biologists. Its striking resemblance to a whale shark's body pattern is one of the major reasons for this misidentification (Fig. 62). The species is fairly common along the east coast of India and a considerable number of Bow-mouth guitarfish land every year along the Andhra Pradesh coast as well. We have speculation that fishers have misidentified Bow-mouth guitarfish as a pup/juvenile of whale shark. To eliminate such doubts, we took steps to distribute postcards with details on identifying Whale Shark pups. Fishermen who encountered a Whale Shark pup could fill out a self-addressed and stamped postcard and return it to us. Thus far, we have distributed 1,500 postcards (Appendix 3 (III) to fishers along the Andhra Pradesh coast.

Fig. 62: Adult Bow-mouth guitarfish (Rhina ancylostoma) landed at Visakhapatnam harbour

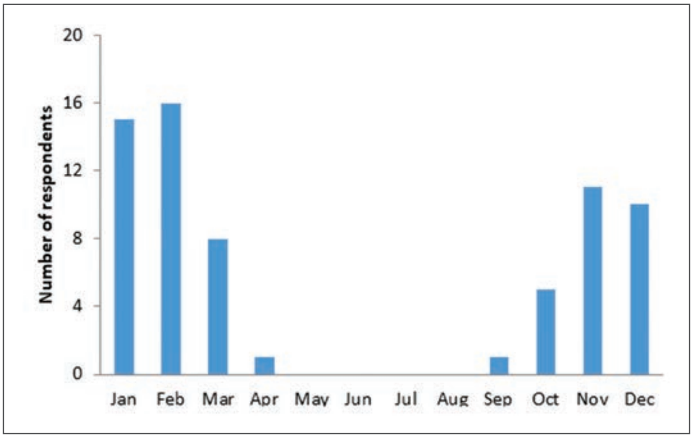


Fig. 63: Seasonality of Whale Shark pup encounters.

Awareness level of fishers on the Wildlife (Protection) Act, 1972 (WPA).

The majority of the interviewed fishers (88%; n= 650) were aware of the Wildlife (Protection) Act, 1972. While their knowledge of the law may not be comprehensive, they are aware that certain species like dolphins and turtles are protected. 10% (n=70) of the fishers were unaware of the law and 2% (n=8) did not respond to this question. However, it is assumed that the 2% who didn't respond were equally unaware of the law (Fig. 64).

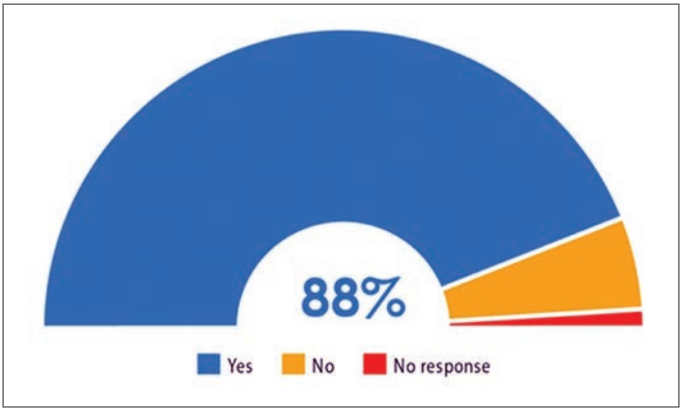


Fig. 64: Awareness level of fishers about WPA, 1972

We also assessed the fishers' awareness of the legal protection status of Whale Sharks. Out of the 650 fishers interviewed, only 357 (54%) were aware that the species is protected by law, prohibiting its capture, killing or sale in the market. The remaining 40% were unaware of this legal protection, indicating the need for ongoing awareness programs regarding the legal provisions concerning Whale Sharks. (Fig. 65).

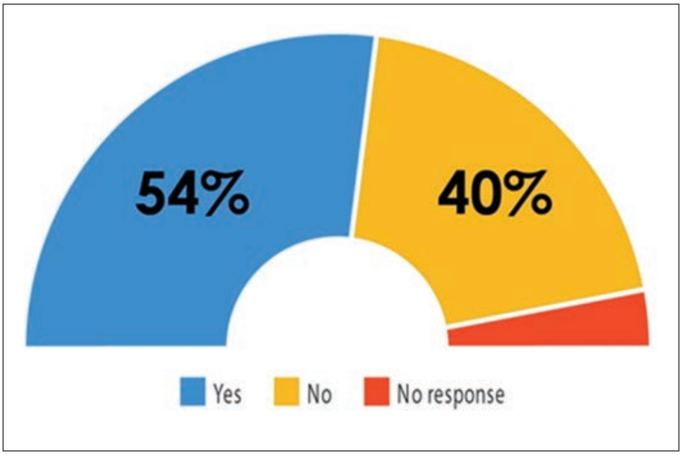


Fig 65. Awareness level of fishers on protected status of Whale Sharks

Geographic locations of Whale Shark sightings or where they are believed to aggregate

One of the outputs of this project was to identify Whale Shark aggregation sites along the Andhra coast (Fig. 66). Based on the responses from fishers, these aggregating locations were plotted on a bathymetric map, resulting in the identification of 2 Whale Shark aggregation locations. Of the 314 respondents who reported having sighted Whale Sharks during fishing operations, they occurred off Kakinada (opposite Coringa mangroves) and between Nizampatnam and Machlipatnam (opposite Krishna mangroves) (Fig. 66). The reports indicate that Whale Sharks were observed at depths ranging from 20 meters to 200 meters. (Fig. 67).

(Whale Shark aggregating locations along the west coast of India is given in Appendix 3 (VII).

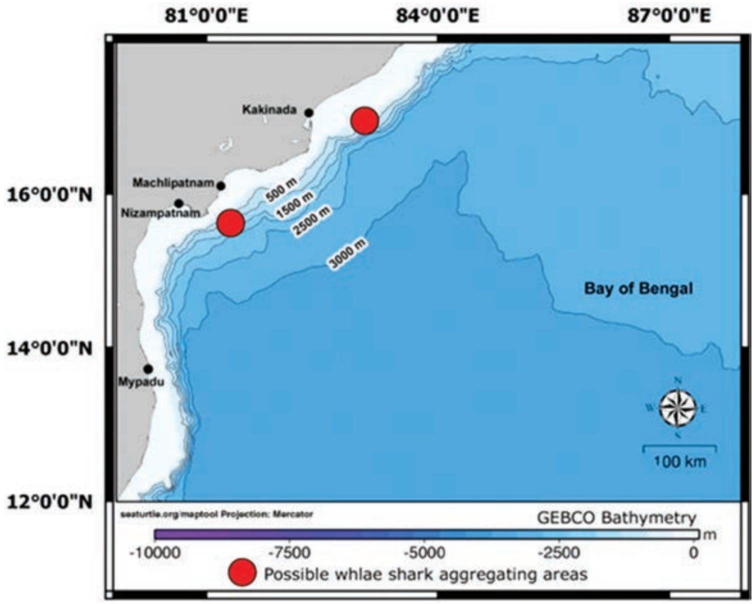


Fig 66. Geographic locations of Whale Shark sightings, or where they are believed to aggregate.

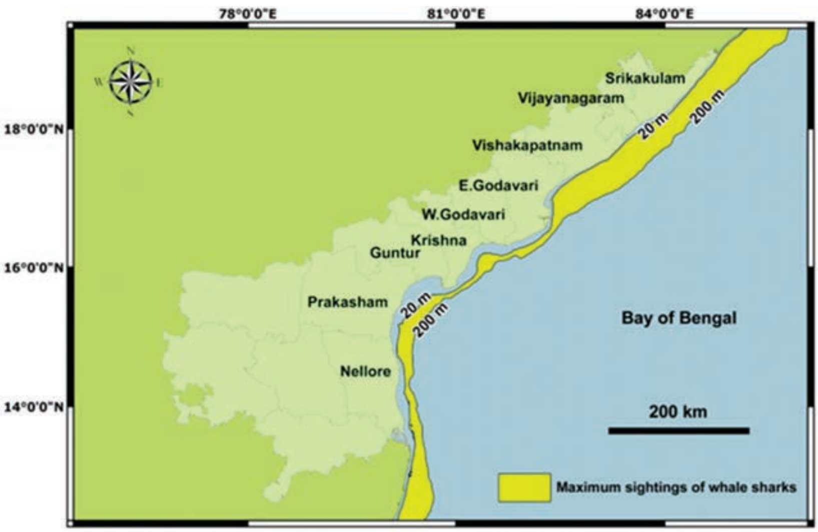


Fig 67. Depth range of Whale Shark sightings recorded along AP coast.

Discussions:

Targeted fishing for Whale Sharks stopped globally in 1990–2000s. However, incidental catches of Whale Sharks continue to be reported worldwide, and Whale Shark products are still available in international markets. Grave injuries and inferred mortalities resulting from vessel strikes and fishing activities pose significant threats to Whale Shark aggregations on a global scale. In the absence of proper conservation action, population declines are likely to persist in the future.

Based on count data, habitat availability and modeled population estimates, 75% of the global Whale Shark population is inferred to occur in the Indo-Pacific region and 25% in the Atlantic. Studies indicate a significant decline in Whale Shark numbers by 40-92%, with an estimated overall decline of 63% in the Indo-Pacific over the last 75 years. Given that a majority of the global population is concentrated in the Indo-Pacific, the overall global decline is inferred to be ≥50%. Globally, the Whale Shark is, therefore, assessed as Endangered.

Over the past decade, Whale Shark landings have been reported from various coastal states of India excluding Gujarat, primarily due to the level of awareness among the fishers. In Gujarat, however, awareness levels increased up to 69%, after WTI and the International Fund for Animal Welfare (IFAW) launched the Whale Shark Campaign in January 2004 in collaboration with the Gujarat Forest Department, TCL and Gujarat Heavy Chemicals Ltd. Well-known religious leader, Shri Morari Bapu supported the initiative leading to a grand success of the campaign which was reflected in the positive response amongst the civilians, fisherfolk and even the Government. Now the Whale Shark has become a source of pride for Gujarat with several cities (Dwarka, Okha, Porbandar, Mangrol, Veraval, Diu, and Ahmedabad) coming forward to declare the Whale Shark as their city mascot. The Dept. of Posts, Govt. of India released a special postal cover and stamps as a token of solidarity towards spreading Whale Shark conservation awareness among the masses. Currently, fishers of Gujarat are releasing entangled Whale Sharks after cutting their nets with proper photo documentation, to claim net-loss compensation from the Dept. of Forests, Govt. of Gujarat. The awareness campaign, compensation program and self-documentation scheme for net loss compensation are currently limited to Gujarat. Whale Shark aggregation, rescues, awareness and involvement of the corporate sector in conservation are all positive responses for Whale Shark conservation along the coast of Gujarat.

The present survey was executed primarily to understand the past and present distribution of the species along the AP coast, solely based on the TEK of the fishing community. This survey is part of a larger initiative to expand the Whale Shark conservation strategy and action plan to other parts of the east coast. A total of 650 interviews were conducted in 84 fishing villages along the 980 km long coastline of Andhra Pradesh from October 2015 to April 2016. Results revealed that the percentage of Whale Shark sighting was high in East Godavari district (66%) and low in Nellore (20%). Reports of Whale Sharks from the coast have been published more than half a century ago, with early records of Whale Shark landings from Visakhapatnam by Silas (1965).

Based on the fisher survey and historical Whale Shark information from published literature along the AP coast, we assessed the level of threats faced by the species in this area. There is no conclusive evidence to confirm the hunting or targeted fishing of Whale Sharks. Currently, our understanding of the threats is confined mainly to incidental captures, and strandings caused by collisions with ships or boats, as well as fisheries-related activities. These are considered major threats to the Whale Shark along the west and east coasts of India. Many respondents have reported having found entangled Whale Sharks caught incidentally in their fishing gears, specifically in gill nets, trawl nets and shore seine. Among the 3 fishing gears, the gill net is found to be the most predominant gear responsible for Whale Shark entanglement, followed by the trawl net.

While comparing the present survey data with available information for the last 10 years from published literature and articles on Whale Shark incidental catch, most records reported entanglement in gill nets as the primary cause of Whale Shark mortality. Though the legal protection of Whale Sharks has been in effect since 2001, reports of stranding due to human interactions e.g. vessel collisions, incidental landings, by-catch and stranding/beaching are still being recorded. At the same time, sightings or captures of smaller Whale Sharks less than 2.5 m or 3 m are possibly going unreported. According to Akhilesh et al., (2012), since 2001, Whale Shark landings have been high along the western coast of India (58%).

The whale shark's massive tail propels the gentle giant through oceans with surprising speed.

The east coast accounted for 42% of Whale Shark landings, with Andhra Pradesh contributing 11% following Tamil Nadu, which accounted for 22% of the landings.

Increased Whale Shark accidental entanglement/ mortality can be attributed to the upgradation of existing fishing technologies and an increase in the efficiency of craft and gears. Moreover, in recent years, there has been a considerable increase in activity in the motorized sector. There have also been dimensional changes in the gear and the time spent fishing in the mechanized sector by undertaking voyage fishing and the use of sophisticated electronic devices for fish finding has resulted in increased fishing pressure and efficiency. Unlike cetaceans, sharks do not use sound to communicate with each other. However, sharks do sense sound as pressure through their lateral line system, and it is possible that sounds at higher decibels may negatively impact Whale Sharks. Experiments have demonstrated that sharks can hear sounds with frequencies ranging from about 10 Hz to about 800 Hz. The effects of very loud sounds on shark behavior are not well documented; however, it is possible that they could potentially disrupt normal behavior such as feeding, mating, or migrating from one place to another. According to the Whale Shark recovery plan submitted to Common Wealth of Australia (2005), the global Whale Shark population decline has been attributed to the fishing pressure in International waters especially from India, Taiwan and the Philippines.

Geographic locations on Whale Shark sightings or probable aggregation based on responses of the fisherfolk have been plotted on a bathymetric map. As a result, 2 Whale Shark aggregation sites have been identified along the AP coast, one near Kakinada (opposite Coringa mangroves) and the other between Nizampatnam and Machlipatnam. Further in-depth research and the frequent cruise surveys in these aggregation sites may provide valuable insight into their lifecycle. Records of Whale Shark aggregation on the west coast (from Gujarat) are based on the Whale Shark rescue data maintained by WTI in collaboration with the Gujarat Forest Department and TCL from 2005 onwards; overall, 606 Whale Sharks were rescued by fishermen along the Saurashtra Coast of Gujarat (Veraval, Sutrapada, Mangrol and Dhamlej) from 2005 till September 2016.

The present survey has given us considerable bit of information about the status of Whale Sharks in the Bay of Bengal, which is one of the Large Marine Ecosystem (LME) in the world. More involvement of stakeholders (fishing communities, civic societies, educational institutions and corporates) is required to convey the message of Whale Shark conservation to a wider audience.

CHAPTER 5

EAST COAST SURVEY

Study of Whale Shark and Marine Megafaunal Distribution along Odisha and West Bengal

B. C. Choudhury, Sajan John, Sanjeeb Kumar Behera, Mathew M Thomas

Wildlife Trust of India

Coastal tourism emerged during the 19th century (Davenport & Davenport, 2006). It focused on a central theme of business, however, in the last few decades, coastal and marine tourism initiatives have grown as a major source of income for the fishers and local communities that were otherwise largely dependent on marine resources for their livelihood. This eco-marine tourism primarily involves watching/monitoring and diving/snorkeling with marine megafauna (Higham and Lück, 2008) and has gained widespread popularity globally (Vianna et al., 2011).

Without proper management and regulation, these tourism initiatives can have adverse effects. They not only impact the critical habitats of marine species but

Despite growing over 12 meters, they are harmless to humans.

also affect the species themselves. Uncontrolled development aimed at sustaining tourism near coastal areas not only harms the local community but also damages the coastal ecosystem. This supports the 'self-destruct theory of tourism postulated by Holder (1988) which states that an attractive natural site may become developed to cater to an upscale, exclusive market seeking low-density settlement and willing to pay premium prices. Soon other developers enter the scene, and the competition intensifies, leading to lower room rates and potentially reduced standards to attract more visitors, ultimately transforming the location into a mass tourism destination (Davenport & Davenport, 2006). Therefore, it is crucial to implement effective regulation and sensible management of coastal tourism activities to prevent the degradation of the destination and maintain its appeal over time.

Rationale of the survey

Marine resources were once considered inexhaustible; however, significant stock declines have prompted scientists and managers to rethink this assumption. Coastal communities that are completely dependent on these marine resources are being affected by their depletion, largely triggered by intensive mechanisation and over-exploitation, and to a certain degree, changing climatic factors.

One of the solutions to combat this was to reduce the dependency of coastal communities on marine resources by providing alternative livelihood opportunities. The objective of this survey was to understand the spatial and temporal distribution of marine megafauna through fishers and how this information could be used to develop marine megafauna-based tourism as an alternative livelihood option for coastal communities.

Marine megafauna such as cetaceans, sea turtles, elasmobranchs, etc., are highly mobile species spending most of their lives beyond the direct reach of human observation. This makes any long-term study of their behavior in the wild both challenging and expensive. Over the last few decades, these species have been subjected to pressures from the increasing intensity of human activity in the ocean (Halpern et al., 2008).

The questionnaire surveys conducted along coastal Odisha and West Bengal aimed to provide insights into the hotspots for sighting Whale Sharks and other marine megafauna, the season and frequency of sightings, areas with the highest occurrence of sightings, and the frequency and abundance of encounters during the fishing activities.

Based on these findings, a marine megafauna tourism plan could be developed to support the coastal communities with alternative sources of income, gradually reducing their reliance on marine resource harvesting.

The project was initially designed for Odisha, however with the approval from MFF, a no-cost extension was obtained that enabled the scope of work to expand to the West Bengal coast.

Objectives

1. To understand the distribution of Whale Sharks and other marine megafauna across Odisha and West Bengal coasts and the range of threats experienced by them, through secondary information.
2. To understand the receptiveness of coastal fishing communities of Odisha and West Bengal in opting for marine megafauna-based tourism as an alternative source of livelihood.

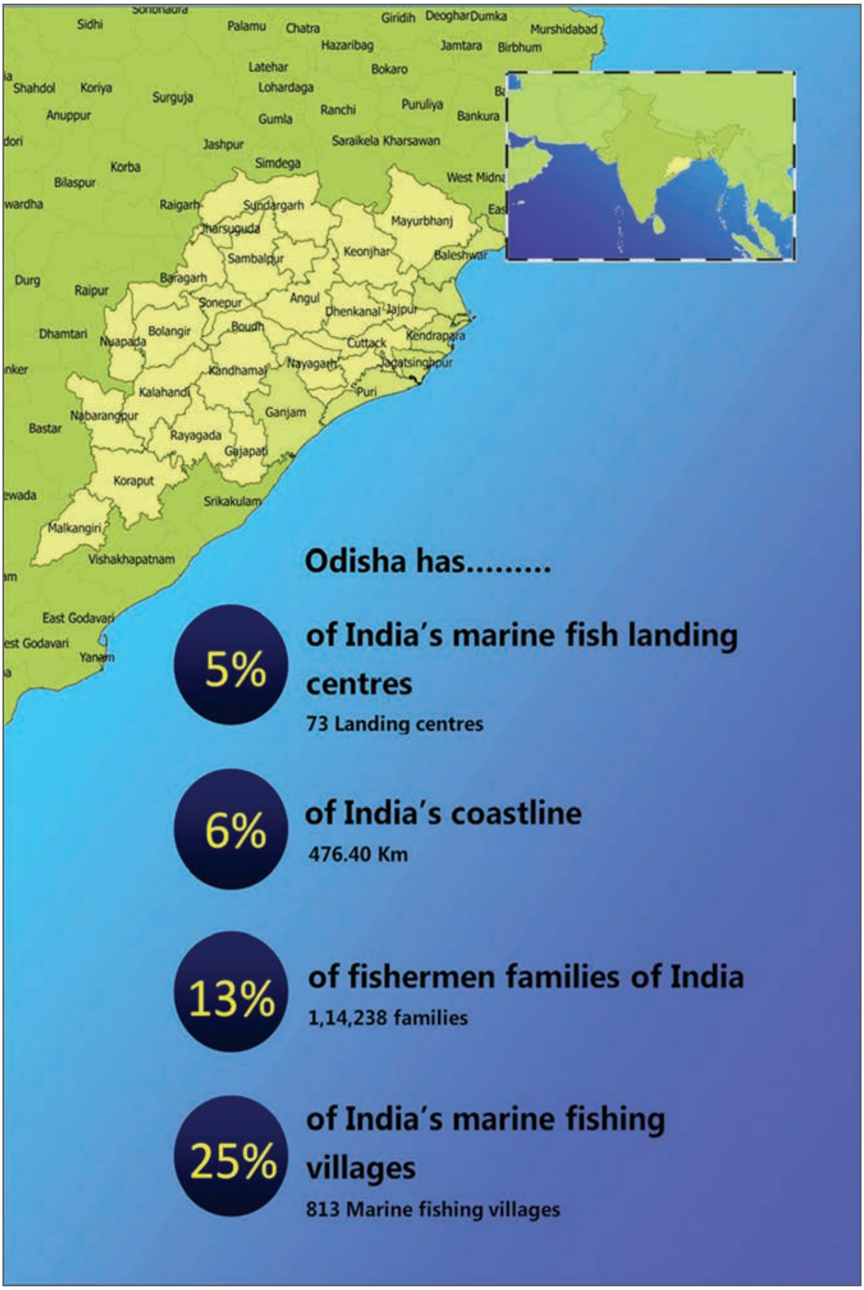
Study Area

Odisha

Odisha is one of the vital maritime states of India, located between 17o 49'N to 22o 34'N latitude and from 81o 29'E to 87o 29'E longitude on the eastern peninsula of India. With a coastline of 480 km and a continental shelf area of 25,000 sq. km, the state shares its boundaries with the Bay of Bengal along its eastern and south-eastern boundaries, West Bengal in the northeast, Jharkhand in the north, Chhattisgarh in the west and Andhra Pradesh in the south. Odisha covers an area of 155,707 sq. km and includes six maritime districts, namely Balasore (80 mm), Bhadrak (50 Km), Kendrapara (68 km) Jagatsinghpur (67 km), Puri (155 km) and Ganjam (60 Km) (Fig 68).

Odisha is home to 3,878 fishing villages of which 813 are marine and 3,065 are inland. The total fisher population of the state is 14,80,704 comprising 6,05,514 marine fishers and 8,75,190 inland fishers. There are approximately 1,69,000 active marine fishers in Odisha (CMFRI census, 2010).

Fig. 68: Surveyed coastal districts in Odisha


Sidhi
Palamu
Chatra
Giridih
DeogharDumka
Murshidabad
Hazaribag
Jamtara
Birbhum
Latehar
Bokaro
Shahdol
Koriya
Surguja
Lohardaga
Anuppur
Gumla
Ranchi
Puruliya
Bankura
Jashpur
Saraikela Kharsawan
Korba
Simdega
Bilaspur
Raigarh
Sundargarh
Jharsuguda
Mayurbhanj
Keonjhar
Baleshwar
Sambalpur
Durg
Raipur
Baragarh
Sonepur
Angul
Dhenkanal
Jajpur
Dhamtari
Nuapada
Bolangir
Boudh
Cuttack
Kendrapara
Kandhamal
Nayagarh
Jagatsinghpur
Kalahandi
Puri
Nabarangpur
Ganjam
Bastar
Rayagada
Gajapati
Koraput
Srikakulam
Malkangiri
Vishakhapatnam
East Godavari
Yanam
Odisha has.........
5%
of India's marine fish landing centres
73 Landing centres
6%
of India's coastline
476.40 Km
13%
of fishermen families of India
1,14,238 families
25%
of India's marine fishing villages
813 Marine fishing villages

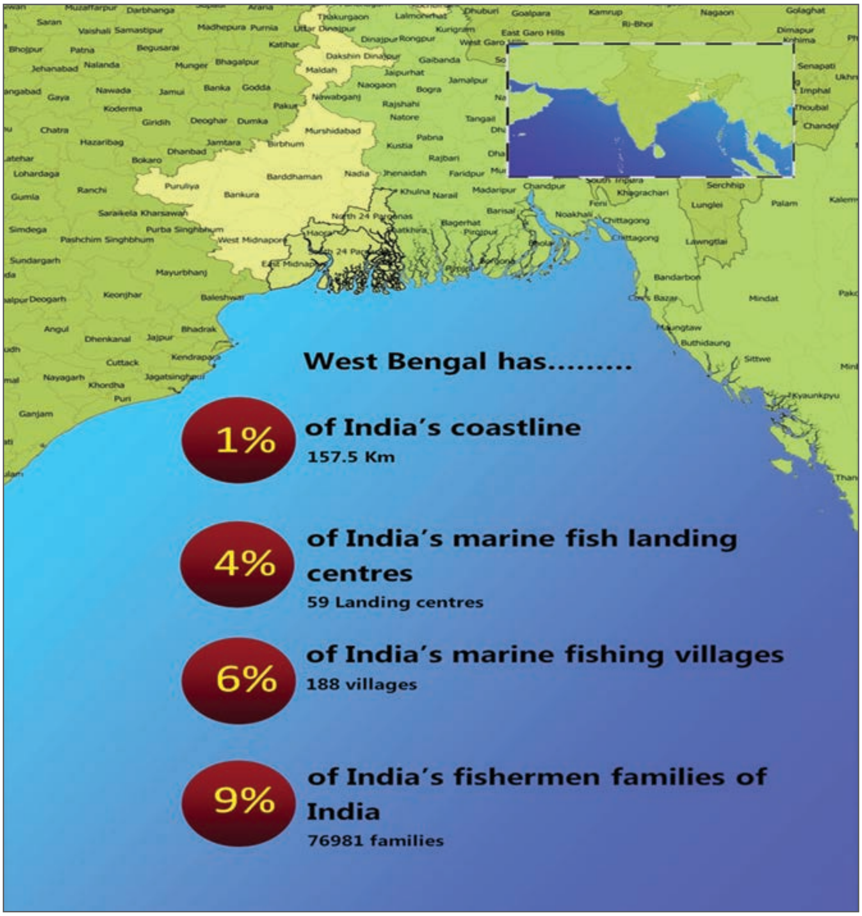
West Bengal

West Bengal is located between 21o 38'N to 27o 10'N latitude and from 85o 38'E to 85o 50'E longitude on the eastern peninsula of India, covering a total area of 87,853 sq. km. The continental shelf extending up to 200 m depth covers an area of 20,000 sq. km, constituting 3.6% of the total area of the Indian continental shelf. West Bengal's continental shelf is wide (about 150 km) and shallow. Along its coastline, which extends over 157.5 km, the state has two main maritime districts: East Midnapur and South 24 Parganas (Fig. 69).

West Bengal is bordered by Bhutan and Sikkim to the north, Sikkim, Bangladesh to the east, Assam to the northeast, Bay of Bengal, on its northwest by Nepal and Bihar to the west. Out of a total population of 91.3 million, the fisher population of West Bengal was more than 3.2 million. Among these, 14.32% (380,138) were marine fishers.

The state had a total of 76,981 fisher households, with South 24 Parganas accounting for 40,684 households and East Medinipur having 23,189 households. (CMFRI census 2010).

Fig 69. Surveyed coastal districts in West Bengal



Survey design and methodology:

Literature Review

The first phase of the project involved a review of existing marine megafauna information:

- Published literature was reviewed to understand scientific information on Whale Sharks and other marine megafauna along the east coast of India.
- Grey literature on the past and present status of marine megafauna along coastal regions of Odisha and West Bengal, along with media reports detailing threats were also reviewed.

They often move between warm surface waters and cooler deep waters, showing remarkable adaptability

These reviews covered various disciplines related to marine megafauna, such as conservation biology, anthropology, marine ecology, and conservation. Sources of information comprised published and unpublished literature obtained through library searchers, databases, and the internet. The results of the literature review were summarized according to key themes relating to ecology and migration, uses, threats, traditional and technical knowledge across geographic regions and cultural perspectives of marine megafauna. The literature review primarily involved desktop textual analysis of information, focusing on identifying topics and analyzing themes as well as establishing a framework for the ground study.

Consultation with professional institutions and organizations

The survey team started collecting existing information on Whale Shark landing, stranding and sighting records in coastal Odisha and West Bengal from different scientific institutions, and governmental and Non-Governmental Organizations (NGOs) working in these regions.

Developing the survey questionnaires

A refined version of the existing Whale Shark survey questionnaire used along the west coast of India and the Andhra Pradesh coast was used (see Appendix 3 (VIII).

Questions and topics in the questionnaire related broadly to the following themes:

i. Understanding the distribution of Whale Sharks and other marine megafauna across the coast of Odisha and West Bengal.

ii. Range of threats experienced by Whale Sharks and other marine megafauna along the coast of Odisha and West Bengal.

iii. Understand the receptiveness of coastal communities in choosing marine megafauna tourism as an alternative source of livelihood.

Planning and finalizing the fish landing sites and villages for the survey

Details on the major and minor fish landing centers along the Odisha and West Bengal coasts were collected from the CMFRI database. Villages for the survey were selected based on the number of fishing crafts and proximity to major fish landing centers.

Planning the surveys

The questionnaire survey primarily targeted male fishers who were categorized into two groups i.e., retired Fishermen (>55 age) and active Fishermen (<55 age). The importance of focusing the questionnaire survey on retired fishermen was to gather historical information about the megafauna in their area of operation, and active fishermen was to gather the present information about the megafauna in the area of operation and also to understand their receptiveness. Information was also gathered from institutions and organizations (Table 14)

Table 14. Range of information gathered from professional institutions and Non-Governmental Organizations.

Organization visited/Consulted	Kind of information gathered
Behrampur University	Marine megafauna information from Odisha
ICZMP Project	Details of ecotourism initiatives and livelihood alternatives
Forest Department	Stranding and sighting data
Dakshin foundation	Marine turtle distribution
Odisha State Biodiversity Board	Marine Megafauna information from Odisha
Bhawanipatna College	Marine Megafauna information from Odisha
Ganjam College	Marine Megafauna information from Odisha

Conducting the questionnaire survey

The questionnaire was translated into Oriya and Bengali (the native-speaking language). The survey with a single respondent lasted between 30-45 min (Fig. 70). Public gathering locations such as fish landing centers and local fishermen societies were targeted as they facilitated easier outreach to fisherfolk. Along with the translated questionnaire, the interviewer also carried some resource materials like Whale Shark pictures and scale models which were shown to the target audience for correct identification (Fig. 71).

To understand whether the coast is a breeding area for this species, printed postcards with information on Whale Shark pups were distributed to the fishers. Fishermen who encountered a Whale Shark pup could fill out a self-addressed and stamped postcard and return it to us. We have distributed 1,500 postcards (Appendix 4 (II)) to fishers along the Odisha coast (Field survey photos in Appendix 4 (XI)).

Fig 70. Several informal interactions were conducted along Odisha and West Bengal coasts before kick-starting the actual field data collection to get firsthand knowledge of the coast and fishing behavior of the community.

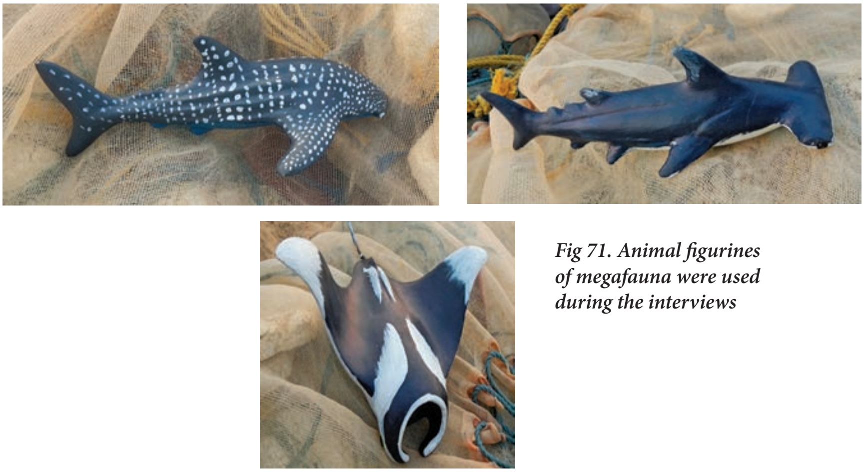


Fig 71. Animal figurines of megafauna were used during the interviews

Data Analysis

The results of the literature review and field interviews were analyzed qualitatively, using Microsoft Excel.

Results

Literature Review

Based on the published journals and media reports, the study tabulated information on marine megafauna, landing and scientific studies along the coast of Odisha and West Bengal. Details are given in Appendix 4.

Results based on questionnaire survey in coastal Odisha

Overall, 1632 interviews were conducted along the Odisha coast between October 2016 and May 2017 with the fishers of Ganjam, Puri, Kendrapada, Jagatsinghpur, Bhadrak and Baleswar (Fig. 72 and Table 15).

Table 15: Details of surveyed villages and interviews-Odisha coast

Surveyed districts	No. of villages visited	No. of fishermen interviewed
Ganjam	19	189
Puri	25	250
Kendrapada	41	405
Jagatsinghpur	16	161
Bhadrak	18	177
Baleswar	95	450
Total	**214**	**1632**

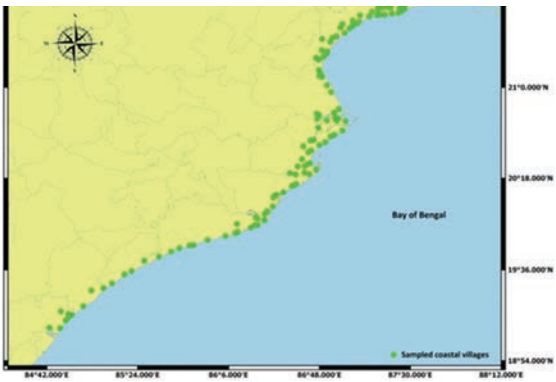


Fig. 72: Locations of sampled villages along Odisha Coast (Village details are given in Appendix 4 (VII)

Results based on the questionnaire survey in coastal West Bengal

Overall, 760 interviews were conducted along the West Bengal coast between June 2017 and July 2017 with the fishers of South 24 Parganas and Purba Medinipur (Fig. 73 and Table 16).

Table 16: Details of surveyed villages and interviews along the West Bengal Coast

Surveyed districts	No. of villages visited	No. of fishermen interviewed
South -24- Parganas	35	360
Purba Medinipur	35	400
Total	**70**	**760**

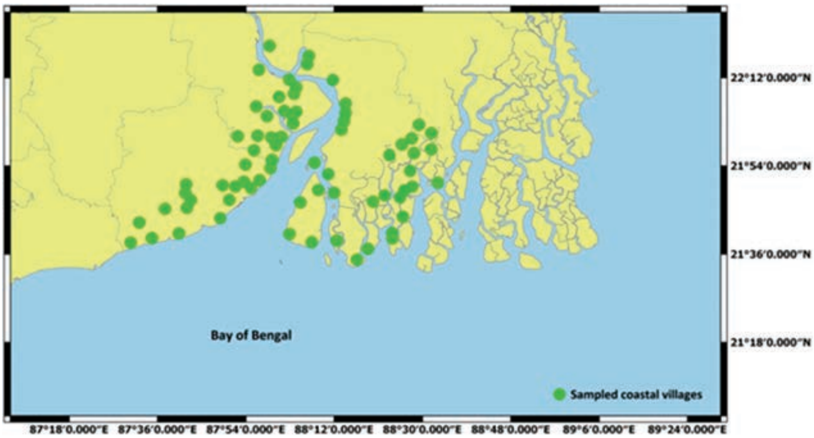


Fig 73. Locations of sampled villages along the West Bengal Coast (Village details are given in Appendix 4 (VIII))

Whale Shark and other marine megafauna sightings by fishers

Among 1,632 respondents interviewed along the Odisha coast, 44% (n=718) reported having sighted Whale Sharks in the Bay of Bengal while fishing (Fig.74A). The highest proportion of respondents who encountered Whale Sharks was from south Odisha.

Among 760 respondents interviewed along the West Bengal coast, 39% (n=296) reported having sighted Whale Sharks in the Bay of Bengal while fishing (Fig 74B).

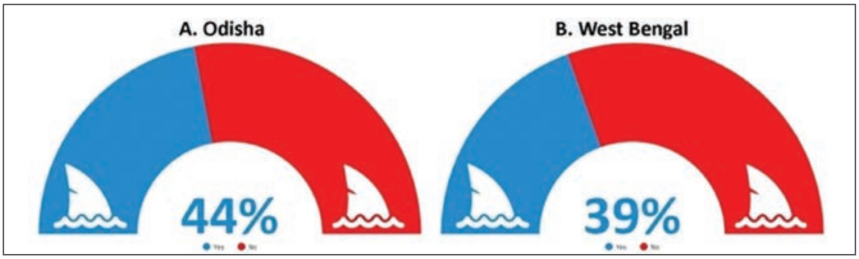


Fig 74 (A and B). percentage of fishers who have sighted Whale Sharks during fishing operation

Sightings of marine megafauna near the Rushikulya River mouth in south Odisha suggest that this area likely serves as part of the habitat for megafauna. Moreover, fishers were aware of the occurrences of these megafauna, noting their arrival with southerly currents each year during February-March. Offshore Gopalpur has a submerged beach ridge at a depth of 25 to 30 m, supporting extensive live sedentary fauna such as sponges, gorgonians, and soft and hard corals (Rao et al., 2001). This submerged beach ridge is about 25 km south of the Rushikulya River mouth, potentially serving as a feeding ground for turtles and other megafauna (Fig. 75).

The nearest known marine megafauna (especially Bryde's whale) aggregation site to West Bengal is close to the Bangladesh region of the Swatch-of-No-Ground (SoNG) submarine canyon (Smith et al., 2008).

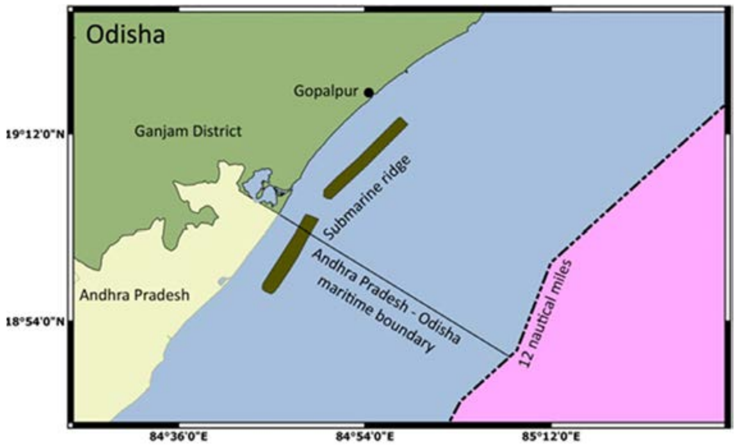


Fig 75: Submerged beach ridge offshore Gopalpur supports extensive live sedentary fauna such as sponges, gorgonians, and soft and hard corals.

Awareness level of fishers on the Wildlife (Protection) Act, 1972 (WPA).

While the majority of the interviewed fishers (65%) were aware of the Wildlife (Protection) Act, 1972, 35% were unaware of the law. Despite their lack of knowledge about the law, they were aware of the legal measures in place, understanding that it was illegal to kill certain species such as turtles and dolphins (Fig. 76).

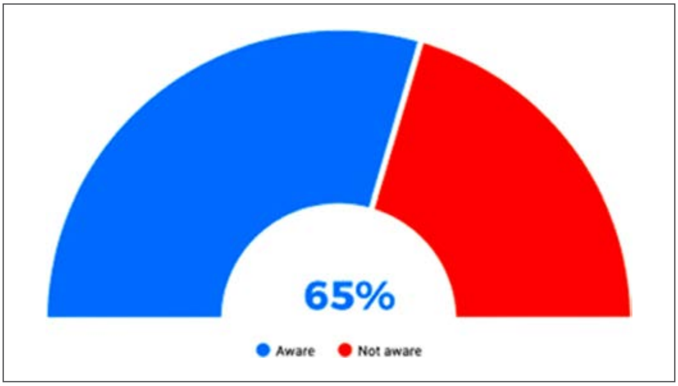


Fig 76. Awareness level of fishers on WPA

The fishers were also asked if they were aware that Whale Sharks are protected by law. Out of 1,632 interviewed fishers from Odisha, only 35% (n=571) were aware that they are protected by law and cannot be captured, killed or sold in the market (Fig. 77 A). Similarly, in West Bengal, out of 760 interviewed fishers, only 28% (n=212) were aware that they are protected by law (Fig. 77 B). In Odisha, fishers were very much aware that marine turtles are protected and cannot be harmed. However, in both states, the awareness levels among coastal communities regarding the protected status of other marine megafauna were generally lower.

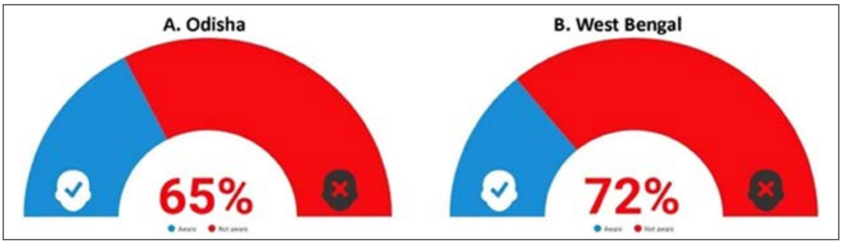


Fig 77 A and B. Awareness level of fishers on the protected status of Whale Sharks

The results indicate the need for maintaining an awareness program about the legal provisions of Whale Sharks and other marine megafauna.

Fishers awareness of megafauna

The majority of fishers were familiar with various marine megafauna species. Despite the use of different local names for these species in different parts of the coast (Table 17), most fishers correctly identified them when shown pictures or animal figurines.

Table 17: Common names of megafauna species along the Odisha & West Bengal coast

Dolphins	Gadmu, Shishuk, Shisu Magar
Whales	Timi, Timuri, Timingala
Porpoises	Susuka , shushook
Whale sharks	Phula Magar, Phul Boxsarra, Bagh Kamoot, Phul Khatak, Harina Magar, Munda Magar, Baghua Timi, Timiri Magar (in places were Noliya fishers are dominant they call it Bokku Sora, Jaru Menu, Boka Sora, Kithalam Sora, Gunna Sora, Puli Sora, Machala Sora, Neru Sora, Rubber Sora, Puli bokku Sora, Thimmiri menu and Gali Sora)
Sharks	Sarra, Magar, Hangar, Khatak, Kamot
Saw fishes	Nagol fal, Kata poni
Hammerhead sharks	Jual Kamoot, Raban Kamoot, Jual Khatak
Ray fishes	Chila Sankar, Badudia, Chila Fesha, Chila Machha, shanker machi
Turtles	Kaincho, Katna, Thabelu

Megafauna distribution

Maximum megafauna sightings (70%) were between shoreline to 10 km (5.40 nm) offshore, where the water depth ranged from 10 to 50 m. However, fishers have seen whales and Whale Sharks closer to shore where they normally used to see dolphins and porpoises (Fig. 78).

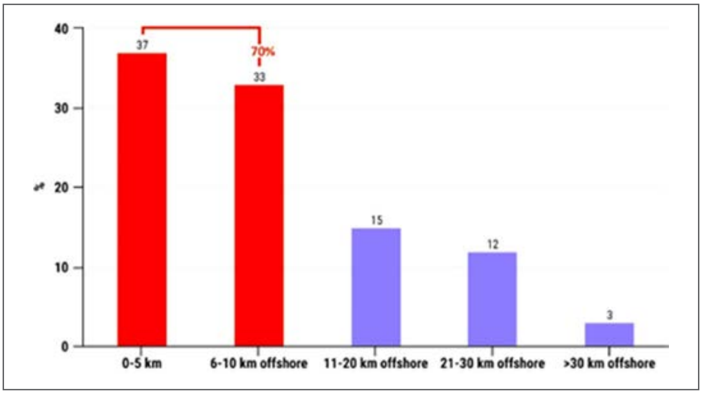


Fig 78. Megafauna sightings in relation to distance from the shore

Megafauna in incidental catch

Incidental catch is one of the major threats to marine megafauna and is a global concern. Among various kinds of fishing gear used, gillnets and purse seines have been identified as the primary gears accounting for incidental catch along the west coast of India.

Overall, trawl nets and gill nets contributed 98% and other gears contributed 2% of incidental megafauna catches along the Odisha coast. Marine turtles are largely entangled in trawl nets, whereas small cetaceans such as dolphins and porpoises are more commonly entangled in gill nets (Fig. 79). (See Appendix 4 (X) for common names of crafts and gears).

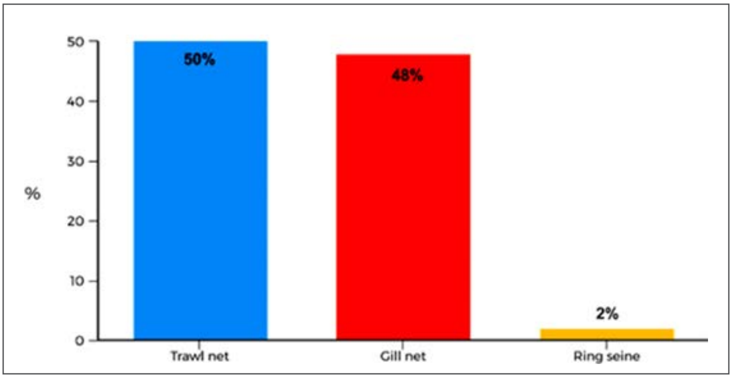


Fig 79: Percentage of megafauna entanglements in different fishing gears.

Perception of fishers

Most fishers (90%) considered megafauna to be harmless. However, few fishers of the south and central Odisha coast consider them (mainly Whale Sharks and whales) to be dangerous owing to their size (Fig. 80).

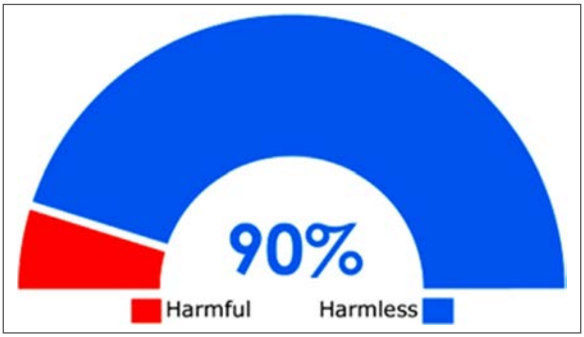


Fig 80. The majority of fishers considered megafauna to be harmless.

Frequency of megafauna sightings over a year

Over a calendar year, fishers sighted megafauna during different months in the Bay of Bengal (some fishers even go up to Andhra Pradesh). The variations in the number of sightings across different months were assessed to identify the peak seasons of these sightings.

To represent the result more realistically, the cumulative percentage of respondents for each sighting month of the year was calculated. In all, of the 6 coastal districts surveyed, respondents reported sighting megafauna during the winter months (September-October to March-April). However, they also reported seeing turtles and dolphins during the summer months, albeit less frequently than during the winter period (Fig. 81).

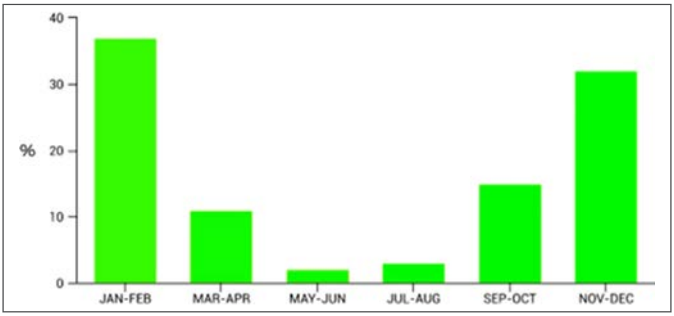


Fig 81: Megafauna sightings during a calendar year

Spatial Distribution of Marine Megafauna including Whale Shark

One of the objectives of the project was to identify the spatial and temporal aggregation of marine megafauna (if any) along the Odisha and West Bengal coasts. Based on the responses from fishers and findings from literature reviews, aggregating locations were plotted onto a map. This helped identify spatial and seasonal megafauna aggregation locations along the coasts of Odisha and West Bengal. Fishers have reported sporadic sightings of marine megafauna during their fishing operations; however, none of those records strongly prove the existence of their aggregations on either a spatial or temporal scale. Fishers were confident in seeing turtles between November and March in the mouth regions of Rushikulya River, Devi River and Gahirmatha. Apart from turtles, none of the fishers were confident about the spatial distribution of other megafauna species.

Fishers mainly sighted marine megafauna near river mouths (especially marine turtles, dolphins and porpoises). The depth range of these sightings was between 5-20m and a distance of 2 to 10 km from the shoreline.

The spatial and temporal distribution of megafauna is plotted on a map with the probability[1] of sightings (Fig. 82-86).

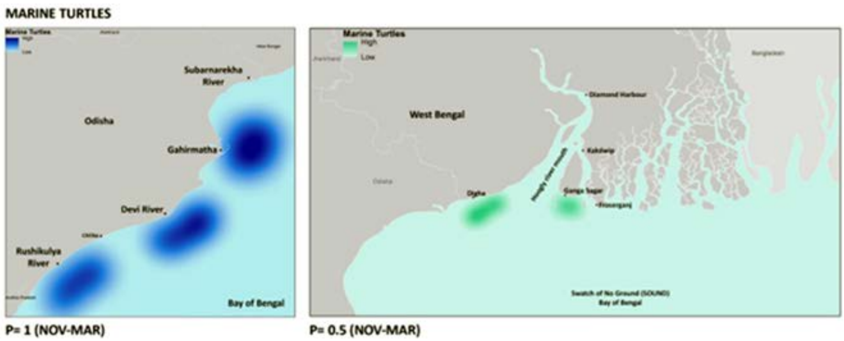


Fig. 82: Sighting frequency of marine turtles (shades denote the intensity of the sightings based on fishers' perceptions. "P" denotes the probability of sightings, and months in parentheses denote season of distribution)

[1] Mathematical probability is the measure of the likelihood that an event will occur. Probability is quantified as a number between 0 and 1, where, 0 indicates impossibility and 1 indicates certainty.

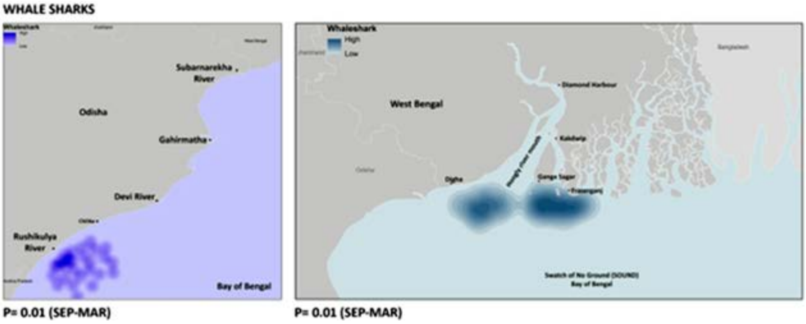


Fig. 83: Sighting frequency of Whale Sharks (shades denote the intensity of the sightings based on fishers' perceptions. "P" denotes the probability of sightings, and months in parentheses denote season of distribution)

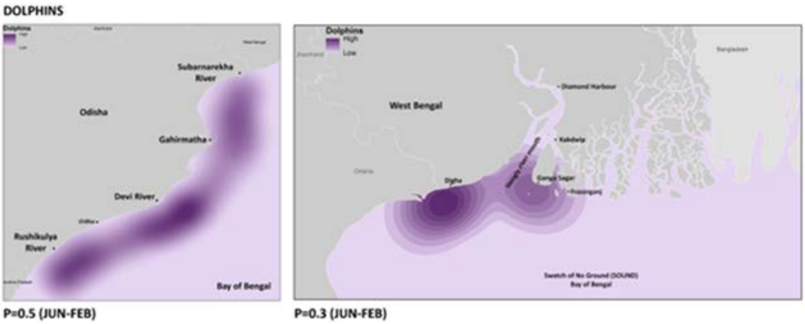


Fig 84: Sighting frequency of dolphins (shades denote the intensity of the sightings based on fishers' perceptions. "P" denotes the probability of sightings, and months in parentheses denote season of distribution)

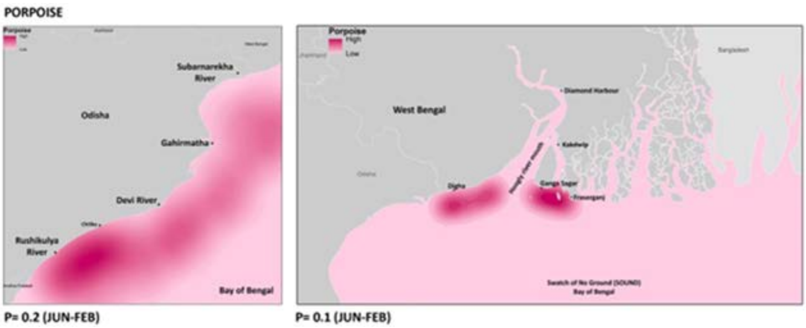


Fig 85: Sighting frequency of porpoise (shades denote the intensity of the sightings based on fishers' perceptions. "P" denotes the probability of sightings, and months in parentheses denote season of distribution)

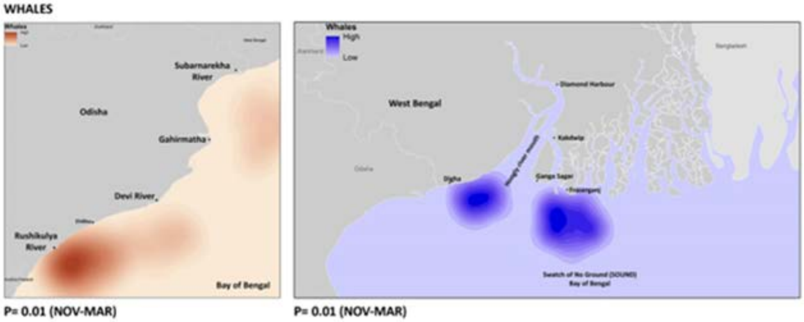


Fig 86: Sighting frequency of whales (shades denote the intensity of the sightings based on fishers’ perceptions. “P” denotes the probability of sightings, and months in parentheses denote season of distribution)

Awareness of fishers on marine megafauna tourism (Odisha)

The majority (85%) of fishers were unaware of marine megafauna tourism. Amongst the 15% who were aware, most were from villages located near marine turtle nesting beaches. Since annual marine turtle nesting events attract a lot of tourists, local communities were aware of this (Fig. 87).

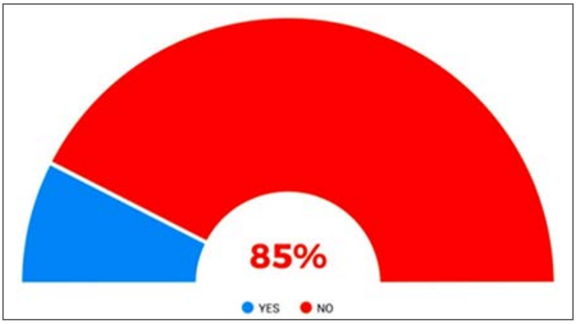


Fig 87: Awareness level of fishers on marine megafauna tourism along Odisha coast.

Readiness of fishers to take up marine megafauna tourism as an alternative source of livelihood (Odisha)

Fishers from Odisha were aware of dolphin-watching tourism in Chilika Lagoon. However, they were not certain about marine megafauna tourism as a source of livelihood. One of the major reasons for this skepticism was the seasonality and low frequency of sightings. In contrast, fishers residing near marine turtle nesting beaches were open to marine turtle tourism (Fig. 88).

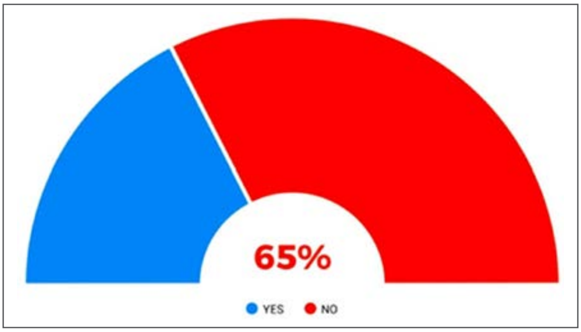


Fig. 88: Percentage of fishers who are ready to take up marine megafauna tourism as an alternative source of livelihood

Discussions

The objective of this survey was to understand the distribution of megafauna species along the Odisha and West Bengal coasts, based on ecological knowledge of the fishing community. This survey was part of a larger initiative to expand the Whale Shark conservation strategy and action plan to other parts of the east coast.

Marine resources were once considered inexhaustible, however, there have been significant stock declines. Coastal communities that are completely dependent on these marine resources are being affected by this. One of the possible solutions to combat this is to reduce the dependency of coastal communities on marine resources by providing alternative livelihood options.

'Marine Megafauna' are large or relatively large species in a marine ecosystem. Species such as sharks, rays, whales, dolphins, porpoises, turtles, large marine birds, etc, are typically considered to be part of this category. In the past few decades, unprecedented die-offs affecting these species fueled already mounting concerns about the health of the ocean. The Whale Shark is the largest living fish on planet Earth. Based on count data, habitat availability and modelled population estimates, it is inferred that 75% of the global Whale Shark population occurs in the Indo-Pacific region, with the remaining 25% in the Atlantic. Studies indicate a substantial decline of Whale Sharks by 40-92%, inferring an overall decline of 63% in the Indo-Pacific over the past 75 years. Given that the majority of the global population is located in the Indo-Pacific, the overall global decline is inferred to be ≥50%. As a result, the Whale Shark is globally assessed as Endangered.

Fisheries are widely considered the greatest threat to vulnerable marine megafauna (Dulvy et al., 2014; Lewison et al., 2004). Hunting used to be a major threat to marine megafauna, however, in the last few decades fisheries bycatch is causing population declines of sea turtles, marine mammals, seabirds and sharks (Lewison et al., 2004; Reeves et al., 2003). Among fishery-related threats, the major issue is mortality due to incidental capture/bycatch. The global landings of elasmobranchs are currently 760,000 metric tons (t) but a similar amount is a part of unreported bycatch (Stevens et al., 2000). In developing countries, small-scale fisheries are important contributors to the local economy (Pauly 2006) and food security. Historically, elasmobranchs, sea turtles and marine mammals have been important sources of human sustenance (Robards and Reeves 2011; Vannuccini 1999). However, along the Indian coastline, marine megafauna is generally not targeted nor consumed except for sharks (specifically Whale Sharks) and rays (mobulids) for their fins and gill plates, respectively.

Another major threat to marine mammals is "Ocean Noise" which is reported from all over the world. Sound, unlike light, is transmitted very efficiently through water. The efficacy of underwater sound propagation also allows marine species to use underwater sounds as a primary method of communication with one another as well as for locating prey. Noise introduced into the ocean by human activities has detrimental effects on many marine species. Elevated background noise levels caused by human-induced sources prevent their ability to detect calls from conspecifics, echolocation pulses, or other natural sounds. A second concern is that strong noise might cause temporary or permanent reductions in hearing sensitivity. The third potential effect is a change in species' behavior. Reactions can range from brief interruptions of normal activities i.e. resting, feeding or social interaction to short/long-term displacement from noisy areas often resulting in stranding.

There have also been dimensional changes in the gear and the time spent fishing in the mechanized sector by undertaking voyage fishing, and the use of sophisticated electronic devices for fish finding has resulted in increased fishing pressure and fishing efficiency (Bindu, 2011). Unlike cetaceans, sharks do not communicate using sound but sense it through their lateral line system. Sounds at higher decibel levels may potentially have negative impacts on Whale Sharks. Experiments have demonstrated that sharks can hear sounds with frequencies ranging from about 10 Hz to about 800 Hz. The effects of very loud sounds on shark behavior are not well documented; however, it is possible that they could potentially disrupt normal behavior such as feeding, mating, or migrating from one place to another (Whale Shark Recovery Plan, Australia, 2005).

At present, our knowledge of the threats to Whale Sharks and other marine megafauna is confined mainly to incidental captures, strandings caused by collisions with ships or boats along with fisheries-related activities, and Ocean noise. Destructive fishing gear such as trawl nets and gill nets has been responsible for the majority of marine megafauna mortality along the coasts of Odisha and West Bengal. For trawl fisheries, exclusion devices are an increasingly common tool for avoiding the capture of non-target species without substantially affecting commercial landings (Komoroske and Lewison, 2015). Bycatch Reduction Devices (BRDs) such as Turtle Excluder Devices (TED) are useful in eliminating bycatch of marine turtles with minimum target catch loss.

Among 2,392 respondents interviewed along the coasts of Odisha and West Bengal, 44% (n=718) and 39% (n=296) respectively, reported having sighted Whale Sharks in the Bay of Bengal while fishing.

The majority of respondents who reported encountering Whale Sharks were from south Odisha. Offshore Gopalpur (south Odisha) has a submerged beach ridge at a depth of 25 to 30 m, supporting extensive live sedentary fauna such as sponges, gorgonians, and soft and hard corals (Rao et al., 2001). This submarine ridge might be a factor that attracts marine megafauna. Similarly, the nearest known marine megafauna (especially Bryde's whale) aggregation site to West Bengal is in the vicinity of the Swatch-of-No-Ground (SoNG) submarine canyon which extends into the Bangladesh region (Smith et al. 2008). The SoNG is a shelf canyon that deeply incises the Bengal shelf near the Ganges–Brahmaputra river mouth, intersecting the beds of the subaqueous river delta and serving as a temporary sediment deposition area between the river mouth and Bengal fan.

Whale sharks are often solitary creatures, roaming thousands of kilometres alone in search of plankton and small fish.

Shark fin trade

Even though detailed studies on the shark fishery in the Indian Ocean are scarce, India is one of the three major shark trading countries with an average yield of 25,000 tonnes (according to estimations between 1961-2012) and responsible for 9% of the global shark catch (Dhaneesh & Zacharia, 2013). India is the second largest shark fishing nation in the world after Indonesia. Globally, an estimated 100 million sharks are killed each year, primarily to feed the billion dollar 'shark fin' industry.

In 2015, India issued a notification prohibiting the export of fins of all species of sharks. Even though the Ministry of Commerce had prohibited both import and export of shark fins in India, fishers were allowed to catch and trade sharks for their meat [provided they were not listed in the Schedule I of the Wildlife (Protection) Act 1972].

Fins are one of the most sought-after part of elasmobranchs. Shark fin soup is considered a delicacy in China and its territories, and it is also a key ingredient in Traditional Chinese medicines (TCM). Due to this demand, shark fins are exported from countries like India. The Whale Sharks, known for their large fin size, have also become a regular target for fin harvesting in many parts of the country, especially along the Gujarat coast.

New Ferry Wharf and Sassoon Dock in Mumbai, Veraval in Gujarat and Tuticorin in Tamil Nadu were the major centers of collection, processing and export of shark fins in India. Whereas Tamil Nadu, Kerala, Gujarat, Maharashtra, Andhra Pradesh and Karnataka account for 85% of the shark landings in India.

Fig. 89: Whale Shark fins kept for drying were recorded by one of the authors (Sajan John) during his field surveys in 2007 from Markandi Fishing Village, Ganjam, south Odisha.

A majority of the interviewed fishers (65%) were aware of the Wildlife (Protection) Act, 1972. Even though they were not familiar with the specifics of the law, they were aware that certain legal measures were in place and that it was illegal to kill species like turtles and dolphins. In Odisha, fishers showed a high level of awareness that marine turtles are protected by law and should not be harmed. However, in both states, the awareness level of coastal communities on the protected status of other marine megafauna was low. The result indicates the need for implementing ongoing awareness programs about the legal provisions of Whale Sharks and other marine megafauna.

Based on the fisher survey and historical Whale Shark information from published literature along the Odisha coast, we assessed the level of threats faced by the species in the coastal waters. While there is no conclusive evidence to confirm the hunting or targeted fishing of Whale Sharks, photographic records of Whale Shark fins collected in 2007, forced us to speculate the occurrence of some degree of opportunistic finning along the southern coast of Odisha at that time. A total of 2,392 (Odisha=1,632 and WB=760) interviews were conducted across 284 (Odisha=214 and WB=70) fishing villages along the coasts of Odisha and West Bengal from September 2016 to July 2017. Results revealed that in Odisha, the percentage of marine megafauna sightings was high in south Odisha.

In India, marine megafauna tourism is not very popular. Among those surveyed, only 15% were aware of marine megafauna tourism. Among the 15%, the majority resided close to either Olive Ridley mass nesting beaches or Chilika Lagoon. Despite this proximity, there is uncertainty about the viability of marine megafauna tourism as a livelihood option. One of the major reasons for this skepticism is the seasonality and low frequency of sightings.

Goa is the only place in India where free-ranging marine dolphin-watching tourism is active (Chilika is an enclosed lagoon, hence it is not included here). This contributes both recreational value for tourists and monetary benefits for the coastal communities in Goa (Fig. 90). However, non-adherence to existing regulations by dolphin-watching operators is detrimental to the dolphins (Somishala Remedios, 2017 unpublished MSc thesis).

Somishala Remedios

Fig. 90: Advertisement for dolphin-watching trips at Candolim Beach, Goa

Geographic locations of marine megafauna sightings, or probable aggregation based on the fisherfolk response have been plotted. Fishers have sporadically observed megafauna; however, these records do not conclusively establish the existence of these aggregations on a spatial or temporal scale.

Along the Odisha coast, the probability of seeing megafauna along the southern coast is comparatively higher than on the northern side. Furthermore, in-depth research and the frequent cruise surveys in these aggregation sites may provide valuable insight into marine megafauna distribution.

Tourism is one of the largest sectors that provides economic prosperity to communities. Specifically, eco-tourism and conservation tourism offer valuable experiences for tourists, students and researchers, while also generating revenues that can open a pathway for securing financial investments for conservation programs. Moreover, they can play a crucial role in securing the livelihoods of coastal communities by providing an alternative source of income through jobs and local marketing. While ecotourism initiatives are considered environment-friendly, it's important to note that many of these initiatives require some degree of infrastructure development with little ecological and social effect and large economic outcome.

Vulnerable marine megafauna is an important source of income, both in fisheries (both targeted and Bycatch) and increasingly from ecotourism activities (Cisneros-Montemayor et al., 2013; O'Connor et al., 2009). However, there is a lack of information regarding the non-monetary value of these marine megafauna to fishers (societal value) including cultural and religious significance, which also has conservation implications.

The present survey has provided a considerable amount of information about the status of Whale Sharks and other marine megafauna in the Bay of Bengal, which is one of the Large Marine Ecosystems (LME) in the world. More involvement of stakeholders (fishing communities, civic societies, educational institutions and corporates) is required to conserve and protect the marine megafauna species in this region.

Recommendations

Based on the findings of the present survey, both Odisha and West Bengal appear to lack a promising scope for developing marine megafauna tourism. Challenges in spotting marine megafauna in offshore habitats coupled with the low awareness level of coastal communities on marine megafauna tourism, and low receptiveness to take up marine megafauna tourism as an alternative source of livelihood are the restraining factors. Since coastal Odisha is famous for the mass nesting and mass hatching of olive ridley turtles, a potential starting point could be exploring marine turtle tourism as an experimental initiative. However, this should be approached with careful planning to ensure it benefits coastal communities while safeguarding the species and their habitats.

Incidences of marine megafauna stranding due to fishing and vessel traffic are on the rise. Every year, thousands of olive ridley turtles migrating from Sri Lanka to the Odisha coast for breeding, perish due to fishing activities. To minimize these casualties, it is imperative to set up a Marine Megafauna Stranding Response Unit equipped with both offshore and onshore support.

Since aquatic animal health is not a practicing subject under veterinary medicine in India, it is recommended that veterinarians should be trained to handle marine megafauna casualties. Furthermore, this topic be made part of the veterinary curriculum.

Bycatch Reduction Devices (BRDs) are important tools to reduce marine megafauna bycatch. All mechanized fishing vessels should be fitted with BRDs during their fishing operation (At least during marine megafauna aggregation, spatially and temporally).

CHAPTER 6

CONSERVATION ACTION

Conservation of Whale Shark in Gujarat

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Wildlife Trust of India

1. Project background and objectives

The Whale Shark belongs to the order *Orectolobiformes* and is the only species in the family *Rhincodontidae.* Although it does not have a close relation with other sharks, it shares some features with sharks belonging to the order *Orectolobiformes*, such as the nurse shark *(Ginglymostoma cirratum)* and the zebra shark *(Stegostoma fasciatum)*. The Whale Shark *(Rhincodon typus)* is a slow-moving filter-feeding shark and the largest known extant fish species. There are two other large filter-feeding sharks, the basking shark *(Cetorhinus maximus)* and the megamouth shark *(Megachasma pelagios)*, but they are in the mackerel shark order and are not closely related to the whale shark.

Stirring plankton clouds creates feeding opportunities for other marine life.

Whale Sharks live in all tropic and warm-temperate seas, except the Mediterranean. They are thought to be primarily pelagic (preferring an open-ocean habitat) but seasonal feeding aggregations are also known to occur at several coastal sites throughout the tropics. The Whale Shark is known to occur in the waters of over 130 countries (Turnbull and Randell 2006 a), and the best-documented Whale Shark sites are in the Gulf of Mexico, the Gulf of California, Belize, Honduras, Western Australia, the Galapagos, New Zealand, Philippines, Indonesia, Madagascar, Mozambique, Kenya, India, Pakistan, Maldives, Seychelles, Indonesia, and Thailand. The first historic account describing a Whale Shark was from Seychelles waters, in an entry in the ship's log of the Marion Dufresne expedition in 1768, just 12 years after the first settlement of these islands (Lionnet, 1984). The first record of a Whale Shark being fished is also from these waters, in the 1805 log of Captain Philip Beaver (Smith, 1829), and foretells the fate of the species in the Indian Ocean. Despite these early records and the first scientific recording of the species from the Indian Ocean by Andrew Smith in 1828 and 1829 (Smith, 1829), remarkably little is known about the Whale Sharks' range and status in this region (Fowler, 2000). Targeted fisheries in the northern Indian Ocean show a dramatic decline in the species (Hanfee, 2001) calling for an urgent review of the species status in this region.

The Whale Shark is generally of limited value to traditional fisheries. However, since the early 1990s, an increase in demand for Whale Shark flesh and fins in some Southeast Asian countries, especially Taiwan *(Chen et al. 1997)*, led to localised targeted increase in fishery landings in some regions, especially the Philippines, India and Taiwan. Artisanal fishing for Whale Sharks has existed in a number of countries, e.g. Indonesia, the Philippines, Iran, Maldives, India and Pakistan (Anderson and Ahmed (1993), Hanfee (2001), Compagno (2002), Rowat (2007), White and Cavanagh (2007)). The surface swimming behaviour of Whale Sharks has also led to mortality from collisions with boats, which are not often reported but presumably are a regular occurrence in some areas (Rowat 2010). Strandings are also relatively common in some areas, e.g. off South Africa where it is thought that the Whale Sharks may be killed or stunned by sudden chilling due to cold water masses *(Beckley et al. 1997)*.

Over the last two decades, a number of countries have banned fishing of Whale Sharks, e.g. Maldives in 1993 (Anderson and Ahmed 1993), the Philippines in 1998 *(Pine et al. 2007),* Honduras in 1999 (Compagno 2002), Thailand in 2000 (Fishing Act B.E. 2490), India in 2001 (Wildlife Protection Act, 1972), Palau (2003), Belize in 2003 (Graham 2007), Seychelles in 2004 (Wild Animals Bill), and Taiwan in 2008. The increase in fishing efforts and targeted fishing for elasmobranchs in the world oceans led to concerns over the sustainability of vulnerable species, including Whale Sharks, given their low productivity. International policies relating to the conservation and protection of Whale Sharks include Appendix II of the Convention for the Conservation of Migratory Species of Wild Animals in 1999 (CMS 1999), Appendix II of CITES (Convention on International Trade in Endangered Species) (CITES 2002) (Fowler 2000), Annex 1 (Highly Migratory Species) of the United Nations Convention on the Law of the Sea (UNCLOS), and the Convention on Biological Diversity. Despite its protected status in many countries, illegal and incidental capture of the species continues to be reported *(Kasinathan et al. 2006; Riley et al. 2009).*

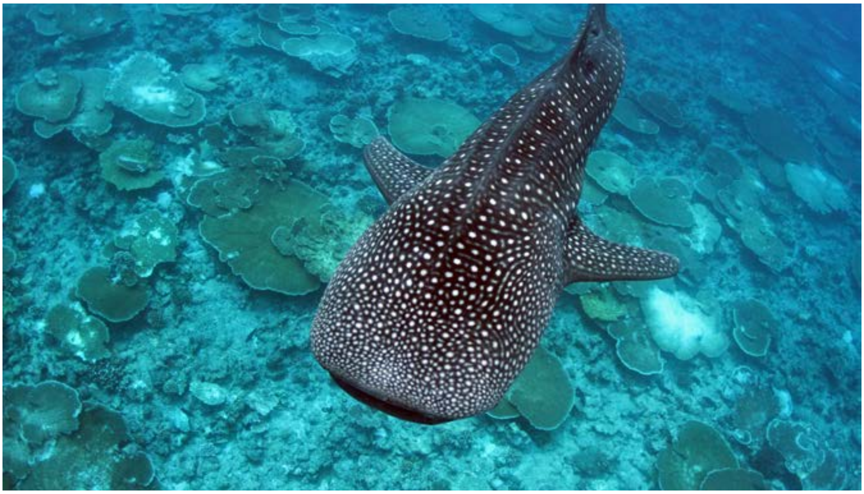
In spite of the ban on the fishing or killing of Whale Sharks or possession of Whale Shark products in India, incidental catch of the species has continued along the coastline (Romanov (2002), Chaudhary *et al.* (2008), Sajeela *et al.* (2010), where some cases go unreported due to the large area covered. This is in part due to the lack of awareness of the imposed law, lack of education on the vulnerability of the species and the high cost incurred when rescuing and releasing an accidentally netted whale shark, including a stranding and rescue operation network.

In view of this plight of the species, WTI, in partnership with the Gujarat Forest Department (GFD) and Tata Chemicals Limited (TCL), felt the need to initiate a Whale Shark conservation project along the west coast of India.

A better understanding of the ecology of the Whale Shark and defining critical habitats off the west coast of India would help in the long-term conservation of the species globally.

The broad objectives of the conservation action project are to :

- Rescue and release the incidentally captured Whale Sharks
- Track Whale Shark migration in the marine environment
- Understand Whale Shark relationship with its marine habitat
- Genetically profile Whale Sharks in Indian waters
- Assess Whale Shark aggregation areas on the Gujarat coast
- Create awareness through campaigns
- Explore the prospect of Whale Shark tourism in Gujarat



Spot patterns remain stable throughout life for long-term studies.

2. Survey area

The state of Gujarat along India's west coast has a 1600 km coastline with a continental shelf extending over an area of 1,84,000 km2. The state comprises 13 coastal districts, with 263 fishing villages. A total of 123 fish landing centres are spread across the 13 coastal districts. The landing centres support 24,152 fishing crafts, of which 13,047 are mechanised craft, 7,376 motorised and 3,729 traditional crafts. Based on the State fisheries statistics 2012, the total fishing population in Gujarat is 3,23,215, which depends heavily on marine resources for their livelihood.

The study area and base station for the project activities were selected based on the following criteria:

- **Historical Whale Shark landing records:** Gujarat has the highest recorded landings of 279 sharks in Dec 1999 alone, with nearly 40 Whale Shark landings in a single day (Hanfee. 2001). This was the primary reason for initiating a conservation action programme in the state. A review of the landing records of Gujarat revealed that the Gujarat coast had the highest hunting records of Whale Sharks before the ban. The data also provides the Whale Shark abundance in the targeted locality.
- **Whale Shark historical sighting:** Whale sighting records off the coastal villages in Gujarat were collected by interviewing fisherfolk. This information provided

the team with possible Whale Shark aggregation sites along the Gujarat coast, where the team could focus their attention.

- **Community involvement:** As the project objectives also required the involvement of local communities in the conservation programme, assisting and empowering them, the fishing villages along the Gujarat coast which were earlier involved in Whale Shark hunting and trade were chosen to be WTI's main focus of attention. While the local government authorities were willing to collaborate, Tata Chemicals Limited who supported the project, was also located in Gujarat, hence, the project was initiated along the Porbandar coast.
- **Accessibility:** A focal point with access to maximum landing centres and to the sea was also considered for setting up a base station. Based on these criteria, the following sites were selected for implementing the project.

2.1. Survey area

Based on past records of Whale Shark landing and hunting along the coastal areas of Gujarat, four major fishing villages i.e. Veraval, Sutrapada, Dhamlej and Mangrol in Junagadh district, were found to be the most sensitive sites, as they had the maximum number of incidental capture of Whale Sharks, and had active fishing ports and landing centres. The following four sites were chosen as the project area:

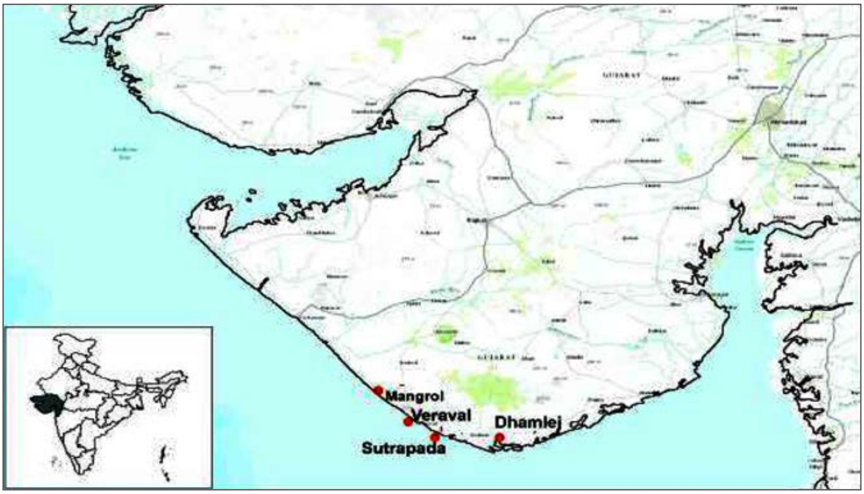


Fig. 91: Project area along the Gujarat coast

2.1.1. Veraval

Veraval town, situated along the Saurashtra coast, is one of the largest fish landing zones in Gujarat. It has three fish landing centres: Jaleshwar, Bhidiya and Veraval port which accounts for 20 to 30% of fishermen of the total population of the three towns. As per provisional reports of Census India, the population of Veraval in 2011 was 153,696; comprising 78,1661 males and 75,535 females. The fishermen of Veraval and Bhidiya port mostly belong to Kharva samaj (community) and Koli samaj, whereas more than 90% of Jaleshwar fishermen belong to Machhiyara samaj. There are about 5000 IBM (in board motor) trawler boat operators at

Veraval, including Bhidiya port and at least 1500 OBM (board motor) small fibre boats (locally called 'peelani' boat) operate from Veraval port, including Jaleshwar fishing point. Veraval was also selected for setting up the base station as it was strategically a good location for accessibility to the sea and other project sites.

2.1.2. Sutrapada

Sutrapada is 20 km south of Veraval, towards Kodinar. It has a total population of 1,22,406, of which 62,435 are male and 59,971 female. About 20% of the population comprises fishermen who are isolated from the rest of the population and inhabit the Sutrapada coast. In Sutrapada, there are 60 IBM (comparatively smaller than a trawler and locally called '*bethada*') and 800 OBM small fibre boats operated by fishermen.

2.1.3. Dhamlej

Twenty kilometres north of Sutrapada is Dhamlej, a previous Whale Shark landing village, which also has a considerable number of fishermen who depend on daily fishing for their livelihood. The total population of Dhamlej is about 70000, of which 30-40% are fishermen, who live separately along the coast of Dhamlej. There are 600 to 700 OBM (Out Board Motor) boats operated by the Dhamlej fishermen. It has only two *bethada,* but does not have any trawler.

2.1.4. Mangrol

Mangrol is situated 50 km north of Veraval, towards Dwaraka and is one of the most important fish landing centres along Gujarat's Saurashtra coast. The total population of Mangrol is 1,32,733, which comprises of 68,186 males and 64,547 females. The fishermen comprise 15-20% of Mangrol's population. Like Veraval, Mangrol also has a considerable number of trawler boats, in addition to '*peelani*' fibre boats. There are over 1500 trawler boats and 500 small fibre 'peelani' boats operating at Mangrol fishing port. Mangrol has emerged as one of the well-known fishing boat building centres in Gujarat, in addition to Veraval.

2.2. Demography of the selected project sites

As interaction with the fishing community was an essential component of the project, a demographic understanding of the locations was compiled by the project sociologist. A literature survey, community interaction and a field survey by the sociologist revealed the following: Gujarat fishermen community comprised of four different castes; Rajput Kharwa, Koli Kharwa, Ghoghala samaj, Machhiyara samaj (the only Muslim fishing community).

2.2.1. Rajput Kharwa

Rajput Kharwa is the largest fishing community among the four. Members of the community are Hindus by religion and Rajputs by caste. They are based largely on the Veraval coast. Rajput Kharwas are comparatively more literate and economically better off than the other communities of fishermen.

2.2.2. Koli Kharwa

The second major community of Hindu fishermen is Koli Kharwa, concentrated in the Bhidiya site of Veraval coastland, but also based in several village settlements in Saurashtra and a few other parts of coastal Gujarat. They are also known by their sub-castes, such as Moila Koli, Ghedia Koli, Ghoghaliya Koli etc.

2.2.3. Ghoghala

Also Hindus, this community is mostly based in Sutrapada, Dhamlej and Muldwarka fishermen villages.

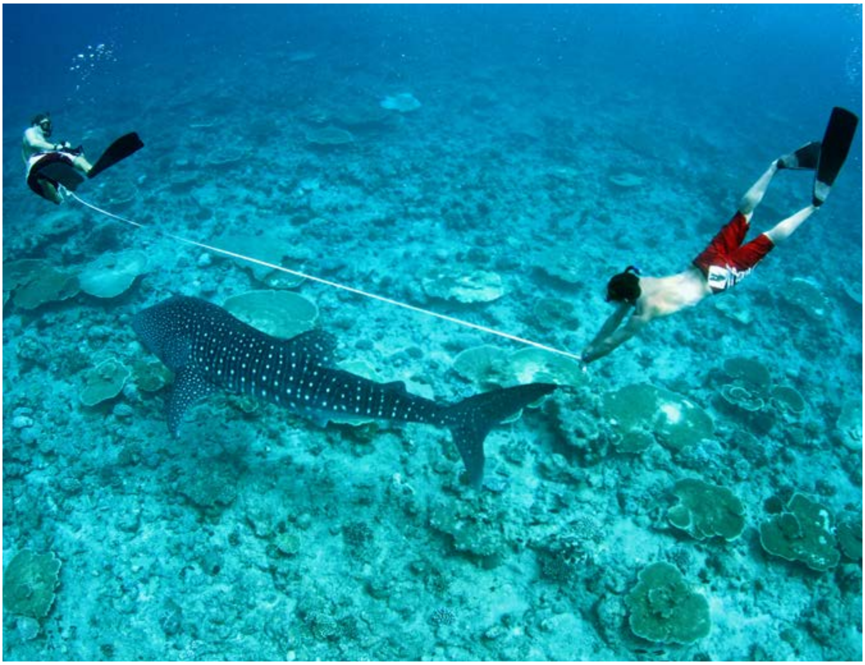
2.2.4. Machhiyara

Machhiyaras are the only Muslim fishermen community, concentrated mostly in the Jaleshwer area, adjacent to Veraval. A few Machhiyara families also inhabit the Muldwarka, Dhamlej, Hirakot, Chorwad and Mangrol Bara regions of the Saurashtra coast of Gujarat.

3. Historical Whale Shark occurrence and distribution along the coast of Gujarat: A survey

Despite its size and ranging patterns, the Whale Shark *(Rhincodon typus)* is among the most threatened species in the world. For years, people have hunted Whale Sharks for their meat, fins and bones for use in delicacies and medicines, skin as an abrasive and mostly for their massive livers for extraction of oil. The World Conservation Union (IUCN 2013) lists the Whale Shark as vulnerable to extinction, as a result of directed fisheries, high value in international trade, a highly migratory nature, a K-selected life history and generally low abundance (Norman 2000). Owing to this colossal hunting globally, their numbers have dwindled and they are hence given legal protection by various countries, among which the Indian Government had given the highest possible legal protection under Schedule–I of the Indian Wildlife (Protection) Act, 1972 as amended in 2002.

It is unlikely that Whale Sharks can tolerate intensive fishing pressures because they are thought to share the typical elasmobranchs' life-history patterns of slow growth and late maturity (Colman 1997). The effects of overfishing of this species may be manifested in other parts of the world since these are reported to be highly migratory with some individuals travelling thousands of kilometres across oceans (Eckert and Stewart, 2001).



Weighing up to 20 tons, they glide gracefully despite enormous size.

Whale Shark abundance in Taiwan (Chen and Phipps, 2002), India (Hanfee 2001), and the Philippines (Alava *et al*. 1997) has been inferred from fisheries-dependent data. Although catch-independent population estimates of marine mammals are commonly available, in part due to their need to surface and breathe, most population estimates of large migratory fish, particularly sharks, remain primarily based on catch-dependent/by-catch data. These surveys are, therefore, linked to fishing areas/zones as opposed to the species' activity spaces or full habitat range and, therefore, may not adequately represent the studied populations (Graham and Roberts, 2007). However, very little is known about their occurrence, numbers and home range. Though Whale Sharks were reported from all along the Indian coast, the majority of the reports are from the northwestern maritime state of Gujarat from where, 1,866 Whale Sharks were reported between 1989 to 1998 (Pravin, 2000). A staggering 591 Whale Sharks were reportedly caught and slaughtered during 1999-2000 alone along the Gujarat coast (Hanfee. 2001). After the launch of awareness programmes by the Wildlife Trust of India (WTI) in 2004, supported by Tata Chemicals Limited (TCL) and in collaboration with the Gujarat Forest Department and the local fishing communities *(Cha*udhary *et al. 2008)*, it was felt necessary to have some knowledge of their historical occurrences in the off-shore waters in the state of Gujarat where nearly 187 Whale Sharks were released from fishing gears during 2004-2005. The survey aimed to find whether there was any change in the seasonality and place of occurrence, numbers and associations of Whale Sharks if any, with marine mammals, over the past 50 years along the Gujarat coast.

3.1. Survey area

The state of Gujarat is located on the north-western side of the Indian peninsula, with a coastline of 1600 km, with an estimated 3,23,215 fishermen from 263 marine fishing villages dependent on marine and coastal fishery resources. The survey was undertaken from September–October 2008, covering 31 key fishing villages across the coast of Gujarat, starting from Jakau in the north and extending up to Nargol in the south (Fig. 92).

Based on the prevailing fishing practices and also for the benefit of analysis and presentation, the entire coastline of Gujarat was divided into three regions, Region-I, starting from Jakau in the north to Salaya in the south; Region-II, starting from Rupen in the north to Jafrabad in the south; and Region-III, starting from Hajira in the north up to Nargol in the south.

3.2. Methodology

The survey was done in three phases, covering one region at a time. Fishermen above the age of 55 and who have already retired from active fishing were selected for the survey. 151 fishermen from 31 villages were interviewed for the survey (Appendix 5 (I)). The questionnaire was developed following *Maynou et al.* 2011, except that the time period was not further divided into any segments owing to the stress put on the interviewees' memory.

Fig. 92: Map showing survey area

After recording the name, age and place, the questions asked during the interview included:

1. The age at which the interviewee started fishing,
2. The age at which he stopped fishing,
3. whether he had seen a Whale Shark during his fishing career,
4. if, yes, the frequency,
5. the season in which most of the sightings occurred,
6. whether they observed any change in the seasonality of occurrences during their fishing career,
7. the number of Whale Sharks seen together mostly,
8. the location of frequent sightings, such as the distance and direction from the shore, and depth at sightings,
9. the estimated number of encounters during their career,
10. whether they had seen any mammals such as whales, fin-less porpoises and dolphins,

11. if so, their frequency,
12. and their location
13. whether they observed any association between Whale Sharks and mammals and/or sea turtles etc.

Questions one and two were asked to calculate the time period from which the fishermen reported their observations. For questions, four and eleven, the interviewees were asked to rate frequency as frequent, occasional and rare. Pictures of mammals were shown for easy and accurate identification.

3.3. Results

Since the respondents were between 50-95 years old and they took to fishing as a traditional source of livelihood since they were between 12-15 years old, the results were based on observations made by them over a period of 54 years, from 1926 to 1980, going back to 82 years in time (Table-18) since the beginning of the present study. For ease of presentation and understanding, the results are presented separately for the three regions viz., Region–I (Kachchh), Region–II (Saurashtra) and Region–III (Khambhat).

3.3.1. Region – I

The northern coast of Jamnagar and Rajkot districts were also included in the Kachchh region during the survey, keeping in mind the prevailing fishing practices. A total of 66 fishermen were interviewed from eight fishing villages, namely, Salaya, Sikka, Bedi, Tuna, Bhadreshwar, Mundra, Mandvi and Jakhau. The fishermen interviewed were between 60 and 92 years of age (Fig. 93).

A total of 66 fishermen were surveyed from various fishing villages from this region, among whom, 37.8% reported having seen Whale Sharks during fishing operations for more than two decades, and about 62.2% reported not having seen a Whale Shark during their fishing life (Fig. 94).

The likelihood of sighting a Whale Shark had shown a gradual decline from Salaya towards Jakhau in the northernmost part of Gujarat (Fig. 95). Among the 37.8% (n=25)of respondents who reported having seen a whale shark, 24% (n=6) reported to have sighted them frequently and 76% (n=19) reported occasional sightings off the coast of Rupen and Okha (Fig. 96).

Table 18. Age class and average age of the fishermen interviewed from the three regions surveyed

Region of survey	No. of interviews	Age range of interviewees	Average age
Region – I (Kachchh)	66	60 – 92	70.7
Region – II (Saurashtra)	66	50 – 95	63.4
Region – III (Khambhat)	19	55 – 80	62.1

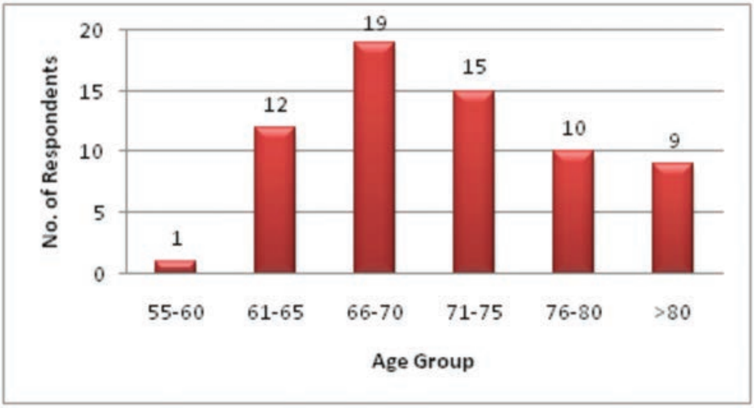


Fig. 93: Distribution of respondents across various age groups

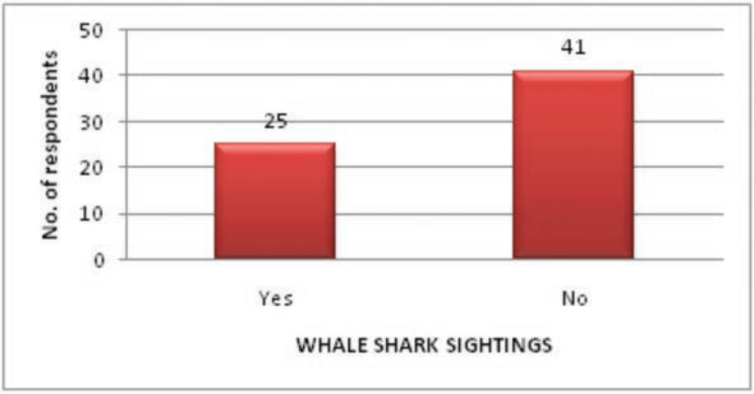


Fig. 94: Whale Shark sightings in the Kachchh region

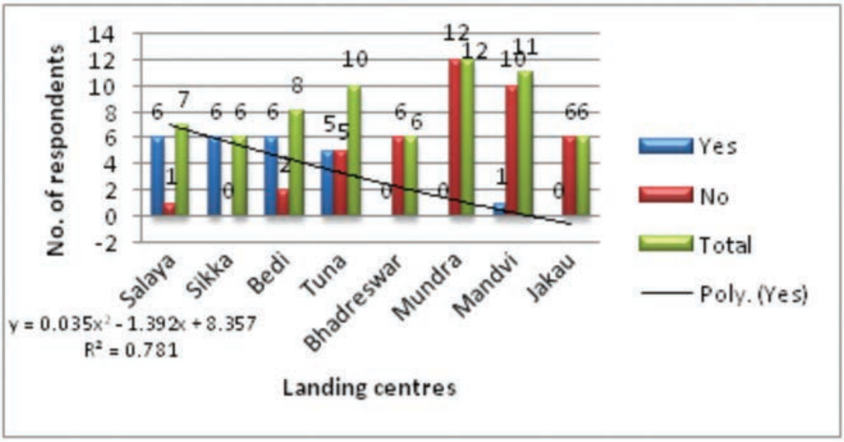


Fig. 95. Whale Shark sightings across various landing centres in the Kachchh region

The seasonality of sightings began in October, attaining a peak during November-March and lasting up to April, and sometimes even till May. However, most sightings reportedly occurred between November and April (Fig. 97).

Among the respondents, 36% (n=9) claimed to have had less than 50 Whale Shark encounters during fishing, 24% (n=6) had 50 to 100 encounters, and 40% (n=10) had more than 100 encounters during their fishing lives (Fig. 98).

About 36.9% of the total respondents reported sighting whales, 18.4% had seen fin-less porpoises and 69.2% had seen dolphins during their fishing operations. However, no one had reported seeing a dugong even once. Dolphins were reported to have been sighted frequently by 60% of the respondents, 33.3% have reported having seen them occasionally, and only 2 of the respondents said that they rarely saw them during a fishing operation. With respect to other marine mammals, 58% of the respondents reported occasional sightings of fin-less porpoises, 50% of the respondents had reported having sighted whales occasionally, and 41.6% reported rare sightings of whales (Fig. 99).

3.3.2. Region – II

The Saurashtra coast has long been an abode for Whale Shark congregations and fishermen from this region are known to have caught Whale Sharks in staggering numbers before legal protection for the species came into force. Fifteen fishing villages starting from Okha in the north and extending up to Jafrabad in the south were covered under this region, and 66 fishermen between the ages of 50 and 95 years were interviewed (Fig. 100). Everybody except one respondent reported having seen a Whale Shark during fishing operations and 95% reported the sightings are frequent (Fig. 101 and 102).

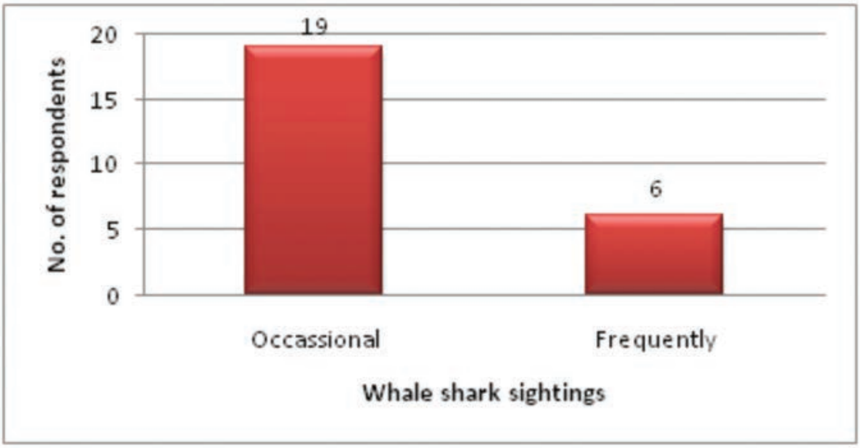


Fig. 96: Frequency of Whale Shark sightings

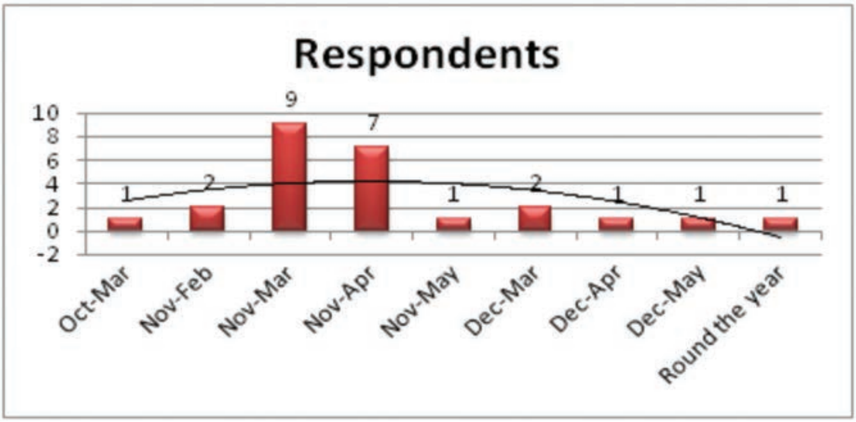


Fig. 97: Responses indicating seasonality of Whale Shark sightings

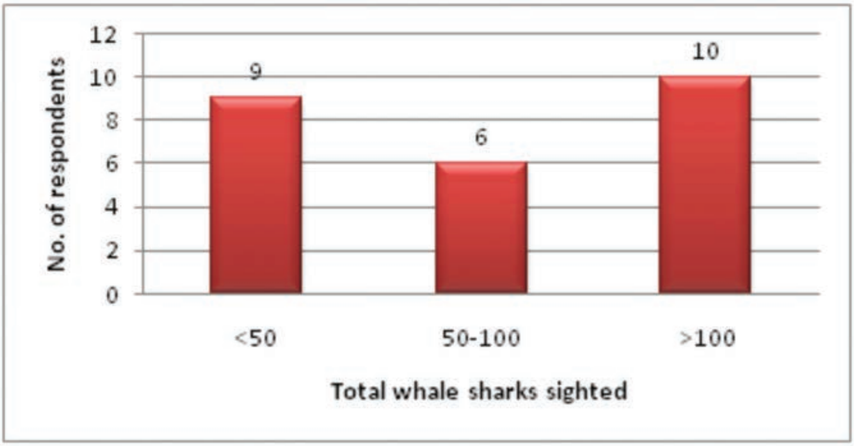


Fig. 98: Distribution of Whale Shark encounters along Saurashtra coast

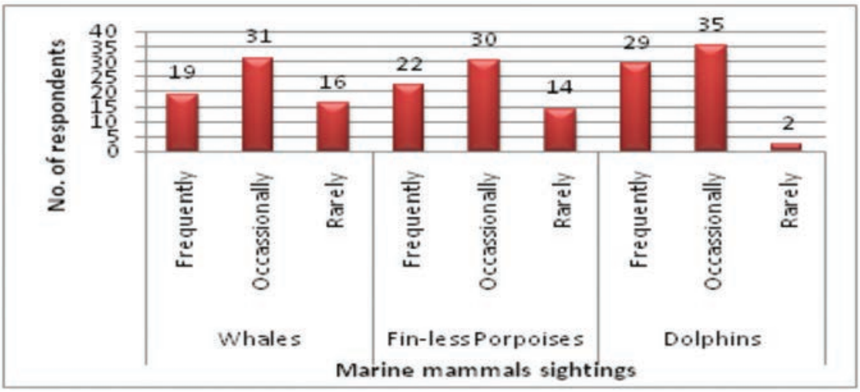


Fig. 99: Frequency of marine mammal sightings during fishing operations along the Saurashtra coast

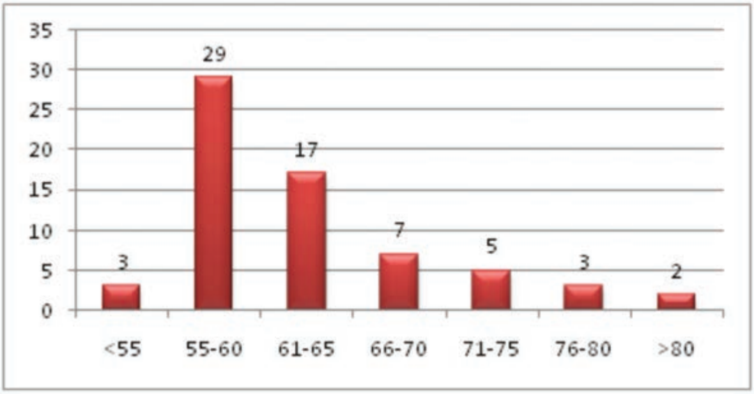


Fig. 100: Distribution of respondents across various age groups along Saurashtra coast

The seasonality of sightings of Whale Sharks was similar to that reported from the Kachchh region (Fig. 96). Though 6% of the respondents claimed to have seen Whale Sharks throughout the year, the seasonality of sightings seems to be more concentrated during the months of November to March, and sometimes extended up to April (Fig. 103).

The possibility of sighting a Whale Shark during fishing is mostly reported between the depths 20- 30 fathoms (1 fathom = 1.822 meters) while they come as close as up to 5 fathom deep waters, and move out as far as up to 60 and sometimes even up to 100 fathom depths during the season.

The group size of the Whale Sharks sighted varied across the survey area. 40% of the respondents claimed to have seen a group of 2—3 Whale Sharks during sightings, while 44.6% claimed to have seen them basking solitarily, and 10.7% reported to have seen groups of 3-5 Whale Sharks together. Such variations in this section may be due to a difference in the time of the day of the sighting, which suggests differing social behaviour of the Whale Sharks at different times of the day (Fig. 104).

When asked about the total number of Whale Shark sightings observed during their fishing days, 52.3% (n=34) reported to have seen 50—100 Whale Sharks, 29.2% (n=19) reported 25—50 sightings and 15.3% (n=10) reported to have seen more than 100 Whale Sharks (Fig. 105). 62.12% (n=41) of the respondents have reported having sighted whales, 8.66% (n=8) had seen finless porpoises and everyone (100%; n=66) saw dolphins during fishing (Fig. 106). However, no one had seen a dugong. Among the respondents who had sighted these marine

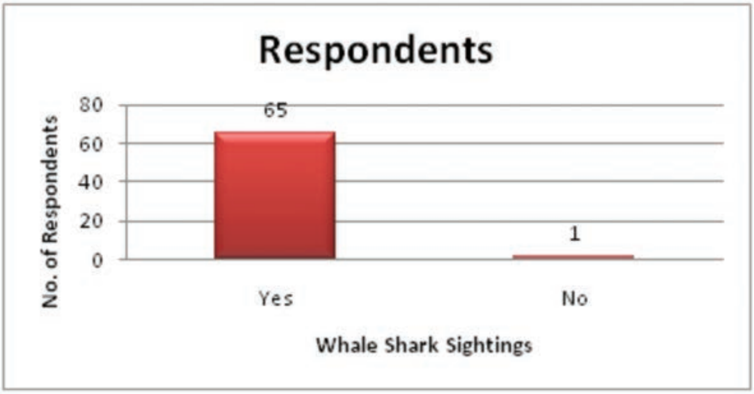


Fig. 101. Whale Shark sightings along Saurashtra coast

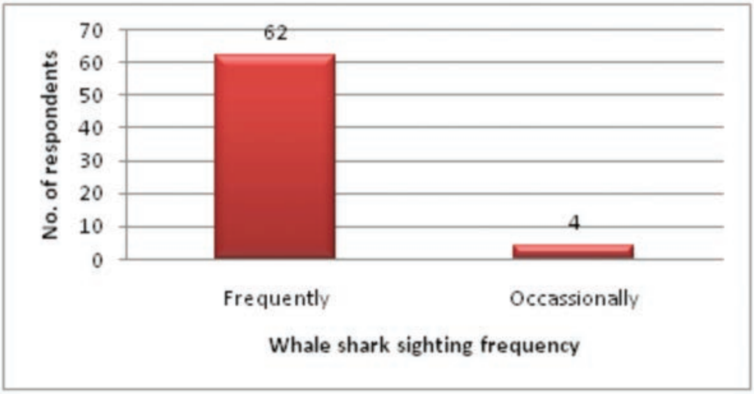


Fig. 102. Frequency of Whale Shark sightings along Saurashtra coast

mammals, 53.6% (n=22) had reported occasional sightings of whales, and 12% (n=5) reported having sighted them rarely. Fin-less porpoises were However, dolphins seem to be more in numbers since 65% (n=43) of the respondents have reported to have seen them frequently during their fishing operations, and as close as 2—3 nautical miles away from the shore.

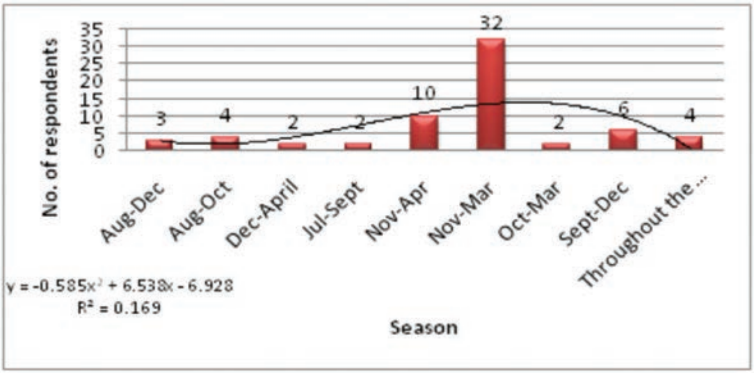


Fig. 103: Seasonality of Whale Shark sightings along Saurashtra coast

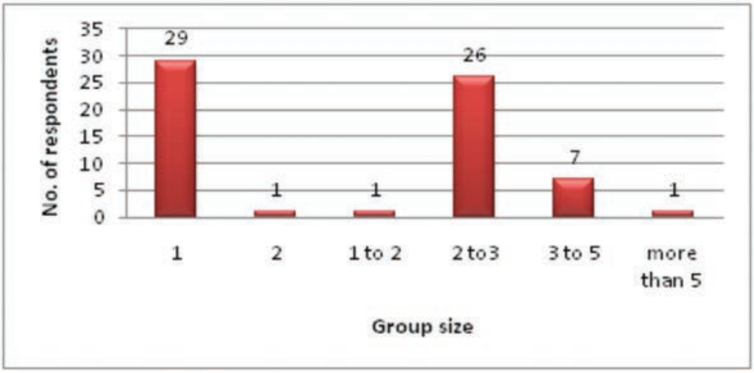


Fig. 104: Group size of Whale Sharks along Saurashtra coast

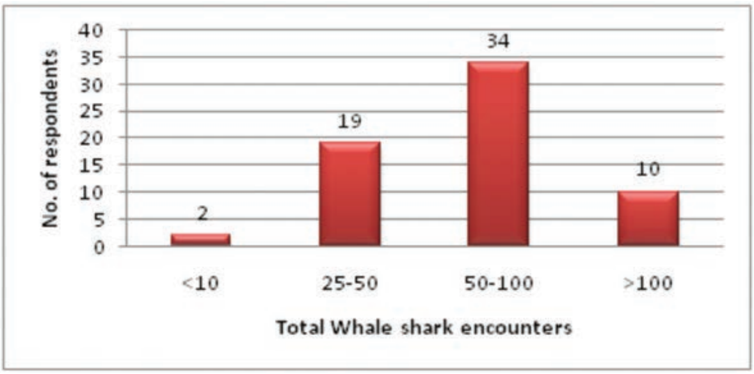


Fig. 105: Total Whale Shark encounters along Saurashtra coast

3.3.3. Region – III

The marine fishermen from this region fish within the mud banks and creeks of the Gulf of Khambhat and most of them were engaged in mud-skipper fishing during the older days. Very few fishermen ventured into the sea towards the shores of Saurashtra. Seven fishing villages were surveyed and 19 fishermen between the age of 55 and 80 were interviewed (Fig.107).

Of the 19 fishermen interviewed, 14 respondents reported having seen a Whale Shark during fishing, of these 42.1% (n=8) had reported seeing them rarely and 28.5% (n=4) had seen them occasionally while fishing off the shores of Saurashtra (Fig. 108). The reported seasonality of Whale Shark sightings were similar to that reported from Kachchh and Saurashtra regions. Though they tend to start congregating as early as July, the sightings peaked between the months of November and March to April (Fig. 109).

The Whale Shark sighted during fishing had been reported to be solitary by 57.14% (n=8) of the respondents; 21.42% (n=3) reported seeing two Whale Sharks together, and 14.28% (n=2) reported having seen two to three Whale Sharks together (Fig. 110). Nine out of 14 respondents had seen 10-50 Whale Sharks during fishing, three had seen below 10, while two have seen between 51 and 100 (Fig. 111). Of the total respondents, seven had rarely sighted whales, 11 had seen fin- less porpoises rarely and 13 had seen dolphins frequently (Fig. 112) and as close as 2—3 nautical miles from the coast.

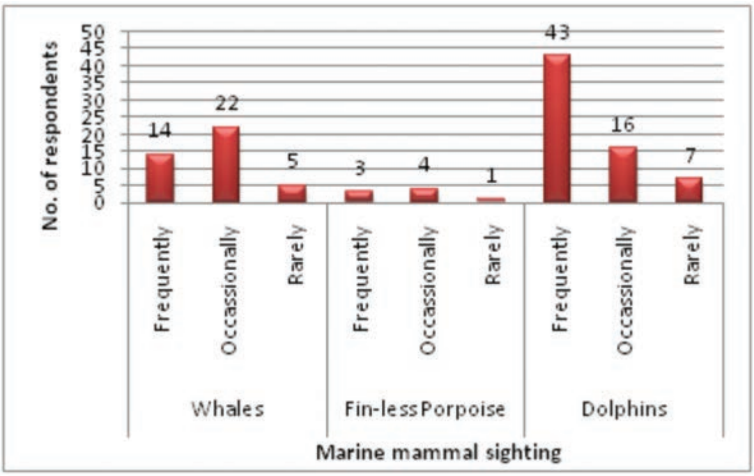


Fig. 106: Frequency of occurrences of marine mammal sightings in Gulf of Khambhat

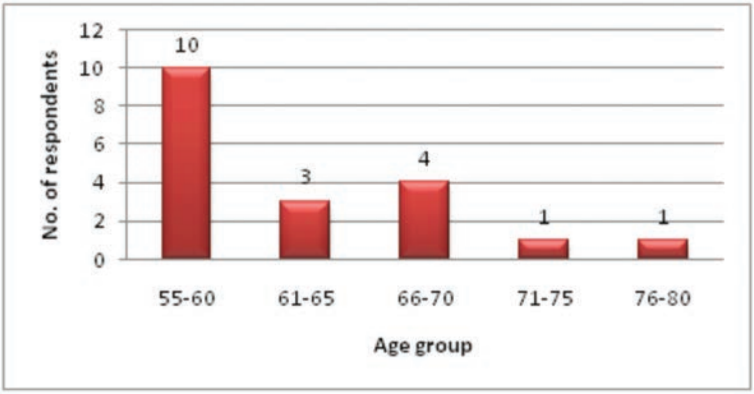


Fig. 107: Distribution of respondents across various age groups in Gulf of Khambhat

3.4. Conclusion

A total of 151 fishermen, between 50 and 95 years of age, were interviewed from 31 fishing villages along the coast of Gujarat. Of these, 68% (n=105) reported to have seen Whale Sharks during fishing operations for more than two decades. Among them, 72% (n=106) claimed to have seen Whale Sharks frequently, and 27% (n=48) saw them occasionally during their fishing trips. The number of respondents who had seen Whale Sharks varied across the fishing villages and their information on their fishing grounds has revealed that the probability of sighting a Whale Shark is higher towards the coast of Dhamlej and Muldwaraka villages and that the maximum concentration of Whale Sharks occurred along the Saurashtra coast (Fig. 113) from November to April and sometimes till May.

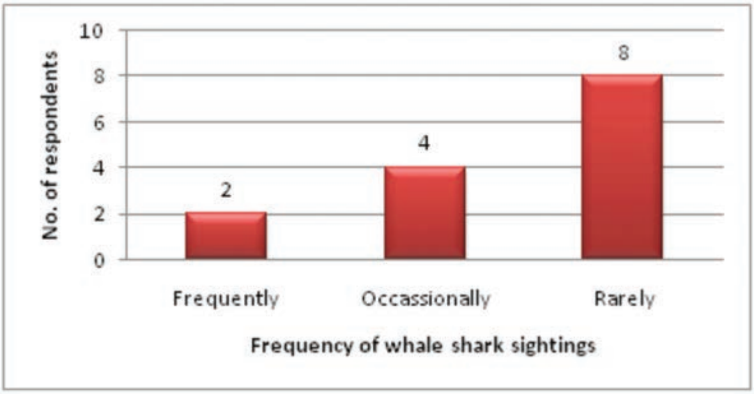


Fig. 108: Frequency of Whale Shark sighting in Gulf of Khambhat

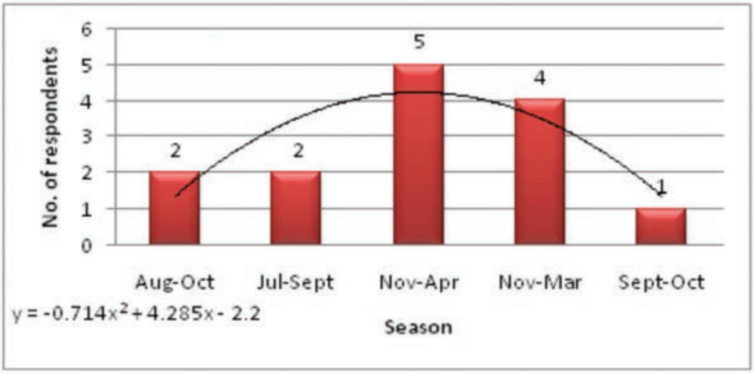


Fig. 109. Seasonality of Whale Shark sighting in Gulf of Khambhat

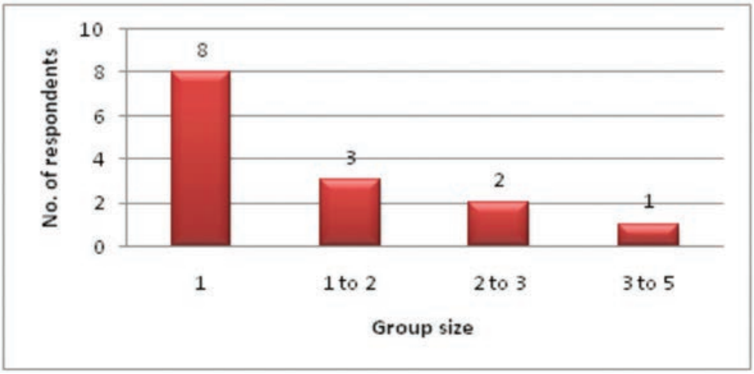


Fig. 110: Group size of Whale Sharks sighted in Gulf of Khambhat

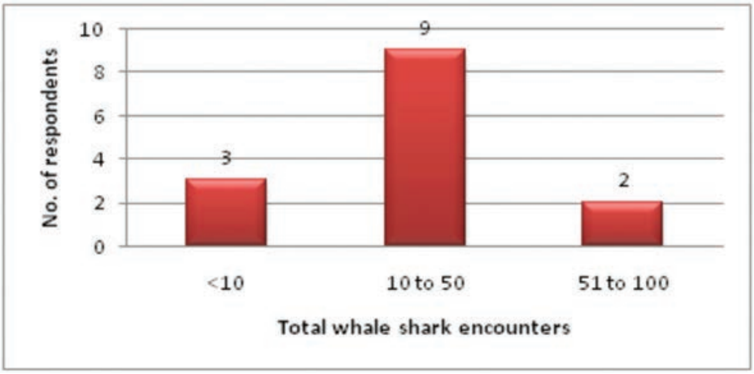


Fig. 111: Total Whale Shark encounters in Gulf of Khambhat

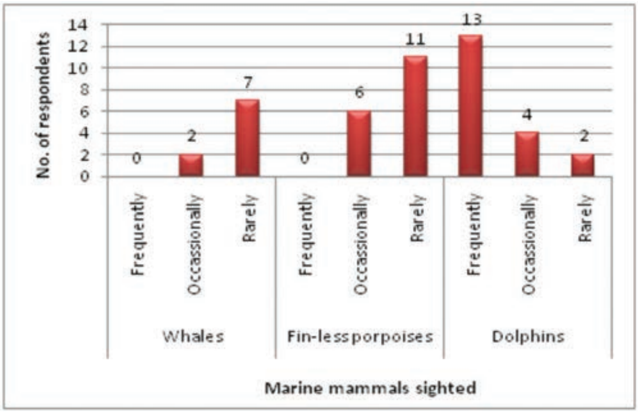


Fig. 112: Occurrences of marine mammals along the coast of South Gujarat in Gulf of Khambhat

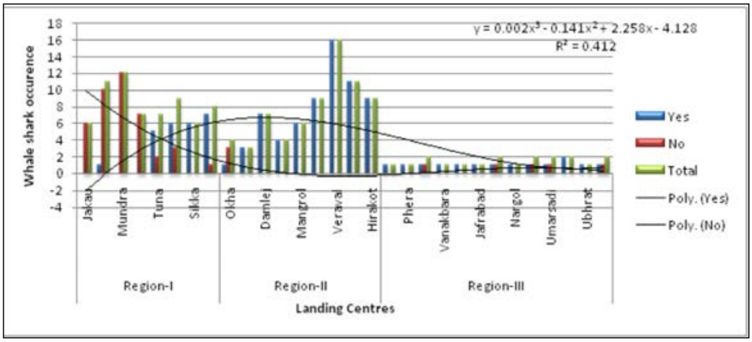


Fig. 113 Whale shark sightings across various fishing villages of Gujarat

Only one of the respondents reported any change in the numbers, the seasonality or the location of sightings throughout these years. However, most fishermen reported to have sighted Whale Sharks at depths of 20-40 fathoms off the coast from Porbandar to Diu. This and the present information on Whale Shark rescue suggest that there has been no change in the whale shark's habitat and the season of occurrence for the past 80- 85 years. Whale Sharks also do not exhibit a continual association with other marine mammals and reptiles such as sea turtles.

It can be inferred from the above observations on their past abundance and distribution that there are no natural threats to the Whale Shark populations along the coast of Gujarat. Though their population was threatened to a major extent by fishing and trade, recent conservation efforts by WTI and the local forest department, with support from the local fishing communities, have abated the threat to some extent, as is evident from the voluntary rescue of the animals caught accidentally.

However, it cannot be ascertained that Whale Shark populations and distribution are immune to human activities in the state's offshore waters. There is a need to regulate fishing along the coastal waters to create safer waters for this species.

4. Whale Shark rescue analysis

Launched in 2004, the Save the Whale Shark Campaign led to the creation of *Vhali* (or "dear one") – a Whale Shark depicted by a local popular religious leader Morari Bapu as an incarnate of God. Bapu also correlated it with the long-standing Indian tradition of '*Atithi Devo Bhavo*' in which guests are likened to gods, and he described the Whale Shark as a guest who deserves equal respect. It proved to be a people-friendly method to reach out to the masses and spread awareness: now not only do most fishermen realise the implications of Whale Shark hunting, but they also have started to contribute to the cause by agreeing to release accidentally caught Whale Sharks.

This, however, also meant heavy losses incurred by the fishermen when their nets had to be cut in order to free any trapped Whale Sharks and paved the way for a new policy implemented by the Gujarat Forest Department in 2006 to provide compensation to the affected fishermen whose nets were destroyed in the process. The Wildlife Trust of India's marine team on the Whale Shark Conservation project started assisting such rescues in January 2010 onwards to analyse their efficiency and improve the rescue operation methods.

Since 2005, the Forest Department of Gujarat, Wildlife Trust of India, and Tata Chemicals Ltd. jointly started the Whale Shark Conservation Project. Since then fishermen are releasing incidentally-caught Whale Sharks from their nets. In return, they are provided compensation by the Forest Department for the loss of their nets. A total of 372 Whale Sharks (Fig. 114) were rescued by 7th May 2013 in Gujarat waters, which shows the success of the Whale Shark campaign that led the Gujarat fishing community to regard the shale shark as a daughter of the state, a concept popularised by the spiritual leader Morari Bapu.

4.1. Year-wise Whale Shark rescue

Based on the seven-year data of Whale Shark rescue, the highest number of Whale Sharks were rescued in Sutrapada, Veraval and Dhamlej locality fishing villages in Gujarat. A self-documentation scheme that was initiated in the villages is discussed in detail in the forthcoming section of this report. From 2012 till June 2013, a total of 57 Whale Sharks have been rescued in Sutrapada, Veraval and Dhamlej under this new method (Fig. 115 and 116). The updated rescue records, are attached in the Appendix 5 (III).

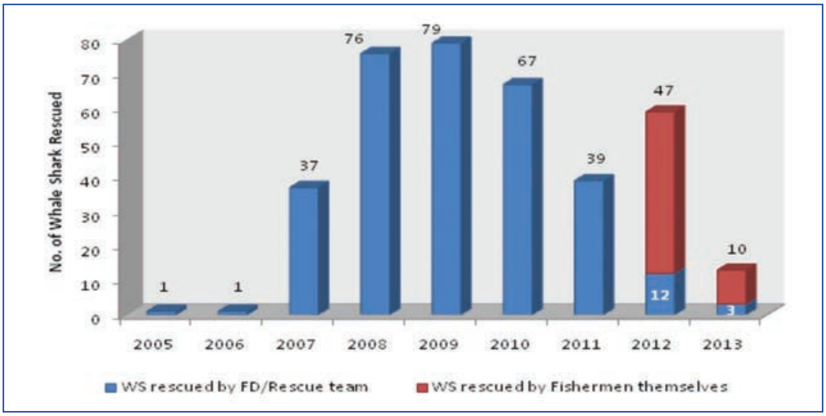


Fig. 114: Total number of Whale Sharks rescued in Gujarat waters (year-wise)

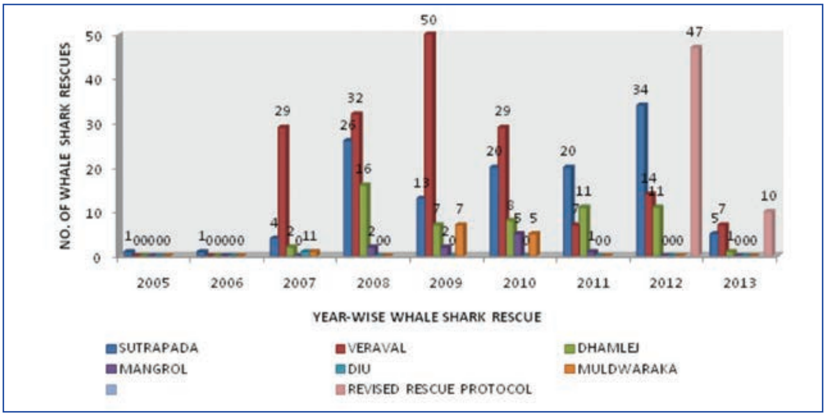


Fig. 115: Number of Whale Sharks rescued in different fishing villages in Gujarat

Table 19: Overall Whale Shark rescue data in Gujarat waters

Fishing villages	2005	2006	2007	2008	2009	2010	2011	2012	2013
Sutrapada	1	1	4	26	13	20	20	34	5
Veraval	0	0	29	32	50	29	7	14	7
Dhamlej	0	0	2	16	7	8	11	11	1
Mangrol	0	0	0	2	2	5	1	0	0
Diu	0	0	1	0	0	0	0	0	0
Muldwaraka	0	0	1	0	7	5	0	0	0
Total rescue	1	1	37	76	79	67	39	59	13
Overall rescue									372

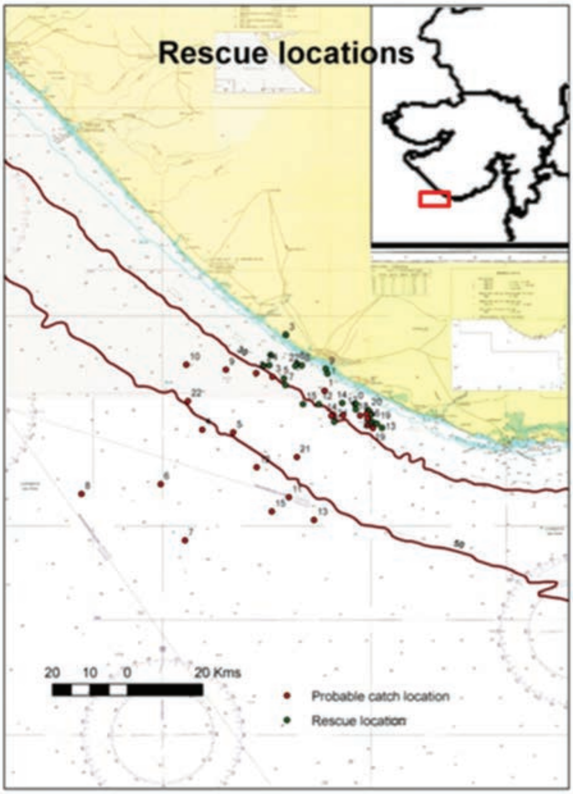


Fig. 116: Map showing Whale Shark capture and rescue locations in Saurashtra coast

4.2. Review of the rescue methods

By 2010, a review of the Whale Shark rescue methodology and release operation was considered in an attempt to make it simplified and much less time consuming, keeping in mind the reaction of the rescued after release Whale Shark to stress and possible mortality.

4.3. Fish stress and mortality- A brief review:

4.3.1. Sharks have negative buoyancy

Sharks do not have an air bladder as other fishes do, but they have a large liver with fats and oils which help them to get some buoyancy. This still does not help them remain totally buoyant so they move their bodies regularly or else they would sink. (Weihs 1981). In case they die and internal decomposition starts, or air gets trapped in the gut, they may start floating.

4.3.2. Sharks and their osmoregulation

Every marine fish has to drink water to retain osmoregularity and release excess salt through their gills or skin. It is just the opposite case with freshwater fishes which continuously release water, as the concentration of the fluids is higher in the body compared to surrounding fresh water. In marine fishes, the concentration of outside water is higher so they drink water.

4.3.3. Exposure to air and dragging

Exposure to air for any marine fish is fatal. Dragging a shark against its gills can kill it in minutes. The gill lamellae may get impaired, making sharks susceptible to breathing normally.

4.3.4. Netting, roping and hooking

Accidentally caught sharks are prone to injuries and internal haemorrhage. Entanglement of the fish with nets ruptures gills, fins and skin. Roping around its gills and keel causes injuries and rashes, and also blocks blood flow, causing internal haemorrhage. Hooking directly injures tissues and causes blood loss.

4.3.5. Discussion

Fish react to the acute stress of capture, exhaustive exercise and handling, with greater disruptions to their physiology and biochemistry than higher vertebrates (Pickering 1981; Adams 1990; Wood 1991; Milligan 1996; Kieffer 2000). Myotomal muscle mass of nearly all species of fish is dominated by the anaerobic white muscle (80–95%), which allows high work output in short bursts (Driedzic & Hochachka 1978). Most fishing techniques cause high anaerobic activity and muscular fatigue, resulting in physiological disruptions of the internal milieu of fish (Wells *et al*. 1984). As the body mass of fish comprises more than 30% white muscle and only 3–6% blood, changes in muscle biochemistry are strongly reflected in the blood (Wells *et al*. 1986).

Wells *et al*. (1986) sampled the post-mortem blood chemistry of a limited number of tunas, marlins and sharks after tournament capture and concluded that elevated levels of plasma electrolytes, osmoregulating, blood metabolites (glucose, lactate), plasma enzymes and haematocrit were useful indicators of capture stress. Manire *et al*. (2001) quantified serological changes associated with gillnet capture in bonnet head sharks (*Sphyrna tiburo*), black tip sharks (*Carcharhinus limbatus*), and bull sharks *(Carcharhinus leucas)*. They concluded that species-specific differences in gill-net mortality were likely associated with the animal's respiratory physiology and the degree of struggling.

Piiper *et al.* (1972) and Holeton & Heisler (1978) found that spotted dogfish, *Scyliorhinus stellaris* (Linnaeus), required up to 24 hrs physiologically to recover from exhaustive activity. Barham & Schwartz (1992) reported that blood glucose and haematocrit levels required 24 hrs to return to normal in neonatal smooth dogfish, *Mustelus* canis (Mitchill). Similarly, capture-induced blood chemistry changes in the dusky shark (*Carcharhinus obscurus*), required 24 hrs for recovery (Cliff & Thurman 1984). However, Spargo (2001) and Skomal (2006) found that acid-base blood chemistry in rod-and-reel-caught sandbar sharks (*Carcharhinus plumbeus*), recovered to pre-stress levels in less than three hours, thereby emphasising the need for species-specific studies.

Francis (1989) found that recapture rates of the gummy shark (*Mustelus lenticulatus*), were less in sharks taken in trawls than in nets, which suggests that trawl-caught fish had significantly greater release mortality.

In the Skomal & Chase (2002) and Skomal (2006) studies, the single Bluefin tuna that died immediately after release had low blood pH and high blood lactate levels indicative of severe acidemia. Muscular fatigue associated with the angling bout precluded obligatory ram ventilation after release, leading to respiratory failure Skomal & Chase (2002) and Skomal (2006).

Gill-net capture and restraint probably involve respiratory and metabolic acidosis and hypoglycaemia as well as cellular damage. Species-specific and individual differences in the mortality of sharks caught in gill nets are likely related to an animal's respiratory physiology and degree of struggling upon capture as well as to the extent of net entanglement around the gill area (Manire *et al.* 2001).

Trawling created an upward spike in pCO2 and a massive drop in pH relative to presumed basal (T3) values in dogfish. These responses were presumably a combined function of net constriction, exhaustive activity and the brief periods on deck following capture. Inversely related pCO2 increases and blood pH decreases have also been reported for other elasmobranchs (Piiper *et al.* (1972), Holeton and Heisler (1983), Cliff and Thurman, (1984)), and teleosts (e.g. (Wood *et al.* (1977 and 1983), Schwalme and Mackay, (1985), Milligan and Wood, (1986), Ferguson and Tufts, (1992))

Given the large size and pelagic nature of these fishes, assessing post-release mortality is difficult and should include multiple approaches that quantify the extent of physical damage and the level of physiological disruption. These fishes interact with multiple gear types, which impose varying levels of stress. Hence, studies must be conducted on a fishery-specific basis.

4.4. Efficacy of Whale Shark rescues

In order to review the current and past rescues, WTI prepared a report in 2011, based on past rescue video documentation analysis and on the levels of stress to the rescued Whale Sharks, and suggested a new rescue protocol for future rescues. To understand the level of Whale Shark stress during rescue it was felt necessary to prepare a similar report based on the rescues attended to, and underwater videos and photographs for the 40 rescues that the marine team of WTI had participated in the analysis was based on close encounters between the marine team and the gentle giants. The purpose of the investigation was to study the condition of the rescued sharks at the time of release and to assess the efficiency of the rescue mechanism.

All Whale Shark rescue operations undertaken by the Gujarat Forest Department have been photo and/or video documented. Details of the fishermen and vessels at the time of rescue were also noted down. In the current review, the rescue documentation footage was used to assess the condition of sharks during the rescue and using different indices of measurement, WTI tried to speculate their fate during and after release.

4.5. Methodology for stress assessment

All the videos were reviewed at the office of the Gujarat Forest Department in Veraval. The condition of sharks was ranked on a scale of 0—3, with no values indicating impaired function, the condition of Whale Sharks was rated based on breathing rate (0-3), body movement 0—3; injuries and internal haemorrhage: 0—3 (Fig. 117), Association of other fishes (P-a) and dragging (P-a) (Fig. 118), ropes around its gills or keel to control it (Fig. 119); hooked (Fig.120).

The overall health condition of the shark was assessed as normal, impaired (moribund with high chances of delayed mortality), and with no signs of life.

Fig. 117: Injuries and internal haemorrhage.

Fig. 118: Dragging the whale shark

Fig. 119: Ropes around its gills

Fig. 120. Hooked

All videos were analysed and rated in the presence of officials of the Forest Department, Gujarat who were implementing the compensation scheme.

Till October 2010, a total of 216 rescue operations were conducted by the Forest Department at Veraval and 156 videos were available with the Gujarat Forest Department during the time of video analysis. The analysis focused on assessing factors such as:

a. Breathing rate / internal haemorrhage/body movement

b. Fish association, dragging, hook and roped

c. Time factor

d. Overall assessment

Each has been discussed in detail ahead:

4.5.1. Breathing rate / Internal hemorrhage / Body movement

An analysis of the 156 videos resulted in 58 cases (37.1%) showing no gill or mouth movement; 34 cases (21.7 %) showing occasional movement and only seven cases (4.48%) showing some frequent movements. It was difficult to place individuals into any category in 57 cases (36.53%). Extreme internal haemorrhage was found in five cases (3.2 %), while it was high and clearly visible in 22 cases (14.1%). In 26 cases (16.6 %) there were mild injuries and in 18 cases (11.5%) sharks were seen without injury or haemorrhage. Eighty-five cases (54.4 %) were difficult to analyse.

In 75 cases (48%) no body movement was detected. Some signs of movement were found in 43 (27.5%) cases and 19 cases (12.1%) showed frequent movements. Only in three cases (1.9%) some strong movements were noticed. (Fig. 121); 16 cases (10.2%) were difficult to categorise.

4.5.2. Fish association, dragging, hooking and roping

Fish association with the shark is an indicator of its health. Out of 156 videos, in 23 cases (14.7 %) no other fish were seen associated with the netted whale shark. In the remaining 133 (85.25 %), it was difficult to make out any association. Whale Sharks were towed in 35 cases (22.4 %) against their gills at the time of rescue. In 117 (75%), no dragging was visible at the time of rescue and in the remaining 4 cases (2.56 %) it was difficult to assess how the animal was dragged. Whale Sharks were hooked in 15 cases (9.16%), whereas in 135 cases (86.5%) no hook was visible to control the fish. In 6 cases (3.84%), the video quality did not allow a proper assessment (Fig 122). Whale Sharks were roped around its gills, keel and caudal peduncle in 154 cases (98.71 %). In 2 cases (1.28 %) it was difficult to make anything out from the video

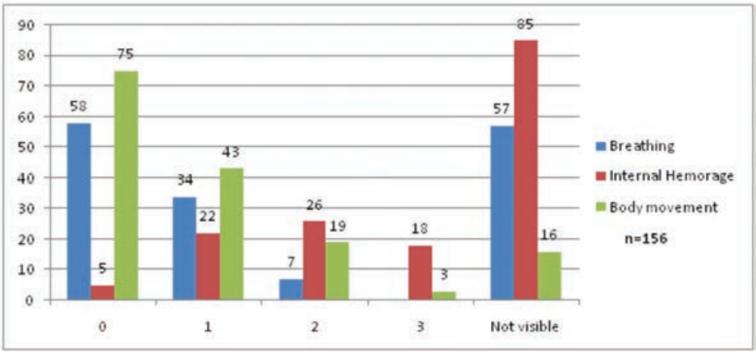


Fig. 121: Graph showing the number of cases in each grade of health indices of shark (0= Poorest, 1= Bad, 2=Good, 3= Normal)

4.5.3. Time factor

An attempt to assess the time taken to complete each rescue was also carried out. Only the time of receiving a rescue call and the time of completing a rescue was available with the Forest Department. Therefore, it was not possible to account for the time between the actual time of fish entanglement with the net and its release. Out of 156 videos, 146 rescue videos were available with the time code.

The rescues were completed on an average time of 1 hour and 53 minutes (SD ±63.10 min), with the shortest time of 20 minutes to the longest duration of 6 hours. The frequency distribution showed a mode at 1:30 – 2:30 hrs (Fig. 123).

The total time for the rescue, in the 19 rescues which had WTI involvement was also calculated. The average time between the actual catch (the time the fishermen discover the trapped whale shark) and release was within 5 hours 12 min (SD± 132 min). The mode of the frequency distribution was 4-8 hrs, much higher than calculated earlier with the data from the Forest Department (Fig. 123).

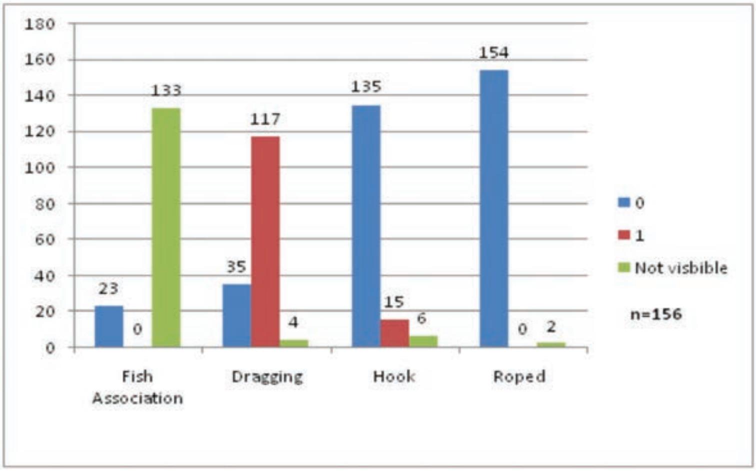


Fig. 122: Graph showing the number of cases with presence and absence status with different indices

4.5.4. Assessment results

Based on the analysis carried out through video recordings, 38 cases (24.35 %), were in a comatose condition, 108 cases (69%) were found with a high risk of possible delayed mortality and only five cases (3.2%) were found in normal condition before release (Fig. 125).

In five cases (3.2 %), the videos were corrupted and no assessment was possible

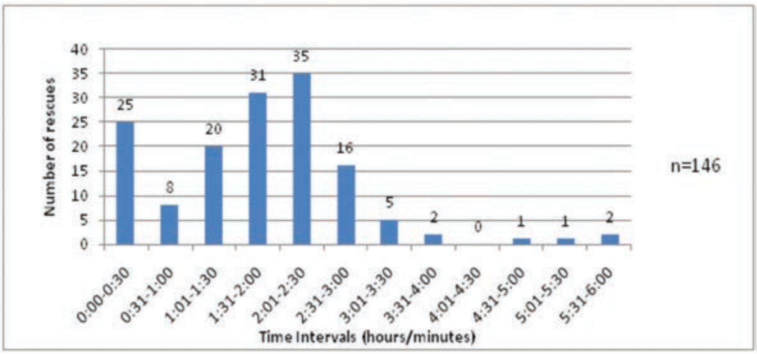


Fig. 123: Number of rescues at different time intervals

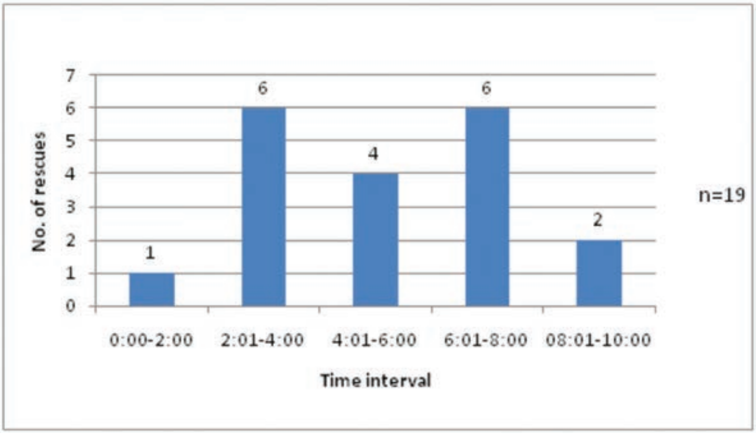


Fig. 124: Number of rescues at different time intervals

4.6. Discussion

Little is known about the post-release mortality associated with the catch and release of sharks, tunas and marlins. Regardless of the fishing gear, captured fish are exposed to varying degrees of stress, which includes the cumulative impacts of physical trauma and physiological stress. Although the magnitude of stress depends on the capture method and handling, studies on fishes show that they all react to the acute stress of capture, exhaustive exercise and handling with more exaggerated disruptions to their physiology and biochemistry than higher vertebrates (reviewed by Pickering 1981; Adams 1990; Wood 1991; Milligan 1996; Kieffer 2000).

In elasmobranchs too, it appears that no phylogenetic predisposition occurs as even very closely related shark species respond differently to capture. For example, Morgan and Burgess (2004), reported that at-vessel mortality was 36% for the Sandbar Shark (*Carcharhinus plumbeus*), less than half of those for the Cogeneric Blacktip Shark (*Carcharhinus limbatus*, 88% mortality) and Dusky Shark (*Carcharhinus obscurus,* 81% mortality). There appear to be no references available on studies conducted on stress level and post release mortality of Whale Sharks or similarly-sized sharks. The video reviews are, therefore, an extremely important tool for the conservation of this species. Though Whale Sharks are big and are known to have a great healing capacity, anaerobic conditions for long durations, internal haemorrhage, dragging, hooking and roping can kill the animals.

Time is a critical factor for any kind of rescue: the greater the delay for any rescue, the lesser the chances of survival. The average time of 1 hour and 53 minutes obtained from the data set was actually the time taken by the rescue team to complete the operation after the call from the fishermen was received. The fish could be caught in the net during the night or early hours of the morning. Data from 19 rescues in which WTI participated revealed the total rescue time increased to 4—8 hrs when the actual time of fish being caught was added. Even a delay of 1—2 hrs negatively impacts the fish's survival.

The video review showed a significant percentage (23.35%) of individuals with no signs of life and an alarming 69 % with high chances of delayed mortality. In 35 cases, it was found that the fish was dragged even during the rescues, which would harm the fish the most. Significantly in 154 cases, it was found that fish was roped from its keel (before tail) and on its gills, mostly to control it and prevent net tearing. This would harm the fish by inflicting internal injuries to the gills and blocking the continuous flow of blood (over-tightening), causing internal haemorrhage.

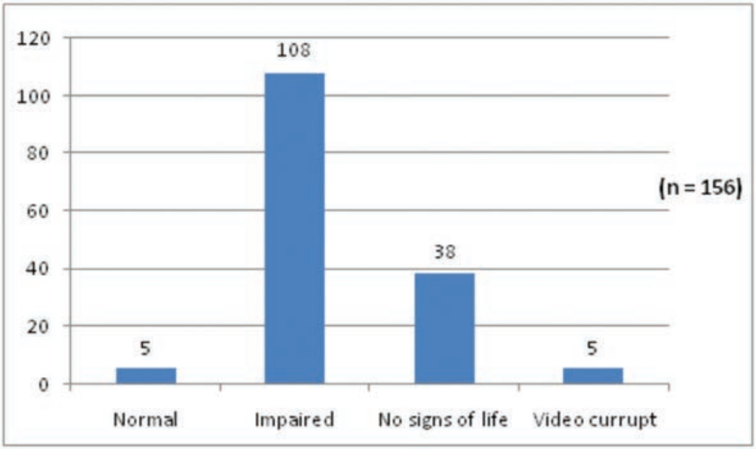


Fig 125. Overall health assessment of Whale Shark rescued

Severe and high injuries and internal haemorrhage, which were visible in 17.3% of cases is a major risk factor causing instant or delayed mortality. The cause for the internal haemorrhage appears to be anaerobic conditions, dragging, hooking and over-tight ropes used to restrain Whale Sharks. Direct injuries due to hooking on the mouth were found in 9.16 % of the cases, resulting in local tissue damage and bleeding. 37.1 % of cases were found with no gill or mouth movement, indicating anaerobic and tiring conditions. In 36.6 % of cases it was difficult to make out such movements, due to the fish position in the videos.

Though no significant difference was found between the timing of suspected dead, impaired and normal sharks tested (Mann-Whitney U test) at 95 % confidence level (impaired vs normal ($z= -.370$, $p= .711$), suspected dead vs impaired ($z= -.799$, $p=.424$), normal vs suspected dead ($z=.883$, $p=.887$). It seems that the lack of data on the actual time of entanglement plays a critical function here.

As mentioned before, the chances of survival of a Whale Shark decrease with an increase in the time taken for rescues. Therefore, it becomes imperative that the time of rescues must be curtailed substantially. The most desirable situation is to release a trapped Whale Shark as soon as possible.

This review resulted in redefining the Whale Shark rescue operation (Fig. 126) on the Gujarat coast.

Fig. 126: Fishermen rescuing Whale Shark at Veraval

5. Redefining Whale Shark rescue operation: Development of self-documentation scheme

The initial rescue protocol dictated that if a Whale Shark was caught in a net, the fisherman had to report it to the authorities and a rescue team would reach the spot to cut it loose, mainly for documentation. But it led to a significant amount of time and transportation expenses. The stress of being captive, at times for hours, was quite intense on the Whale Sharks (leading to stress and high chances of immediate or delayed mortality), with some of them even dying because of it.

The 2011 assessment of the rescue video showed that the stress caused to the fish needed to be reduced, if not eliminated completely and that is when the idea of self-documentation arose. It essentially involved providing the fisherman with cameras, training them to use them and allowing them to document the release operation while cutting the Whale Shark loose without any assistance. Theoretically, by allowing the fisherman to document the capture and release of the big fish, the time taken for it to be released would be drastically reduced. The fisherman would not have to wait around for the rescue team to arrive and would also get adequate compensation in a shorter period of time.

The conceptual refinement rescue method was discussed in consultative meetings with the Forest Department, fishing communities, researchers and local stakeholders to explore the feasibility of the method. The Governing Council meeting held in December 2011 chaired by Secretary Dr. S. K. Nanda, agreed to recommend the changes in the relevant Government Rule of rescue in March 2012. The government of Gujarat made the necessary changes recommended by the Governing Council. Under the Rapid Action Projects of WTI, the conceptual model was executed at Sutrapada, Dhamlej and Veraval to equip and train several fishing communities in self-documentation of a Whale Shark rescue operation using the revised methodology.

5.1. Methodology of new rescue protocols

Using water-proof cameras provided by WTI or their mobile camera the fishermen were advised to photograph the incidentally-caught Whale Sharks along with their boat number (usually written on the sides of their boat) in a single frame to stake claims for monetary relief against their damaged nets.

5.2. Empowering fishing communities to use photo documentation

Several demonstrations of operating the waterproof camera were conducted in Jaleshwar, Veraval, Dhamlej and Sutrapada. For a wider understanding of the method, street plays, dance dramas and other methods were used. Immediately after the training programme, cameras were distributed to the fishermen.

5.3. Train the Trainers programme

In order to train the fishermen on how to use the cameras and the kind of photographs needed to claim relief money, a "Train the trainers programme" was organised in each fishing village. In this training programme, 10-15 fishermen were trained, who would further train the rest of the fishermen, through their respective fishing community heads. A total of 1159 cameras were distributed. The coverage of such programmes through print and electronic media enhanced interest in the self-documentation scheme in other fishing villages as well.

5.4. Media hits

The awareness drive and self-documentation scheme were well supported by local and national media. It was also popularised through social networking sites such as Facebook and Twitter (Fig. 127).

Fig. 127. Volunteers and the WTI Marine team conducting workshops for fishermen.

At the request of the village head, an additional 16 cameras were later distributed in Mangrol. Mangrol fishing port has 500 small OBM boats and about 1500 boat operators. Based on the Patel's (community head) recommendation, WTI arranged for a small gathering of fishermen with forest officials, where 16 water-proof cameras were distributed and training was provided to them on using the cameras.

વેરાવળ બંદરમાં વ્હેલશાર્ક માછલીની
જાળવણી અંગે શેરી નાટક રજૂ કરાયું
માછીમારોને સેલ્ફ ડોક્યુમેન્ટેશન અને કેમેરા અપાયા

5.5. Results of the self-documentation scheme

Soon after the camera distribution, the first rescue happened on 2nd October 2012, where a Whale Shark was accidentally caught in a gill net near Veraval. No

Fig. 128: The first rescue under the self-documentation scheme was on 2nd October 2012. This picture was taken using a mobile phone.

rescue team ventured into the sea to document it; the fisherman used his mobile camera (Fig. 128) for documentation and reported to have released the Whale Shark immediately.

After this, 111 more rescues happened under the self-documentation scheme, from Veraval, Sutrapada and Dhamlej (Fig. 129). Details about the rescues have been given in Appendix 5 (III). The new method has drastically reduced the rescue duration, as it eliminated the time taken to inform the concerned departments after an incidental catch by the fishermen and the time taken for a rescue team to reach the location. Analyses of the pictures obtained in the self-documentation scheme are under process, which will provide us with data on the efficiency of the new method.

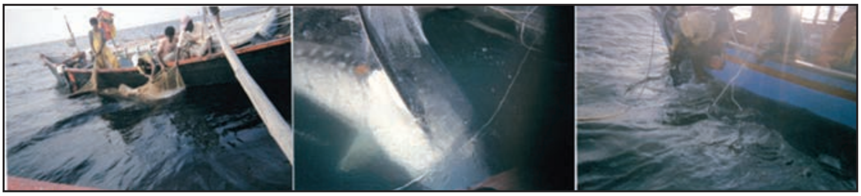


Fig. 129: Sample photos of Whale Shark rescue documented using the waterproof camera.

5.6. Other concerns of Whale Shark rescue

Rescuing the netted Whale Shark by fishermen, using a camera under the self-documentation scheme has shown admirable results for the Whale Shark conservation project in terms of the number of rescues. It has developed a good understanding among fishermen to rescue the Whale Shark on their own and as soon as possible.

Certain factors that need to be looked into to make the scheme more effective include:

1. Fishermen deploy their nets in the late evening and start retrieving them early morning, and if a Whale Shark gets entangled in their net, the fishermen have to wait for sunrise to get sufficient light as they do not have cameras to take photographs.

Solution: *They should be given training in using torch lights along with the camera to give sufficient light for a decent-quality photo and/or provide them with improved cameras with flash units.*

2. Forest officials who undertake rescue documentation work report that fishermen are unable to provide rescue photographs of the quality recommended and

required by the forest department, which leads to the rejection of their relief claim. This has been found mainly due to two reasons;

i. Fishermen have not received sufficient training as complaints about camera operation are the common reason for bad pictures.

ii. Cameras are handled by untrained fishermen while the trained fishermen are engaged in retrieving nets.

Solution: *Effective hands-on training is needed for individual fishermen who received the waterproof camera. The training should cover all the activities such as,*

a) How to rotate the roll manually after taking one picture

b) Documenting rescue pictures as per forest department requirements which are:

1. An entangled Whale Shark in the net.
2. Cutting the net, without harming the whale shark.
3. Releasing the entangled Whale Shark from the net.
4. Taking a snap of both the Whale Shark and boat number for Forest Department documentation purposes. It's easier for the department to process the document for net damage compensation.

c) Fishermen heads to inform their fishermen to replace the used roll in the waterproof camera with a new roll after each Whale Shark rescue documentation.

For effective rescue records, the date and time are required to be printed on the clicked photos, but the current cameras do not have this feature, which needs to be considered for future work.

Most Whale Sharks are accidentally caught in the gill nets that are laid out. In the first instance, Dinesh Khoraba spread his maul net to catch tuna fish and ended up catching the majestic Whale Shark instead. The endeavour of trying to save Whale Sharks, and give them a fighting chance for survival would not have been possible without the cooperation of the local fishing communities in Gujarat. Students from schools and colleges such as the Choksi College and Fisheries College (under the Junagadh Agriculture University) also strived to sensitise the communities through street plays and spreading awareness about the stress to the whale shark, the change in the government ruling, and the benefits to the fishermen, with respect to time and finances.

While local fishermen of Gujarat have voluntarily released the accidentally captured Whale Sharks, the ingenious self-documentation process cut the time lost in reaching and releasing the sharks, making it a pivotal point in the history of the conservation effort to save the whale shark.

6. Whale Shark habitat preference

The accessibility of the seasonal aggregation of Whale Sharks in theVeraval region provides an excellent opportunity for researchers to undertake studies on this rarely encountered and poorly-understood shark.Initial research efforts lacked clearly- defined objectives and were often hampered by limited scientific research on Whale Shark biology and ecology. Some aspects of the research should seek to provide information to environmental management bodies to minimise possible detrimental impacts. In general, occurrences of Whale Sharks appear to be sporadic and unpredictable, which is partly a reflection of the lack of knowledge about the animal's habitat and ecology.

6.1. Methodology

WTI aimed to study the habitat and ecology of Whale Sharks along the Saurashtra coast. Three experimental sites were selected based on the information available on the Whale Shark citations. The experimental sites included: 1. Veraval - A(0 km), B (5 km), C (10 km), D (20 km); 2. Diu - A(0 km), B (5 km), C (10 km), D (20 km); and 3. Mangrol - A(0 km), B (5 km), C (10 km), D (20 km) (Fig. 130). Sampling was done in the fishing season, which fell into three categories: post-monsoon (September to October), winter (November to February), and pre-summer (March to April).

Whale Shark bodies are built to withstand high pressures at depth, with flexible cartilage and slow metabolism helping them survive in the deep ocean

All water sampling and water quality analyses were carried out according to the standard sea water analysing protocols (Strickland & Parsons, 1968) at the regional centre of the Central Marine Fishery Research Institute, Veraval. The methods used for the analysis of various parameters are tabulated in Table 4. Parameters such as sea surface temperature, salinity, pH, visibility, DO, gross and net primary productivity, ammonia, nitrate, phosphate, silicate, chlorophyll concentration, photos, and zooplankton biomass and diversity were recorded from September 2010 (post-monsoon) to April 2011 (pre-summer).

Zooplankton samples were collected (Fig. 131) from surface hauls by employing standard plankton nets. The plankton net is towed horizontally from the boat for 10 minutes using three bridles (suspension lines), which are tied to the ring at equal distances from each other. While making the collections the speed of the vessel is maintained at1 to 2 nautical miles per hour. After the 10-minute haul, the net is taken out of the water and is washed from outside by jetting seawater to bring down all the plankton into a collecting bucket. After the excess water is drained off from the net and through the window of the collecting bucket, the bucket is carefully removed from the net and the plankton, along with the water, is poured into a wide-mouthed 500-ml polythene bottle. The collected samples were preserved in a 5% formaldehyde solution. With regard to phytoplankton, one litre of water from each station is collected in a wide-mouthed 1000-ml polythene bottle and preserved in a 5% formaldehyde solution.

The gross and net primary production rates were calculated, using the light and dark bottle oxygen technique (Gaarder & Gran, 1927). The chlorophyll content of the water was estimated following the methods of Strickland & Parsons (1968). A sample of one-litre water with phytoplankton was collected from the surface of the stations. The phytoplankton organisms were enumerated by the settling method and qualitative and quantitative evaluation of the flora. For the quantitative estimation of zooplankton in the samples, the displacement method was used and the zooplankton volume was determined. As it is not possible to analyse the entire zooplankton sample collected during a haul,sub-samples of a minimum of 2ml of zooplankton were used for qualitative analysis of plankton groups. The sub-sampled plankton were analysed by counting in a plankton-counting chamber under a microscope (Fig. 132).

The analysis of all data was done using the NCSS software package for statistical analysis (ver. 8).

6.2. Results

Auto-correlation was checked between various habitat parameters (e.g. pH, ammonia etc). None of the variables seemed to be strongly correlated. A strong para correlation was found among the variables.

Only two variables depth and visibility showed a significant correlation (r=0.644614).

The correlation matrixisgiven in Table 20. Differences in the readings of various habitat variables (e.g. pH, ammonia etc) between different sites were analyzed by applying ANOVA.

Based onthelocations(places), among all parameters studied, the pH values showed a significant difference (F=3.44, P=0.043902). Visibility also showed a significant difference (F= 9.39, P= 0.000592). Other factors such as gross productivity, nitrateandsilicatesalso showed a significant difference between Veraval, Mangrol and Diu (F=3.53, P=0.040715), (F=4.56, P=0.017909) and (Fratio=3.68, P=0.036080) respectively.

Table 20. Various parameters measured

Sl. No.	Parameters	Methods	Instruments
1.	Temperature	-	Thermometer
2.	pH	-	pH meter
3.	Salinity	-	Salinometer
4.	Dissolved Oxygen	Winkler's	-
5.	Visibility	-	Secchi Disk
6.	Nitrate	Strickland & Parsons (1968)	Spectrophotometer
7.	Phosphate	Strickland & Parsons (1968)	Spectrophotometer
8.	Ammonia	Strickland & Parsons (1968)	Spectrophotometer
9.	Silicate	Strickland & Parsons (1968)	Spectrophotometer
10.	Chlorophyll	Strickland & Parsons (1968)	Spectrophotometer
11.	Primary productivity	Gaarder & Gran, 1927 (Light & Dark Bottle)	
12.	Phyto- and Zooplankton analyses	Standard phyto- and zooplankton sample collection and analysis method	Hemocytometer, Micros ope

Fig. 130: Project area at Mangrol, Veraval and Diu (in yellow) and sampling sites (in red)

Fig. 131: Onboard fixing of water samples

Fig. 132: Zooplankton collection through the planktonic net

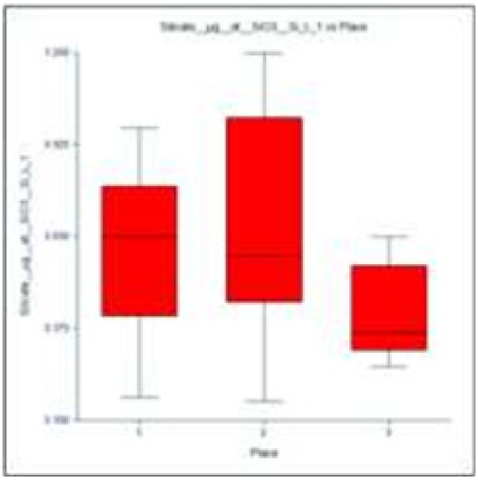


Fig. 133: Response of silicate between different places
(Post-monsoon=1, Winter=2, Pre Summer=3)

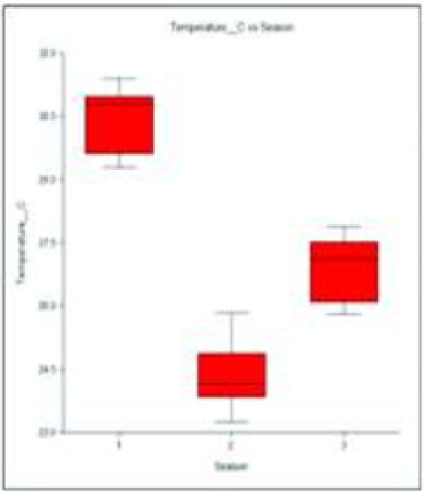


Fig. 134. Response of temperature

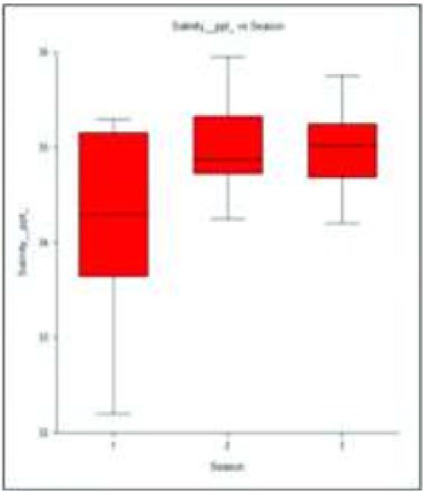


Fig. 135: Response of salinity

(Post-monsoon=1, Winter=2, Pre Summer=3)

Table 21. Correlation matrix showing correlation coefficients (r) of only significantly correlated habitat parameters

	Depth (m)	Visibility (m)	DO (ml/L)	Net Productivity (mg C/L/hr)	Ammonia (µg /L)	Nitrate (µg/L)	Silicate (µg at /L)
Temperature (°C)					0.42		
pH	0.41		0.42				
Depth (m)		0.64					-0.40
Visibility (m)							-0.39
Gross Productivity (mg C/L/hr)				0.51			
Phosphate(µg/L)						0.45	

Auto-correlation was checked among different habitat variables and the significantly correlated habitat parameters are indicated in Table 21. Among them, only two variables- depth and visibility- showed a strong positive correlation (r= 0.64), this may be explained as with increasing depth, the concentration of silicate decreased (r=-0.40).

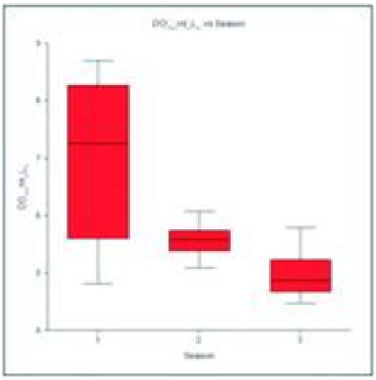


Fig. 136: Response of DO between seasons

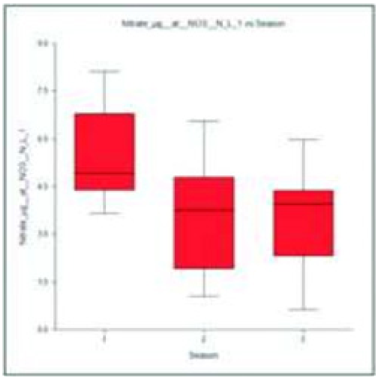


Fig. 137: Response of Nitrate between different seasons

Post-monsoon=1, Winter=2, Pre Summer=3

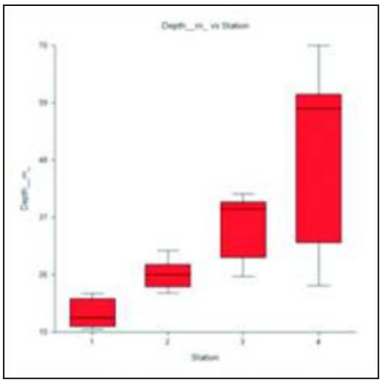


Fig. 138: Response of Depth

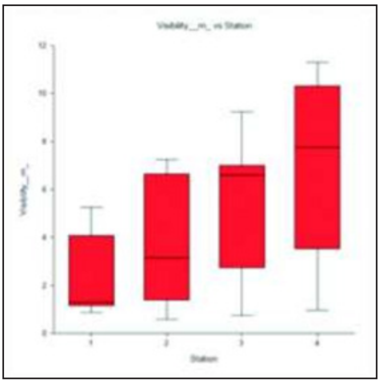


Fig. 139: Response of Visibility

Station (A=1=0 km, B=2=5 km, C=3= 10 km, D=4=20 km)

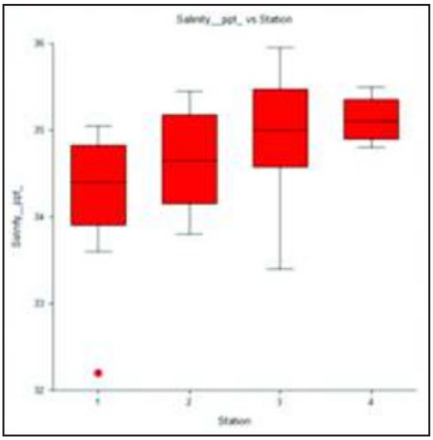


Fig. 140. Response of salinity based on distance from shore

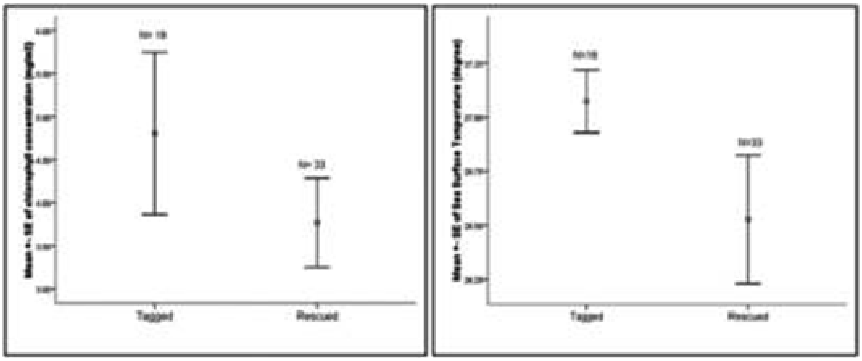


Fig. 141(a). Variable= X1 = Diu_field_temp, X2 = Diu_Sat_temp. for confidence limits = 2.1009

Table 22. Data acquired from MODIS

Chlorophyll	SST
March 2010 (8 day composites)	March 2010(Monthly)
April 2010 (Monthly)	April 2010 (Monthly)
May 2010 (Monthly)	May 2010 (8 day composites)
December 2010 (Monthly)	December 2010 (Monthly)
October 2010 (Monthly)	October 2010 (Monthly)
February 2011 (Monthly)	February 2011 (Monthly)
April 2011 (Monthly)	April 2011 (Monthly)

6.4.Whale Shark habit at analysis with free source satellite data

An overlay of satellite image data available for various parameters for the Whale Shark rescue and tagged locations was prepared to analyse habitat preferences of Whale Sharks off the Gujarat coast.

6.4.1. Data acquisition and methodology

Monthly and eight-day composites of SST and chlorophyll MODIS images having 4 km resolution were downloaded from http://oceancolor.gsfc. nasa.gov/ cgi/l3?per=DAY. Level-3 from MODIS products were produced for several time period composites. In general, longer time periods fill in more of thenaturally occurring data gaps (caused by, for example, clouds, sun glint, inter- orbits gaps, ice, low light, etc.) at the expense of short-lived features which tend to get smoothed out in longer-period composites.

Sea surface temperature (SST) and chlorophyll data were acquired on the different dates when signals were acquired for tagged Whale Sharks as well as rescue locations. Both data sets were processed. HDF files downloaded were converted to ASCII using HDF View, and edited to remove the null values using Context. The SST was linearly stretched using SAGA GIS. Chlorophyll data did not require any stretching. Values of the tagged shark locations and rescue locations were extracted using ArcGIS.

6.4.2. Analysis

Sea surface temperature and chlorophyll

The mean SST was 27.0737°C (+14°C) at the tagged Whale Shark locations and the mean temperature for the rescued Whale Shark location was 26.5264°C (+0.29°C). However, a number of the Whale Shark rescue locations were found to be around 25°C (Table 23).

Table 23. Mean SST

	N	Mean	Std. Deviation	Std. Error Mean
SST (Tagged)	18	27.0737	0.61405	0.14473
SST (Rescued)	33	26.5264	1.702241	0.296322

The mean chlorophyll was 4.8072 mg/cubic m for tagged Whale Shark locations and 3.769849 for Whale Shark rescue locations (Table 24). The chlorophyll valueforwhales sharklocations varied drastically among the locations, leading to no conclusion about whether chlorophyll governed Whale Shark movement.

Table 24. Mean chlorophyll

	N	Mean	Std. Deviation	Std. Error Mean
Chlorophy-ll (Tagged)	18	4.8072	3.9974	0.9422
Chlorophy-ll (Rescued)	33	3.769849	2.973909	0.517691

6.5. Comparative study of satellite data with field data on sampling location

In order to check the reliability of satellite data, a test run was conducted between data gathered from field and satellite data.

6.5.1. Temperature

PairedT-test was applied to thedata.There appears a selective bias in the data originated from satellites, which might be caused by many factors. For temperature, data collected in the field was found higher than satellite data (Table 25).

The field data of Diu was compared with the satellite data. Against a null hypothesis i.e. field data was similar to satellite data, threealternative hypotheses were tested, and it was found that temperature data from the field was elevated as compared with satellite data.

Table 25. Temp. test for difference between temperaturemeans section

Alternative hypothesis	T-Value	Prob. Level	Reject HO at 0.050
Diu_field_temp-Diu_Sat_temp<>0	2.2071	0.040534	Yes
Diu_field_temp-Diu_Sat_temp<0	2.2071	0.979733	NO
Diu_field_temp-Diu_Sat_temp<0	2.2071	0.020267	Yes

Variable= X1 = Diu_field_temp,X2 = Diu_Sat_temp for confidence limits = 2.1009

6.5.2. Chlorophyll

The chlorophyll datawas notnormally distributed. Against a null hypothesis, ie. field data is similar to satellite data, three alternative hypotheses were tested, and it was foundthat the chlorophyll data from the field was lower than satellite data.

Table 26. Tests of assumptions about different sections

Tests of assumptions about differenct sections		
Assumption	Value	Probability
Skewness Normality	-3.4381	0.000586
Kurtosis Normality	2.6648	0.007702
Omnibus Normality	18.9223	0.000078

6.5.3. Seasonal variation in temperatureand chlorophyll content with correlationto Whale Shark rescue and migration location of tagged Whale Shark using satellite data:

The satellite data was analysed to find the seasonal variation in temperature and chlorophyll content with correlation to Whale Shark rescue and migration location of tagged Whale Sharks.

The analysed data did not yield any correlation between the seasonal variation in temperature and chlorophyll content; this could be due to the low sample size or due to the previously discussed errors in the deviation of satellite data and actual field data. Further analysis is needed for any possible correlation to be identified.

Table 26: T-Test for difference between means section

Alternative hypothesis	T-Value	Prob. Level	Reject HO at 0.050
Chloro_f ield-Chloro_ Sat<>0	-2.8005	0.012827	Yes
Chloro_f ield-Chloro_ Sat<0	-2.8005	0.006414	Yes
Chloro_f ield-Chloro_ Sat>0	-2.8005	0.993586	No

Variable= X1 = Chloro_field, X2 = chloro_sat temp. for confidence limits = 2.1199

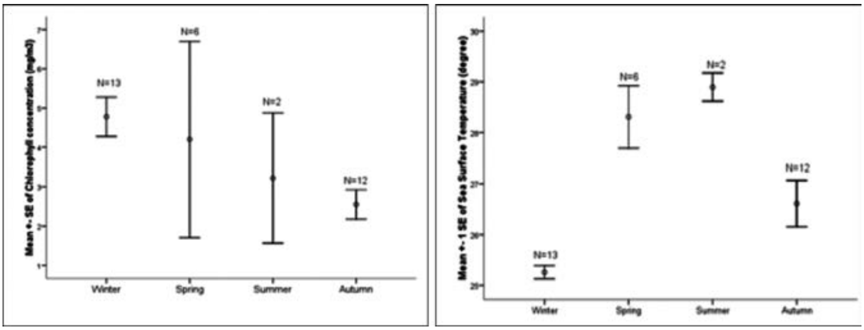


Fig. 141(b). Season-wise mean chlorophyll concentration and(c) season-wise mean SST variation

6.5.4. Seasonal variation in Whale Shark sightings or rescues:

With the available data, it was not possible to run any analysis, but the graphs below show some higher Whale Shark sightings/rescues in some specific seasons (Fig 142 a, b).

6.6. Whale Shark occurrence with reference to depth

When Whale Shark catch locations (of rescued Whale Sharks) were plotted on a map, not much differencewasfoundbetweenthenumbers of Whale Sharksaccidentally caughtin shallow and deeper areas. Eleven catch locations were reported from deeper areas (50 m or > 50 m) and an almost similar number of 12 Whale Sharks were caught in shallow areas (30 or less than30 m).

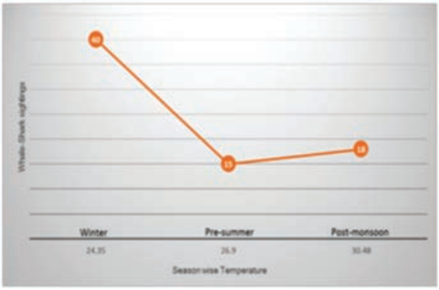


Fig.142 a. Temperature vs Whale Shark sightings/rescues

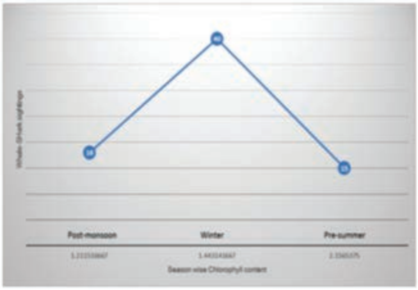


Fig 142 b. Chlorophyll vs Whale Shark sightings/rescues

6.6.1. Zooplankton community analysis

Hierarchical Cluster analysis was applied to analyse how the community structure ofzooplanktons, phytoplankton, diatoms, dinoflagellates, silicoflagellates, blue green algae and nannoplanktons at three study sites varies with seasons. The results are depicted as cluster dendrograms of three seasons, post-monsoon, winter and pre-summer.

Among thezooplanktons (Table 28), Hydromedusae and copepods were most distantly associated (Fig. 143) for all the seasons except winter. Hydromedusae and Siphonophora were most closely associated with zooplanktons throughout the year (Fig. 143, 144, 145, and 146).

Table 28. List of zooplankton community analysis in dendrogram.

1	Hydromedusae	6	Invertebrate larvae
2	Siphonophora	7	Thaliacea
3	Chaetognatha	8	Fish eggs
4	Copepod	9	Fish larvae
5	Sergestidae		

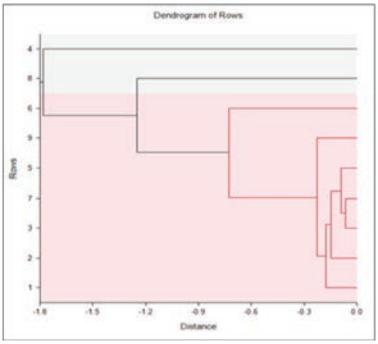


Fig. 143: All season

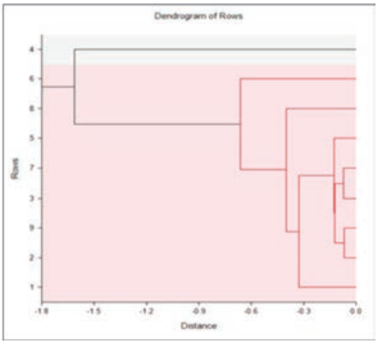


Fig. 144. Post-monsoon

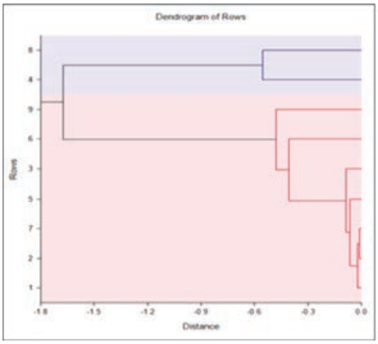


Fig. 145. Winter

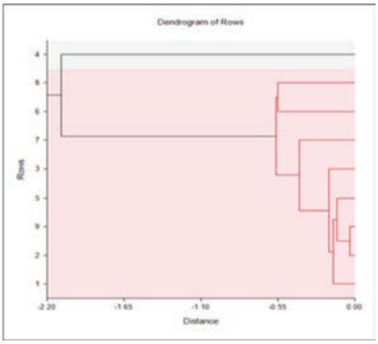


Fig. 146. Pre-summer

Table 29. List of species in dendrogram

1	*Skeletonema costatum*
2	*Thallassiophyxix palmeriana*
3	*Thallassiosira subtilis*
4	*Coscinodiscus excentricus*
5	*Planktoniella sol*
6	*Rhizosolenia robusta*
7	*Eucampia cornuta*
8	*Biddulphia mobiliensis*
9	*Ditylum brightwelli*
10	*Biddulphia sinensis*
11	*Cerataulina bergonii*
12	*Cyclotella sp*
13	*Chaetoceros sp*
14	*Lithodesmium sp*

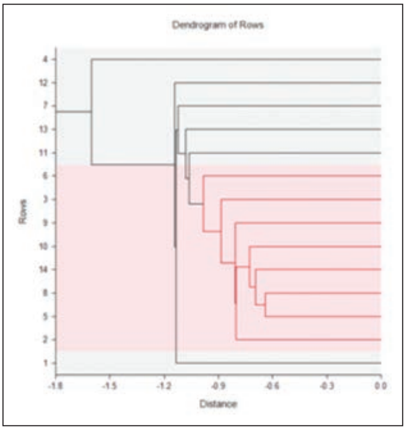


Fig. 147: Post-monsoon

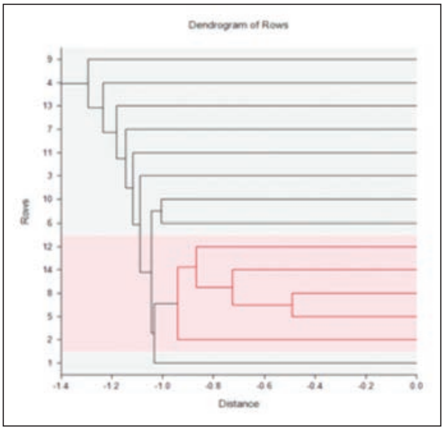


Fig. 148: Winter

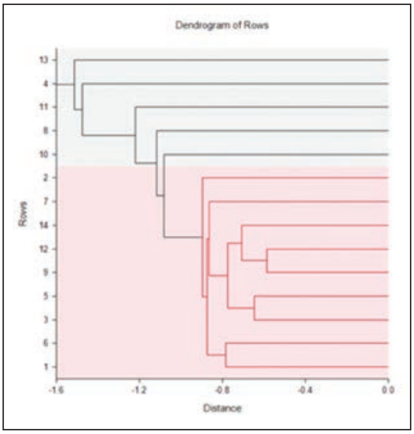


Fig. 149: Pre-summer

6.6.2. Phytoplankton community analysis

Phytoplankton community analysis was carried out in two phases, one for Diatom centrales (Figure 144, 145, 146) and other for Diatom pennales (Figure 150, 151, 152). *Skeletonema costatu* and *Thallassiiophyxix palmeriana* were very closely related during post-monsoon and winter, however, in pre-summer, *Skeletonema* costatum and *Rhizosolenia robusta* were closely associated.

6.6.3 Diatoms pennales

In the case of diatom pennales, three separate assemblages were evident in post-monsoon (Fig. 150) whereas only two community associations were depicted in winter and pre-summer (Fig. 151 and 152) (Table 30).

Table 14. List of species in dendrogram

1	*Grammatophora undulate*	9	*Gyrosigma balticum*
2	*Licmophora delicatula*	10	*Bacillaria paradoxa*
3	*Fragilaria oceanic*	11	*Nitzschia closterium*
4	*Rhaphoneis discoides*	12	*Nitzschia sp*
5	*Thallasiothrix frauenfeldii*	13	*Surirella fluminensis*
6	*Asterionella japonica*	14	*Campylodiscusi yengarii*
7	*Mastogloia exilis*	15	*Navicula sp*
8	*Cocconeis littoralis*	16	*Thalassionemanitz schioides*

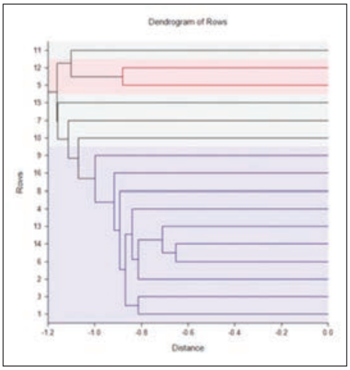


Fig. 150: Post-monsoon

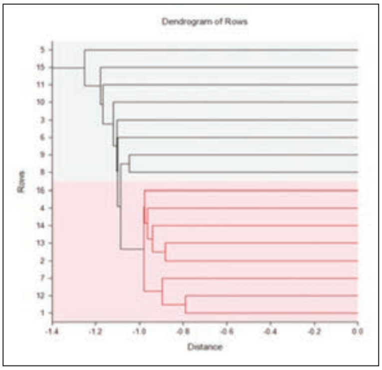


Fig. 151: Winter

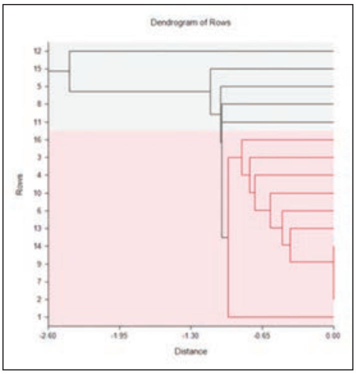


Fig. 152: Pre-summer

6.6.4 Dinoflagellates

In the case of Dinoflagellates, a close association was depicted for *Ceratium sp*. and Cochlodinium citron for all three seasons (Fig. 153, 154 and 155). However, several changes in community composition were also depicted between winter and pre-summer.

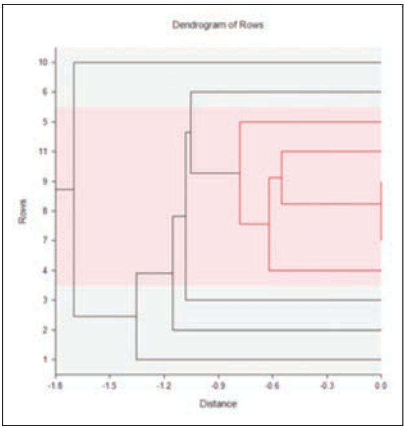


Fig. 153: Post-monsoon

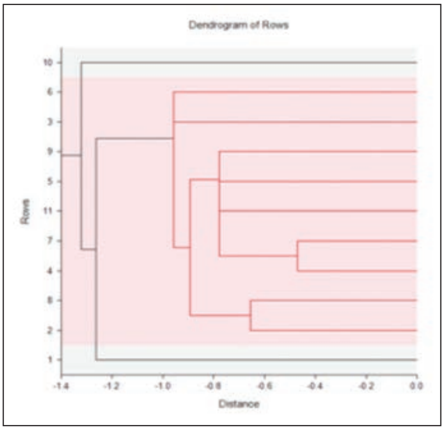


Fig. 154: Winter

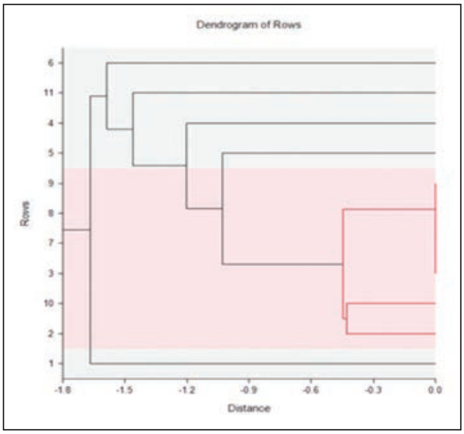


Fig. 155: Pre-summers

Table 31. List of species in dendrogram

1	*Ceratium sp*	7	*Podolampas bipes*
2	*Cochlodinium citron*	8	*Pyrophacus horologium*
3	*Amphisolenia bifurcata*	9	*Diplopsalis sp*
4	*Ceratium declinatum*	10	*Ornithocercus magnificus*
5	*Dinophysis caudata*	11	*Prorocentrum sp*
6	*Peridinium claudicans*		

6.6.5.Silicoflagellates,blue-greenalgae& nannoplankton

Forthisgroup,blue-green algae andNanno chloropsis were not at all associated with all the three seasons (Fig. 156, 157, 158) and were part of two different communities for all the seasons.

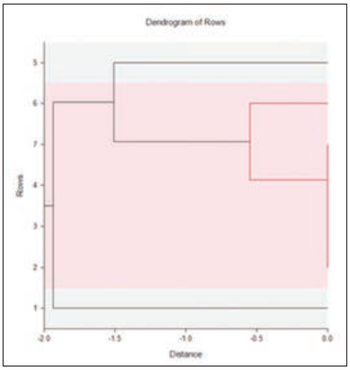


Fig. 156: Post-monsoon

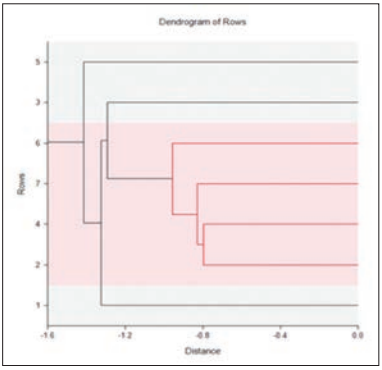


Fig. 157: Winter

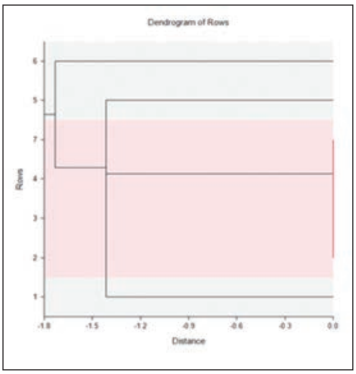


Fig. 158: Pre-summer

Table 32. List of taxon in dendrogram

1	*Blue green algae*	5	*Nanno chloropsis*
2	*Spirulina sp*	6	*Chlorella sp*
3	*Pavlova sp*	7	*Tetraselmis sp*
4	*Dunaliena sp*		

6.7. Conclusion

6.7.1. Various habitat parameters their relation and responses to places, seasons and distance from shore

Among all habitat parameters, only depth and visibility showedsomerelation,which was expected as visibility often improves with depth. The rest of the parameters were weakly or not correlated at all and so nothing could be inferred.

Whale Shark tourism depends on good visibility and current studies show that only the deeper areas which are far from shore show a visibility range of 2.5 m to 10 m (mean = 6.5m). Among the three study sites, Mangrol showed good visibility compared toVeraval which showed a broad range of visibility. Diu had the lowest visibility. This suggests that deeper areas in Mangrol and Veraval are good for initiating Whale Shark tourism and satellite tagging studies. The low visibility in Diu may be due to heavy land runoffs and shallow seas compared to Veraval and Mangrol.

The pH values of all three habitats did not show significant changes and were within normal ranges. But further studies are needed specifically in areas near Veraval where heavy industrial runoffs aredischarged directly into the sea by fish-processing units.

Gross productivity, nitrates and silicates showed a significant difference among the three study sites. TheVeraval area,where a maximum number of Whale Sharks sightings and rescues were reported, showed a greater range and mean values for these parameters, which are important to support zooplankt on and phytoplankt on growth (Whale Shark food). Further studies are needed to confirm whether areas near Veraval are highly productive compared to the rest, as the present study was limited to one seasonal cycle. It is speculated that the high numbers of recues from Veraval may also be due to increased fishing efforts, compared to Mangrol and Diu.

Different seasons showed a marked difference in temperature changes in water. In winter, when the maximum number of rescues was reported, the mean water temperature was 24.35°C (±0.58°C SD). However, more studies are needed to confirm the seasonal temperature preference for Whale Sharks on Saurashtra coast.

A significant difference in DO and Nitrate during post-monsoon suggests heavy runoffs from lands into the sea and churning due to heavy water currents and monsoon.

The depth and visibility revealed a significant difference from shore which was expected. Low visibility closer to shore areas may be due to the heavy disturbance factors of too many boats operating.

6.7.2. Satellite field data and comparison with field data

Satellite data is reliable for studying various marine species habitat and their distribution. In the current studies, when temperature and chlorophyll data from satellite studies and the field were compared, a significant difference was found, which suggests the need to either refine the field protocols and sample analysis or need further studies to understand satellite data.

6.7.3. Temperature and chlorophyll preference by satellite-tagged whale shark

However, when the satellite data was analysed for temperature and chlorophyll at the locations where tagged animals migrated, it was found that the temperature variations between these places were small, indicating that the tagged Whale Shark preferred a specific temperature of 27.07°C (± 0.61°C SD). Probably this was because the data was only for two months (13 March 2011- 24 April 2011). Chlorophyll had wide variations (Mean 4.80 ± 3.99 SD), indicating that there was probably no relation.

6.7.4.Whale shark locations with respect to depth

No difference was found between the number of Whale Sharks caught in shallow and deeper areas. It shows that irrespective of the depth, Whale Sharks search for productive feeding grounds. In the case of tagged Whale Sharks also, frequent switching between deeper and shallow areas was observed. The team could not come to a definite conclusion as the present data size is limited.

6.7.5. Comparison of Whale Shark rescues/ sightings with seasonal temperature and chlorophyll field data

When the numbers of Whale Shark sightings/ rescues are compared with the seasonal water quality changes, the maximum number of rescues was recorded in winter, followed by monsoon and summer. If the mean temperature value of pre-summer time and satellite-tagged animal location temperature data (satellite data) which was during pre-summers (March and April) are compared, there is only a difference of 0.1°C, which suggests that during the pre-summers of 2011 Whale Sharks preferred this temperature. However, further studies are needed to confirm such preferences for specific temperature ranges by Whale Sharks for specific seasons.

6.7.6. Zooplankton community analysis

Samples collected from the study sites listed the presence of Hydromedusae, Siphorophora, Chaetognatha, Copepod, Sergestidae, invertebrate larvae, Thaliacea, fish eggs and fish larvae.

Chaetognatha, Sergestidae and Siphonophora were found continuously, forming clusters during all three seasons. During post-monsoon, fish larvae were found in close association with these species. The high density of fish larvae during post-monsoon is expected as most fish breed during monsoon. Hydromedusae and Thaliacea were found abundantly during winter.

Fish eggs and copepods were also found forming a specific cluster during winter. It is important to note that copepods and fish eggs form a major partof Whale Shark diet. So their increased growth during winter might be the reason for Whale Shark sightings in winter.

Whale Sharks are filter feeders, gliding through the ocean with mouths wide open to collect microscopic meals.

6.7.7. Phytoplankton analysis

Phytoplanktons are the base of a marine ecosystem: they serve as food not only for many small and big marine organisms but also for Whale Sharks. Their enormous growth is also known as food capsules of oceans, which attracts Whale Sharks.

6.7.8. Diatoms centrales

Samples collected from three sites showed the presence of *Skeletonemaco statum, Thallassiophyxix palmeriana, Thallassiosira subtilis, Coscinodiscus excentricus, Planktoniella sol, Rhizosolenia robusta, Eucampia cornuta, Biddulphia mobiliensis, Ditylum brightwelli, Biddulphia sinensis, Cerataulina bergonii, Cyclotellasp., Chaetoceros sp. and LIthodesmium sp.*

Species such as *Lithodesmium sp.* and *Planktoniella* sol showed a consistent grouping throughout all seasons. Two other species, *Biddulphia mobiliensis* and *Cyclotella sp.,* were also found high in numbers during winters, especially when Whale Shark sightings are at their peak. The consistent presence of some species of diatom centrales throughout the seasons and the specific presence of some during winters might be the reason for consistent Whale Shark sightings and more specific sightings in winters.

6.7.9. Diatoms pennales

The analysis of water samples revealed the presence of 16 diatom pennalesspecies viz. *Grammatophora undulata, Licmophora delicatula, Fragilaria oceanica, Rhaphoneis discoides, Thallasiothrix frauenfeldii, Asterionella japonica, Mastogloia exilis, Cocconeis littoralis, Gyrosigma balticum, Bacillaria paradoxa, Nitzschia closterium, Nitzschia sp, Surirella fluminensis, Campylodiscus iyengarii, Navicula sp. and Thalassionema nitzschioides.*

Among diatoms pennales species, *Surirella fluminensis, Campylodiscu siyengarii* and *Asterionella japonica* which are specific community structures during post-monsoon and pre-summer season are replaced by species like *Nitzschia sp*, *Grammatophora undulate* and *Mastogloia exilis* while during winters forming a different community structure.

6.7.9.1 Dinoflagellates

Ceratium sp, Cochlodinium citron, Amphisolenia bifurcata, Ceratium declinatum, Dinophysis caudata, Peridinium claudicans, Podolampas bipes, Pyrophacus horologium, Diplopsalis sp, Ornithocercus magnificus and *Prorocentrum sp* were reported from the analysed samples.

Diplop salis sp, podolampas bipes, prorocentrum sp, ceratium declinatum and *dinophysis caudata* are consistent for post-monsoon and winter. During pre-summer three of these species are replaced by *Amphisolenia bifurcatea Ornithocercusmagnificus and Prorocentrum sp.*

6.7.9.2 Silicoflagellates, blue-green algae and nanoplankton

Blue-green algae Spirulinasp, Pavlova sp, Dunaliena sp, Nanno chloropsis, chlorella sp and Tetraselmis sp have been reported from the three study sites.

Fourspecies, *Spirulina* sp, *Tetraselmissp*, *Nanno chloropsis* and *Dunaliena* spare consistent during post-monsoon and winters, but during pre- summers *Dunaliena* sp and *Nanno chloropsis*, are replaced by *Nanno chloropsis* and blue-green algae.

With data available from only one seasonal cycle, it is difficult to arrive at a definite conclusion for Whale Shark habitat preferences on the Saurashtra coast. In current studies, various habitat parameters showed some differences between the three study sites, which could be a reason for increased sightings specifically near Veraval, though it could also be directly related to more intensified fishing as Veraval port has the maximum numberof operational fishing vessels compared to Diu and Mangrol. Further studies are needed to understand the reasons.

Similarly, it is imperative to conduct further research on the status of the quantum of zooplankton and phytoplankton in the sites. The current study has shown that these areas are rich in copepods and other species which are the preferred food for Whale Sharks.

It is also important to refine either the field protocols of sampling and analysis, or data extraction techniques from satellite images because the current studies showed a significant difference between the two sources. Once it is done, satellite data may help considerably in understanding the Whale Shark habitat. Similar efforts are needed in satellite tagging of Whale Sharks, as their movement data will be a great source of information on the reasons behind these migrations.

During all three seasons, a continuous heavy untreated discharge from fish processing units of Veraval was noticed. It is also important to study the impact of such discharges on the coastal waters of Gujarat, including possible alterations to the marine environment.

7. Whale Shark migration

Whale Sharks are believed to migrate between feeding grounds. Preliminary results from various tagging studies and other observations appear to indicate that this species migrates in response to seasonal concentrations of food. Whale Sharks return regularly to certain locations to feed on blooms of zooplankton (i.e., concentrations of eggs and larvae from the synchronous spawning of fish, crabs or coral) that occur for a few months each year. Whale Sharks in the Indian Ocean are highly migratory, as indicated by Rowat (2007). The tracking information from GPS data and anecdotes from fishermen and tour operators in the Indian Ocean have shown that sharks migrate annually east towards continental Africa, then both south into the Mozambique area and to the north of Somalia, after which they migrate west towards Sri Lanka. The pattern of temporal occurrence shows that Whale Sharks are generally seen on a regular basis during specific periods. The movements have been also linked with the monsoon wind seasons (Anderson and Ahmed 1993). Sleeman (2010) found that surface geostrophic currents did not affect the movements of Whale Sharks. The tracked individuals confirmed that Whale Sharks can effectively swim against prevailing surface currents and they did not seem to utilise the currents to get to productive areas.

A single whale shark can have dozens of remoras and small fishes following it.

Whale Sharks travel long distances and the timing of their movements is typically associated with localised blooms of planktonic organisms and water temperature changes (Compagno 2002). In the Gulf of California(GOC), Eckert and Stewart (2001) used towed satellite tags to demonstrate the extensive movement of Whale Sharks into the North Pacific Ocean. Using towed tags off Southeast Asia, Eckert *et al.* (2002) reported two Whale Sharks that travelled 4,567 and 8,025 km with an overall mean travel rate of 24.7 km/day. By applying PSATs to Whale Sharks at Ningaloo Reef, Western Australia, Wilson *et al.* (2005) documented long-term movements characterised by both in-shore and off-shore habitat utilisation, north-easterly travels into the Indian Ocean. Collectively these studies indicate that Whale Shark is capable of transoceanic movements,crossing numerous geopolitical boundaries, which highlights the need for both regional and multinational levels of management for this species. Whether the migrations (i.e. the seasonal movements of animals from one region to another) of several thousand kilometres are solely driven by feeding events or linked to other aspects of their life history is yet to be determined. Although the Whale Shark has been documented in various parts of the Gulf of Mexico (GOM) (Burks *et al.* 2006 and Hoffmayer *et al.* 2007) and the Caribbean Sea (Gudger 1939 and Heyman *et al.* 2001), the team know very little about the movement and migration patterns of this species.

Conventional tagging is increasingly used to estimate and assess shark populations and movements and since 1962 the National Oceanographic and Atmospheric Administration National Marine Fisheries Service Laboratory (NOAA-NMFS)has implemented a cooperative shark tagging programme with recreational anglers and commercial fishers, leading to the tagging of over 87,000 sharks(Kohler etal. 1998). However, tag shedding appears common in a range of shark species, undermining viable population estimates (Davies and Joubert, (1967), Gruber, (1982), Carrier, (1985), Heupel and Bennett, (1997). Graham *et al.* (2007) have also reported conventional tagging efforts off Gladden Spit, Belize have resulted in very few re-sightings outside the study area.

By comparison, photo identification is a non-invasive method of identifying individuals that relies on cataloguing distinctive scars or markings originally developed to identify terrestrial animals and marine mammals that can be clearly seen (Katona *et al.* (1979) and Arnbom, (1987 b)). In elasmobranchs, photo-identification has been adapted to identify basking sharksin Britain (Sims *et al.* 2000), white sharks at California's Farallon Islands (Klimley,1996), nurse sharks in Brazil's Atol das Rocas (Castro andRosa, 2005) and Whale Sharks world wide including Ningaloo Reef, Australia(Arzoumanian etal. 2005), Belize (Graham,

2003) and more recently in combination with tagging in the Isla Contoy in Mexico, the Bay Islands of Honduras, the Seychelles and Djibouti.

Whale Sharks are born with unique body pigmentation that is retained throughout their lives (Norman 2004). This natural patterning of lines and spots shows no evidence of significant change over the years and may, therefore, be used to identify individual sharks (Taylor 1994; Norman 1999): its uniqueness has been corroborated by traditional tagging and identifications made based on scarring and other visual markers. By combining photographed encounters and spot-pattern matching, a shark may be 'tagged' without physical contact or interferencewith the animal. In an early effort, Norman (1999) established a photo-identification library of Whale Sharks at Ningaloo Reef, Western Australia, with photographs of individual sharks examined by eye for identifying characteristics, including spot patterns.

Photographic identification has several advantages over conventional tagging,particularly for a large threatened species like the whale shark. Photo-ID is non-invasive, reducing both the potential for detrimental impacts from the tags or behavioural response to tagging, which may bias future re-sighting. Given that underwater digital cameras are now ubiquitous within the diving and marine tourism industry, it is easy to obtain ID shots from tourism operators or interested clients themselves as well as from within the scientific community.

It is vital to gather more information through scientific studiesonwhale sharkmovement, so that better conservation models can be developed incollaboration withother range states and countries. The project has used all thethreetechniques i.e. photo- identification, marker tagging and satellite tagging technique, to trace and understand the migration route of Whale Sharks in the Arabian Sea. All techniques have shown varying levels of success in spite of the challenges faced due to the extreme natural conditions of the coastal waters of Gujarat.

7.1. Photo identification

Whale Sharks are easily distinguishable from other species due to their large size and distinctive white-spotted dorsal colouration. The spot patterns are individually unique and appear to be consistent over time, enabling long-term re-sighting of individuals and the application of standard re-sighting based population estimation methods (Meekan *et al.* 2006).

The flanks of the shark are the areas used for identification, based on other successful studies. Photographs should be taken from right angles to the shark.

The important areas to include in the photograph are the upper and lower fifth-gill slit and the inner trailing edge of the pectoral fin. The flank areas approximate a two-dimensional surface, containing large distinctive spots and include suitable reference points for comparison between images (Fig. 159).

A platform like ECOCEAN (www.whaleshark.org) provides a global platform for the submission of Whale Shark photographs, where these photographs are processed and IDs are given to individual animals. ECOCEAN was incorporated in India in January 2010 for the joint research work of the Wildlife Trust of India, Tata Chemicals Ltd, and Forest Department, Gujarat.

7.1.1. Photo ID of the Whale Sharks of Gujarat coast

All photographsused forthephotoID were taken during the rescue operations. Though a number of photographs were documented during the project period, only two were of acceptable quality.They were uploaded to the global online Whale Shark photo ID directory, ECOCEAN. The Whale Sharks were identified as new individuals, not previously photographed/ photo identified, and, therefore, are new additions to the ECOCEAN global directory (Fig. 160).

Some of the hurdles to capturing a good-quality photo ID in Gujarat are:

- **Visibility** is one of the prime requirements for a good photo ID. However, poor water visibility in the Gujarat waters has been a major hurdle for photo ID. In 40 rescues, an average visibility of 2.01m (SD±1.37) was recorded.
- The **position** of the rescued Whale Shark is also a major hurdle for photo ID. As photographs of the sides of the sharks (specifically near the gills), need to be taken for identification, the position of the trapped sharks is sometimes unsuitable for documentation for a photo ID.

Fig. 160: Brad Norman imparting training on identification of individual Whale shark in Verval

- **Net entanglement** is a third major problem, as the trapped Whale Sharks are completely covered in net, to the extent that the spots are not visible. In such cases, a photo ID is not possible.
- **Post-release** from the entangled net, the rescued Whale Shark immediately dives into deeper waters, making photo ID impossible in such situations.

Considering all of the above factors, it seems logical not to depend exclusively on photo ID for migration or Whale Shark population studies off the coast of Gujarat.

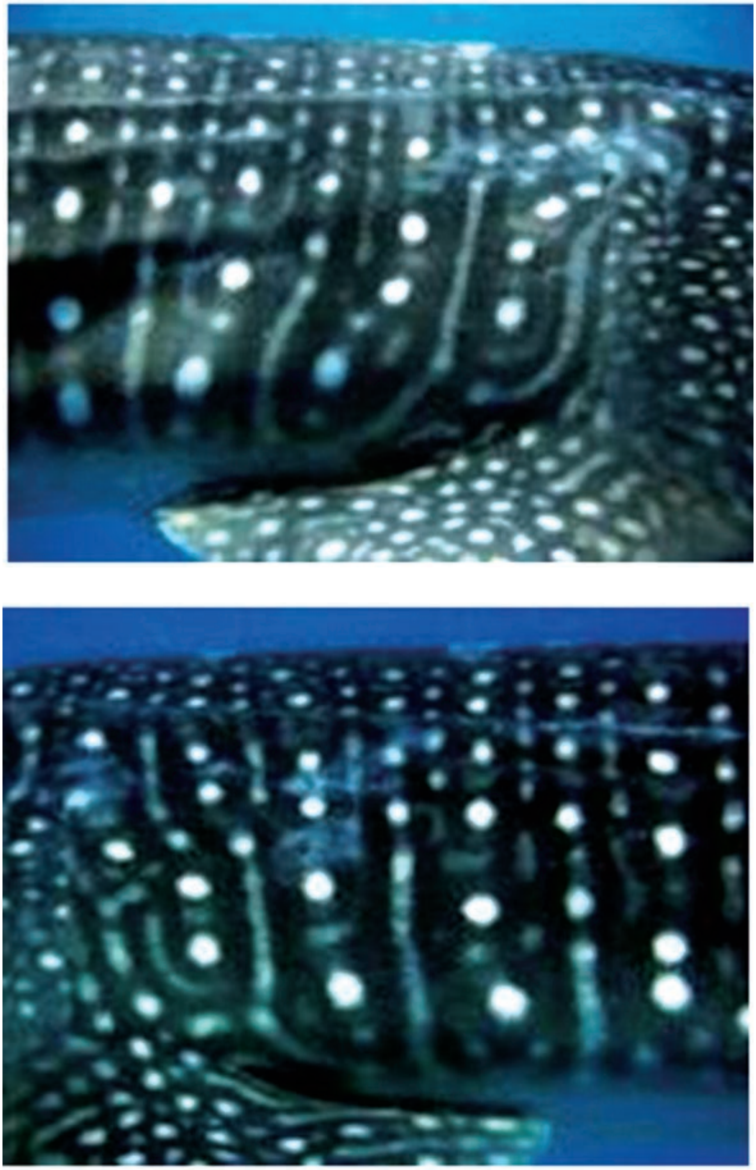


Fig. 159: Perfect angle for whale shark ID showing clear view of spot pattern

7.2. Marker tags

Conventional external tags are another way to mark Whale Sharks; the tags are applied externally. It follows that the tag is easily detectable and no special equipment is required for detection. The tags may carry an individual code, a batch code and/or visible instructions for reporting. Examples of these types of tags include ribbons, threads, wires, plates, disks, SSD, dangling tags and straps (McFarlane et al. 2009).

7.2.1. Tag Used

The stainless steel head dart (SSD tags) tags (Fig. 161) were used to mark the animals. Each SSC tag is labelled with the project name, specific number email id and contact number of the project leader to maximise the chances of reporting in cases of recapture.

7.2.2. Protocol

During rescue, the tags are deployed with the help of an applicator. The preferable area for inserting tags is the base of the dorsal fin. At an angle of 45 degrees, the tags are harpooned into the dorsal muscle where the tag will anchor itself without locking to any specific bony structure.

The upper denticles are slightly removed using a drill, which serves as an easy insertion point for the tag to move in with the help of an applicator. This reduces the chances of secondary injuries to the animal, as using a harpoon at the close end may cause injuries. This method also further helps to take samples for genetic studies.

7.2.3. Marker tags on the Whale Sharks of Gujarat coast

Four marker tags have been successfully deployed during rescue operations, and no recapture of these sharks has been reported to date.

Fig. 161: A standard SSD tag

Table 33. Details of deployed marker tags

S.No	Date	Place	Marker Tag Number	GPS location
1	14.12.2010	Sutrapada	001	N 20°46'377" E 70°29'637"
2	05.03.2011	Veraval	002	N 20°52'376" E 70°16'366"
3	09.03.2011	Sutrapada	003	N 20°47'592" E 70°21'528"
4	13.03.2011	Sutrapada	004	N 20°44'495" E 70°29'349"

A major hurdle in deploying the marker tags is the position of the sharks during the rescue, as marker tags are required to be inserted below the dorsal fin, and in many instances, the position of the sharks makes it unreachable.

7.3. Satellite tagging

Satellite tags across the world are used in various wildlife conservation organisations to track and study the movement of a targeted animal, thereby, helping them not only to understand the animal's migration pattern but also to conserve and secure the habitat the targeted animal uses. Similarly, to understand the migration pattern and also, if required, to extend the conservation activities for Whale Sharks, satellite tags were used in the project.

7.3.1. Tag used

Two fin mount SPOT 5 (Smart Position or Temperature Transmitting Tag) tags supplied by Wildlife Computers were used to monitor Whale Shark movement in the project. The transmitted signals data location was obtained through the ARGOS service provider, which is accurate up to ±350m. The tags can measure temperatures from -40°C to +60°C, with a resolution of approximately 0.2 °C. The temperature is reported in "time-at-temperature" histograms. Several battery configurations are available for the SPOT5 tag. For position-only deployments, a single "AA" battery is capable of providing approximately 70,000 transmissions; a single C-cell provides 180,000 transmissions. As a general rule, a budget of 250 transmissions per day is sufficient to provide daily location calculations via ARGOS. Therefore, a single AA cell provides locations for approximately 280 days; a single C-cell provides locations for 700 days, though the actual results depend on animal behaviour and other environmental temperatures (Fig. 162).

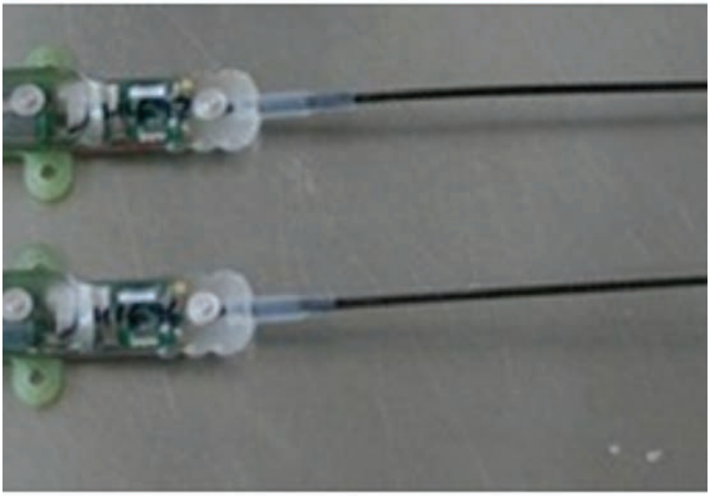


Fig 162: Fin mount SPOT tag

Additionally, the Government of Gujarat has supported in purchasing of 10 tow (SPOT 5) tags supplied by Wildlife Computers. The fin mount tags need to be bolted onto the dorsal fin, while the tow tags need to be speared onto the base of the dorsal fin (Fig. 163).

7.3.2. Tag configuration and testing

Each tag can be configured, using a computer system using SPOT5 host v5.50.2003 software. Transmission intervals and temperature ranges for up to 12 bins, as well as the number of hours over which the temperature histograms are collected (1 to 24), were set by using the SPOT5 Host v 5.50.2003 programme. Based on information available at www.satscape.co.uk satellite pass was predicted and tag transmission was tested. A WTI research team continuously practised on a dummy fin made of hard cardboard and fibre, before setting out for actual deployment.

7.3.3. First tag deployment in India

During a rescue call at Sutrapada on 13th March 2011, the first satellite tag was deployed on a rescued male Whale Shark (Fig. 164). WTI's research team and officials from the Gujarat Forest Department were involved in the tagging. On reaching the rescue spot, the health of the Whale Shark was assessed, after which the tag deployment was initiated.

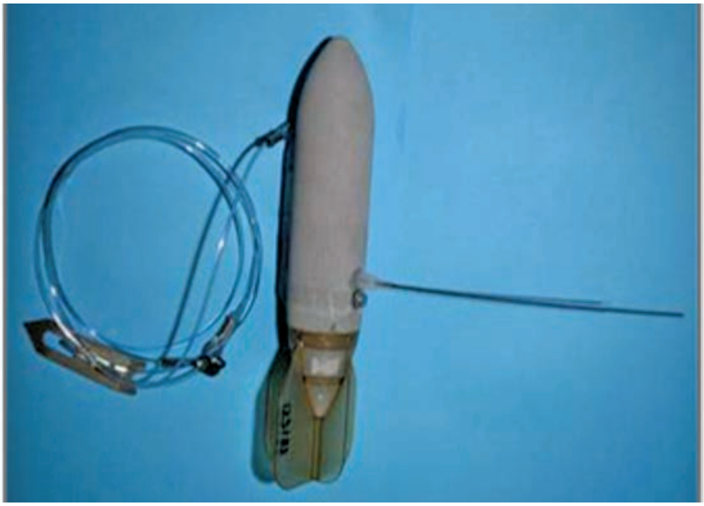


Fig. 163: Fin mount (Floating tethered) SPOT tag

Fig. 164: First satellite tagging of the Whale Shark in India

Prior discussions with fishermen and several international Whale Shark experts revealed that the tail portion is the most visible part of the body above the water when a Whale Shark surfaces.

Fig. 165: satellite-tagged whale shark's movement in Arabian sea

Fig. 166: Tagged WS with the migrating potential fishing zone (red dot- Whale Shark position / blue dot -potential fishing zone)

Fig. 167: Tagged Whale Shark with migrating potential fishing zone (red dot- Whale Shark position/blue dot -potential fishing zone)

7.3.4. Tag transmission

For the first two days, no transmission signal was received from the tag. On 15 March 2011, the first signal was received through the ARGOS satellite tag monitoring system. After the first transmission, regular transmissions were received every two or three days. The project received the tag's location data for 41 days after which the transmission stopped.

7.3.5. Tagged Whale Shark movement

After three days, the data revealed that the Whale Shark was located some 130 km away from the release location. Thereafter, the transmission signals received showed a gradual movement towards the waters of south Maharashtra, Mumbai and Gulf of Khambhat, followed by Diu. Later it was located 25 km away from the location where it was released. The Whale Shark moved back to the Gulf of Khambhat where it spent a longer time compared to the rest of the locations during the 41 days of observation (Fig. 165).

On several occasions, the Whale Shark was found close to PFZ (Potential Fishing Zones), a forecast done by INCOIS (Indian National Centre for Ocean Information Services) based on optimum temperature and chlorophyll–content sensed through satellite imagery (Fig. 166 and 167).

7.3.6. A second attempt at satellite tagging

In May 2013, a second attempt to satellite tag a rescued female Whale Shark (10 ft) was attempted. (Fig. 168) Due to high turbidity and unsuitable weather conditions, the procedure was cancelled and the Whale Shark was released.

Fig. 168: Attempt to tag the rescued whale shark

7.3.7. Second satellite tagging

On 27th December 2013, a recipient of a camera under the self-documentation scheme informed the local forest range officer that a Whale Shark was caught in his fishing net approximately 4.73 nautical miles from the Sutrapada coast. The forest department in turn, informed the WTI Whale Shark research camp at Sutrapada. The WTI Whale Shark rescue team immediately set off to the sea along with all required tagging instruments and reached the fishing vessel with the captured Whale Shark around 10.25 am. On reaching the rescue spot, the health of the Whale Shark was assessed, after which the tag deployment process was initiated (Fig. 169).

Fig. 169: Fishermen cutting their net to release the Whale Shark at Veraval

Fig. 170: WTI and Forest dept. tagging the whale shark before release

Fig. 171: Successful tagging of theWhale Shark

Fig. 172: The tagged Whale Shark is released back to the wild

Fig. 173: Second Whale Shark satellite tagged location

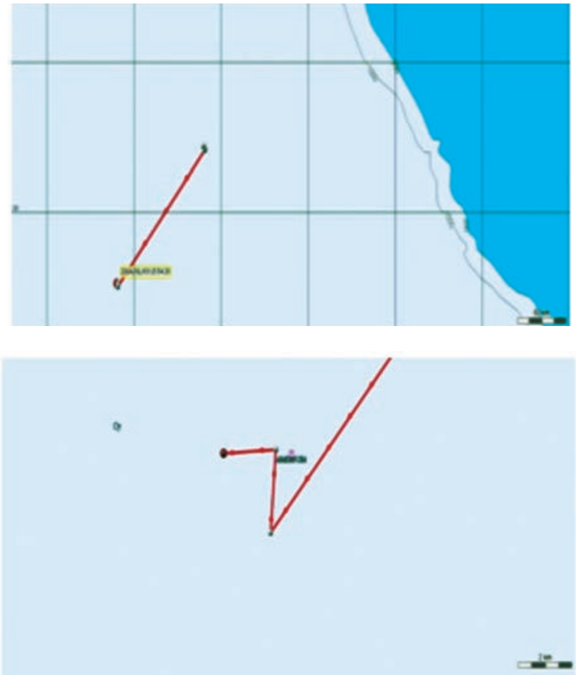


Fig. 174: Tagged Whale Shark movement between 28 December, 2013 to 7 January, 2014 – had travelled 287 NM from tagged location

After examining the condition of the Whale Shark the team deployed a SPOT Tag bearing the following details (Fig. 173).

- SPOT Tag Argos PTT number: 102680 or 0A7A298B
- Tagging Location: Latitude - 20°46'40.30"N Longitude - 70°32'13.50"E 7.3.8. Tag transmission from the second tag

On 1st January 2014, the first signal was received through the ARGOS satellite tag monitoring system. After the first set of transmissions were received for seven days, the transmission stopped (Fig. 174).

7.3.9. Tagged Whale Shark movement

The first signal was received on 28th December 2013 from the tagged whale shark, but the quality of the signals was poor and we were unable to plot the location. The second signal was received on 1st January 2014 from the tagged whale shark. The quality of the signal was good and the location was plotted. The Whale Shark had travelled around 208 nautical miles from the tagged location. The third signal was received on 3rd January 2014 from the tagged whale shark. The total distance the Whale Shark travelled from the tagged location was around 287 nautical miles.

Based on the transmission from the tag it was deduced that the tagged Whale Shark had gone into depths ranging from 24 - 3800 m during the seven days. It is believed that the satellite tag may have stopped signalling due to high pressure during a deep dive of the whale shark.

7.4. Discussion

The first successful satellite tagging of Whale Sharks in India has paved the way for understanding the tagging process and monitoring Whale Shark movement in Indian waters. Interesting movement patterns were shown by the tagged individuals, restricted to the west coast of India. One is that it moved closer to the shore, especially during its longer stay of 41 days in the Gulf of Khambhat. There is a need to understand the water conditions around the movement locations during particular periods.

To understand the sudden move southwards after the release and then the gradual migration back, along with some interesting movement towards PFZ and an increased amount of time spent in the Gulf of Khambhat, habitat-related studies are required in these areas. The failure of tag transmission after 41 days is another issue that needs to be studied as it could be because of the failure of the tag's wet and dry sensor, or some other technical reason. This may require some modification on the tag to avoid such short survival of the tag in future.

In the future actitivies of the project, eight satellite tags procured with support from the Gujarat Forest Department will be used to monitor Whale Shark movements along the Gujarat coast, of which two have been deployed already.

8. Genetic study of Whale Sharks in Gujarat

Quantification of inter-specific and intra-specific sequence variations within the mitochondrial (mtDNA) genome is a powerful tool for examining the population genetic structure, gene flow and migratory movements within and among different populations of fish and sharks (Heist *et al*. 1996; Rosel and Block,

1996; Haig, 1998). It is important to select a locus or loci with a relatively high mutation rate to detect sufficient polymorphism for population-level studies (Heist *et al*. 1996). Various studies have shown that the rate of mutation is greater in mtDNA than in coding regions of nuclear DNA (Heist *et al*. 1996; Parker *et al*. 1998). The mtDNA genome also includes a small non-coding region known as the control region or displacement loop (D-loop), which serves as the origin of replication for the mitochondrial genome, and is usually more variable than other coding genes (Parker *et al*. 1998; Avise, 1994). As maternal inheritance and in a haploid condition, mitochondrial genes have an effective size that is one-fourth that of nuclear genes, Nf = 1/4Ne (Randi, 2000), and therefore, mtDNA variability is sensitive to random drift in small populations and an ideal marker for assessing the genetic structure of recently-diverged or closely related populations or species (Avise, 1994; Randi, 2000).

Sequencing of the mitochondrial control region has been suggested as a useful tool to evaluate genetic structure in sharks (Heist *et al*. 1996; Keeney *et al*. 2003). Pardini *et al*. (2001) analysed the control region in white shark Carcharodon carcharias, which revealed significant differences between Australian/New Zealand and South African populations. Keeney *et al*. (2003) analysed the entire control region sequence of black tip shark *Carcharhinus limbatus* and detected significant partitioning of haplotypes between Gulf and Atlantic nurseries.

The use of microsatellites as a tool to understand the population genetics of a species has revolutionised the field of conservation biology. These repetitive sequences undergo mutations that add or subtract repeat units, and they are, therefore, highly polymorphic. They provide excellent resolution for assessing intra-specific genetic variability and differentiation. Here scientists employ microsatellite analysis to evaluate levels of genetic variability across a global panel of Whale Sharks, and to determine whether sharks from different regions comprise geographically restricted breeding populations. The first identification and analysis of Whale Shark microsatellites demonstrated moderate levels of genetic diversity within the species as a whole, but little evidence for population structure between different geographic regions (Schmidt *et al*. 2009).

8.1. Objective of the project

Whale Shark tissue biopsies were collected for DNA extraction, and then the DNA was analysed using mitochondrial and nuclear genetic markers. This component of the project was carried out in collaboration with the Central Marine Fisheries Research Institute, CMFRI, Cochin (Table 34).

8.2. Genetic sample collection

A small piece of tissue is scraped out using a sharp object. The Whale Shark tissue samples (Fig. 175) collected from rescued animals is preserved in alcohol and processed later in the lab using DMSO tissue buffer. The DNA is extracted and the extracted DNA is compared to the genomic sequences available in the genomic library of Whale Sharks. Tissue biopsies were collected from 12 Whale Sharks when the entangled animals were being freed from fishing nets.

Fig. 175: Whale Shark tissue sample in sterile vial for genetic analysis

Table 34. Details of Whale Shark tissue sample submitted for DNA analysis

Sl. No	Date	Whale Shark tissue sample		
		No. of Sample	Sex	Length (feet)
1	25.09.10	1	Female	15
2	20.10.10	1	Female	12.4
3	30.11.10	1	Male	23
4	13.12.10	1	Male	13
5	14.12.10	1	Female	28
6	13.01.11	1	Female	8
7	05.03.11	1	Female	19.6
8	09.03.11	1	Unidentified	20
9	13.03.11	1	Male	21.3
10	10.10.11	1	Male	20
11	13.01.12	1	Female	10
12	16.5.13	1	Female	20

DNA from five of these samples has so far been subjected to mitochondrial DNA sequence analysis, by amplifying a characteristic portion of the mitochondrial control region. So far five samples have been analysed and seven more samples are under process. Microsatellite analysis of all samples is planned for the future and will serve to extend the population genetic analysis initiated through control region sequencing.

8.3. Results and discussion

Tissue samples of Whale Sharks preserved in alcohol sent to CMFRI were used for analysis.

8.3.1. DNA extraction and PCR

DNA was extracted from the tissue preserved in ethanol using standard phenol/chloroform protocol followed by ethanol precipitation (Sambrook et al. 1989). PCR amplifications were carried out using the primers WSCR1F (5'-TTGGCTCCCAAAGCCAAGATTCTTC-3') and (5'GCATGTataATTTTGGTTACAA-3') WSCR1R following the instruction given by Dr. Jennifer V. Schmidt.

8.3.2. Cloning and Analysis

The amplified PCR products (~1400 bp) were purified and ligated into pJET 1.2/

blunt cloning vector, and cloned using CloneJETTM PCR Cloning Kit (Fermentas Life Sciences, EU) according to manufacturer's instruction.

Sequencing was performed using pJET 1.2 forward and pJET 1.2 reverse sequencing primers (vector primers) and the contigs were assembled using BioEdit sequence alignment editor version 7.0.5.2 (Hall, 1999).

BLAST analysis showed 98-100% identity with different haplotypes of Whale Shark mitochondrial DNA control region reported by Castro et al. (2007), The Whale Shark Rhincodon typus (Smith 1828).

Rty-2 (1397 bp) showed 100% similarity with haplotype 14 (Northwest Pacific) and haplotype 20 (western Indian) with a query coverage of 88%.

Rty-3 (1404 bp) showed 98-99% similarity with most of the haplotypes with a query coverage of 88% and showed 100% similarity with a few haplotypes (including Indian) with query coverage of 47—48% (Appendix 5 (II)).

Preliminary analysis of the five mitochondrial control region sequences has yielded interesting data, and contributed new haplotypes not yet found in Whale Sharks. The data support previous findings of high genetic diversity in Whale Shark populations. There are currently seven more samples available for analysis. To draw conclusions on population levels of Gujarat Whale Sharks, more genetic samples are required.

Table 35. Details of Whale Shark subjected to DNA analysis

Sl. No.	Sample ID	Date of collection	Sex	Sampling location	Other details
1	Rty-02	25/09/2010	F	Veraval (Adri)	--
2	Rty-03	20/10/2010	F	Veraval	Length 3.8 m

9. New records of neonatal (pup) Whale Sharks from the Gujarat coast

Globally, a number of areas are now known to have seasonal populations of Whale Sharks and most of the populations comprise sharks from 3 to 12 m in size. These include studies from the Sulu Sea, Asia (Eckert *et al.* 2002), Ningaloo in Western Australia (Taylor (1989), Taylor (1994), Meekan *et al.* (2006), South Africa (Beckley *et al.* (1997), Belize (Heyman *et al.* 2001), Sea of Cortez (Eckert and Stewart 2001), La Paz, Mexico (Clarke and Nelson 1997), the Gulf of Mexico (Hoffmayer *et al.* 2005; Hueter *et al.* 2005) and from the Indian Ocean (Anderson and Ahmed, (1993), Rowat, (1997), Pravin (2000), Hanfee (2001). While the number of occurrence records of Whale Sharks has increased there is, however, concern that these populations are decreasing in size as noted from areas with targeted fisheries (Pravin 2000; Hanfee 2001) and more recently from areas where there have never been targeted fisheries (Meekan *et al.* 2006; Bradshaw *et al.* 2007). Despite an increase in the known areas of occurrences, few records exist of neonatal Whale Sharks or juveniles less than 3 m in length. This is of particular concern in the development of national and regional conservation initiatives, as potential pupping and nursery areas may unknowingly be impacted by anthropogenic activities. The paucity of such information makes the reporting of any such sightings extremely valuable.

9.1. Discovery of neonatal Whale Sharks across the world

The first discovery of a live and almost fully developed embryonic Whale Shark was from an egg case trawled from a depth of 57 m in the Gulf of Mexico (Breuer 1954; Baughman 1955). This 35-cm total length (TL) embryo was found to have absorbed a large mass of yolk into the abdomen thought sufficient to support the young shark for some time (Reid 1957; Garrick 1964). Wolfson described a further seven juvenile Whale Shark specimens ranging in size from 55 to 93 cm TL (Wolfson 1983), all caught in pelagic purse seine fishery operations. Three were found in the Atlantic and four in the Pacific oceans where the sea bed ranges from 2600 m to 4750 m. Three of the specimens, ranging from 55 to 63 cm TL had a faint vitelline scar marking the attachment of the yolk sac that disappears within a few months of birth in other elasmobranchs (D'Aubrey 1964).

Wolfson also remarked that while her description of the seven juvenile sharks helped provide information on the size at birth, there were no records of sharks between 1 and 4 m TL (Wolfson 1983). The capture in 1995 of a gravid female shark off the coast of Taiwan (Joung et al. 1996) confirmed that the species is ovoviparous, retaining the lecithotrophic young within the uteri, allowing further development. Of the three size classes of prenatal sharks recorded, the largest (58 to 64 cm TL) was a free-swimming pup which was without a yolk sac but which did exhibit a vitelline scar; so the authors suggested that these prenates were ready to be birthed. There are a few other reports of very young Whale Sharks: one was a 61 cm TL specimen found alive in the stomach of a blue marlin, *Makaira mazara*, off Mauritius in 1993 (D. Goorah, personal communication and cited in Colman 1997). Two others were reported from the tropical Atlantic (Kukuyev 1995), one trawled from water deeper than 2000 m and the other in the stomach of a blue shark, *Prionace glauca*. Taylor 1994 reported from Ningaloo, Western Australia, a sighting of 14 young Whale Sharks.

In Bangladesh, the Marine Life Alliance, Comilla, was informed of the capture of an unusually small Whale Shark in March 2006. The specimen was seen at the local fish market at the town of Cox's Bazar, but by the time researchers arrived, the specimen had been sold. Interviews with the fishers revealed that the pup had been caught during a fishing expedition from 15–17 March 2006, in a set bag net 140 km offshore of the town of Cox's Bazar. The specimen was already dead when the net was recovered and was measured at 1.13 m TL. The area where the net was set was in shallow waters of 10 to 20 m depth but was close to the 30- m contour where the sea bed falls steeply to depths of over 100 m.

In the southwestern Indian Ocean, the Marine Conservation Society, Seychelles, has recorded three sightings of less-than3- m Whale Sharks off Seychelles. The first was c.a. 1.5 m in September 1998, off of N.E. Mahe (Rowat, 1998); a second pup of 1.8 m was recorded by aerial survey off S.W. Mahe in October 2005, the length being confirmed by reference to an object measured shortly afterwards; and the third sighting of a less-than-2-m pup was in May 2007, off of Isle Farquar (Henn, 2007).

Table 36. Historical record of Whale Shark pup or juvenile (< 3 m) and past sightings published across the globe

Location of Whale Shark sighting information	Total Length of the Embryo/ Pup/ Juvenile	Year of Sighting	Details of the information	Source of information
Gulf of Mexico	35 cm	Not Mentioned	Fully developed embryonic Whale Shark in landing center	Reid 1957; Garrick 1964
Atlantic and Pacific Ocean	55 to 93 cm	1983	Seven, juvenile Whale Shark caughtin pelagic purse seine fishery operations.	Wolfson 1983
Taiwan	58 to 64 cm	1995	First pregnant female whale shark, 10.6 m TL female caught in Taiwan carried 304 embryos in the uteri	Joung et al. 1996, Chang et al. 1997, Leu et al. 1997
Mauritius	61 cm	1993	Young Whale Shark found alive in the stomach of a blue marlin, Makaira mazara	Colman 1997

Ningaloo, Western Australia	1 m	1994	14 young Whale Sharks freely swimming along Ningaloo Sea	Taylor 1994
Balochistan, akistan	58.6 cm	2000	Fishermen observed the two Whale Shark pup in their gill net, the pup was preserved in formalin by the Fisheries Department, Omara	Rowat *et al.* 2008
North East Mahe, Seychelles	1.5 m	1998	Personal observation by Rowat	Rowat *et al.* 2008
South West Mahe, Seychelles	1.8 m	2005	Pupwas recorded by aerial survey off of S.W. Mahe, thelengthbeing confirmed by reference to an object measured shortly afterwards.	Rowat *et al.* 2008
North West Mahe, Seychelles	2.5 m	2006	Anecdotal record of a pup of c.a. 2.5 m was reported from a diving trip off of N.W. Mahe.	Rowat *et al.* 2008
Isle Farquar, Seychelles	< 2 m	2007	Personal observation by Henn (one of the author)	Rowat *et al.* 2008
Comilla, Bangladesh	1.13 m	2006	Whale Shark pup had been seen at the local fish market at the town of Cox's Bazar but by the time researchers arrived, the specimen had been sold. Interviews with the fishers revealed that this pup had been caught in a set bag-net 140 km offshore of the town of Cox's Bazar.	Rowat *et al.* 2008
Donsol, Philippines	46 cm	2009	Smallest Whale Shark ever recorded had been caught on in nearby San Antonio, a barangay of Pilar town, adjacent to Donsol. WWF - Philippines researcher rushed and rescued the pup.	Aca and Schmidt 2011

9.2. Discovery of neonate Whale Sharks across the Indian coast, Arabian Sea and Bay of Bengal

As noted above, of live-born Whale Sharks, only nine post-natal and no neonatal sharks have been reported previously. The large number of adult Whale Shark aggregations known from the Indian Ocean (Taylor (1989), Anderson and Ahmed (1993), Taylor (1994), Beckley *et al.* (1997), Hanfee (1997) Rowat (1997), Pravin (2000), Meekan *et al.* (2006) would suggest that there should be a population of neonatal sharks somewhere in this region.

Both India and Bangladesh indicated that January to March were peak months of Whale Shark occurrence (Rowat 2007). The Indian Whale Shark fishery, which closed in 2001, had been particularly active from March to May off the northwest coast of Gujarat (Pravin 2000; Hanfee 2001), confirming the presence of high numbers of Whale Sharks throughout the northern Indian Ocean during this season. A search of public reports revealed that a pup had been caught in India off of the southwest coast of Vizhinjam, Kerala (MFIS, CMFRI 2002). The 95-cm-pup was caught in a net in December 2002 and given to the Central Marine Fisheries Research Institute (CMFRI) at Thiruvananthapuram, where it survived in their aquarium for only a day. In 1998, 16 juveniles of about 1 m were reported to be swimming with an adult Whale Shark of 5.5 m off Vizhinjam, India (Krishna- Pillai, 1998). The smallest recorded Whale Shark previously recorded in India has been a 3.15-m specimen caught off the southeast coast of Mandapam (Nammalvar 1986 cited in Pravin 2000).

Table 37. Historical records of Whale Shark pup or juvenile (< 3 m) and past sightings published in the Arabian Sea and Bay of Bengal off the Indian coast

Location of Whale Shark sighting informationn (India)	Total length of embryo/ pup/ juvenile	Year of sighting	Details of the information	Source of information
West Coast (Arabian Sea)				
Kaup, Karnataka	2.5 m	1981	Juvenile Whale Shark observed in landing center	Pai et al. 1983
Vizhinjam, Kerala	1 m	1996	16 juveniles of about 1 m were reported to be swimming with a Whale Shark of 5.5 m off Vizhinjam	Krishna-Pillai 1998

Calicut, Kerala	94 cm	2001	Fishermen reported a young Whale Shark with yolk sac found swimming away 5 km from the Calicut shores.	Manoj Kumar 2003
Thiruv-ananth-apuram, Kerala	95 cm	2002	Pup Whale Shark was caught in a net and given to the Central Marine Fisheries Research Institute (CMFRI) at Thiruvananthapuram, where it survived in their aquarium for only a day.	Rowat *et al.* 2008
Vizhinjam, Kerala	97.5 cm	2002	Juvenile Whale Shark was alive and kept in an aquarium at CMFRI in Vizhinjam for 13 h after being landed at Vizhinjam landing site.	Gopakumar *et al.* 2003
Kochi, Kerala	115 cm	2008	Small juvenile Whale Sharks observed during landing sites surveys	Akhilesh *et al.* 2012

9.3. Whale Shark pup recorded along the Gujarat coast

In March 2013, the WTI research team received the first cogent evidence of Whale Shark pups being found along the Gujarat coast. A young pup was caught in the net of a local fisherman – Mohan Beem Solanki – in Sutrapada. Following the years-long tradition of the fishing community of Gujarat, through the internationally acclaimed Whale Shark campaign, Solanki set the Whale Shark free. When he reported the incident to us, Solanki was unaware of the flutter created by this serendipitous discovery (Fig. 176). He had unveiled a treasure trove, and the fishing community held the key.

Even as our research led by a sociologist went about asking the fishing communities whether they had seen or – hopefully – photographed a Whale Shark pup with the cameras provided to them to facilitate self-documentation during rescues, the fishermen themselves started approaching WTI with information on the pup. Within a month, WTI had reports of four pups spotted off Gujarat coastline (Table 38).

These are significant findings for the project. All caught pups seemed to be between 1 and 3 months old – the size of an arm – indicating that the fish may be breeding, and definitely pupping off the Gujarat coast.

Fig. 176. Whale Shark pup recorded at the Saurashtra coast of Gujarat in the year 2013

Neonatal Whale Sharks are thought to have limited swimming abilities compared to juveniles and adults (Martin 2007). Neonatal Whale Sharks have an elongated body with a strongly heterocercal caudal fin (Garrick 1964; Wolfson 1983; Kukuyev 1995), very similar to neonatal tiger sharks, Galeocerdo cuvier, which have an inefficient anguilliform swimming stroke (Branstetter et al. 1987). The new records of pups in the Saurashtra Coast, Gujarat, indicate that the region is not just a Whale Shark aggregating site, but also an important pupping ground.

Identification and recording of Whale Shark pups may well be the key to the conservation of this species on a regional and global scale (Rowat, 2007). Encouraged by the important findings, the project has launched a reply-paid postcard questionnaire survey along the entire west coast of India, in which the photograph of a Whale Shark pup on the postcard is retained by the fishermen, and information about when and/or where the informer has seen one is printed on the reply-paid card. In this way, the project hopes to collect further information on Whale Shark pupping locations along India's west coast.

Table 38. Whale Shark pup and juvenile reported during the project

Location of Whale Shark sighting informationn (India)	Total length of embryo/ pup/ juvenile	Year of sighting	Details of the information	Source of information
Sutrapada, Gujarat	< 60 cm	2013	A young pup was caught in the gill net of a local fisherman in Sutrapada. The Pup caught and released immediately into the sea. (Fig. 1a, 1b)	Fisher folk
Sutrapada, Gujarat	< 60 cm	2013	A young pup was caught in the nylon gill net of a local fisherman in Sutrapada. The Pup caught and released immediately into the sea. (Fig. 2a to 2d)	Fisher folk
Sutrapada, Gujarat	< 60 cm	2013	A young pup was shored in the Sutrapada beach. The local fishermen taken picture of the pup and buried near the beach. (Fig. 3a, 3b)	Fisher folk
Sutrapada, Gujarat	< 100 cm	2013	Fishermen reported a young Whale Shark found swimming away 20 km from the Sutrapada beach.	Fisher folk

10. Education, Awareness, Communication and Outreach

Although the project focused on Whale Shark science since 2008, the awareness campaign continued on a smaller scale throughout the duration of the project. A 'Whale Shark Day', continues to be celebrated with great enthusiasm by the fishing community, school children and authorities from the Forest Department, Coast Guard, Navy etc every year. During the project period, eight cities (Porbandar, Diu, Dwarka, Okha, Ahmedabad, Veraval, Dwarka and Mangrol) adopted the Whale Shark as their mascot. (Dwarka adopted it twice).

Other than that, awareness activities were held occasionally among the local communities and educational institutions such as schools and colleges.

Awareness activities were also held to appraise fishermen about the things they should do to reduce the stress on Whale Sharks during rescues, as part of promoting the self-documentation scheme.

Whale sharks often stay near the surface to feed on plankton and small fish concentrated in sunlit waters

10.1 The campaign to save Vhali, the whale shark in Gujarat (2002-2008)

The success of any campaign lies in the effectiveness of its message. In this case, targeting diametrically opposite sections of society—the fishing community along the coastal areas of Gujarat and citizens in urban inland areas warranted the usage of a combination of varied media to carry the message. The message itself was multi-pronged; aimed at generating pride among the inland urban centres, and building awareness on the protected status of the shark and ban on hunting among coastal fishing communities.

Fig. 177: Shri Morari Bapu launching the campaign posters with the state Addl. PCCF & CWW Pradeep Khanna (extreme right), WTI Trustee Sujit Gupta (extreme left) and WTI Director Aniruddha Mookerjee

Since the campaign was restricted to the state of Gujarat, a campaign message advocated by a charismatic leader of Gujarat was perceived to be most effective campaign tool. The campaign was formally launched on 20 January 2004 in Ahmedabad, with Shri Morari Bapu stepping forward as the ambassador of the cause. His involvement was historic, marking the first time a religious leader, two major corporate houses, the Wildlife Trust of India (WTI), the International Fund for Animal Welfare (IFAW), and the Gujarat Forest Department joined hands to spearhead the conservation of a little-known fish. At the launch, Morari Bapu described the whale shark as “a marvel of nature and a gift of God” that should be the pride of Gujarat. The Chief Wildlife Warden of the state, Pradeep

Khanna, formally endorsed his ambassadorship, observing that India's cultural and religious values already uphold the sanctity of life, and that embedding conservation within these traditions would create far more lasting protection than enforcement alone. Bapu reinforced this connection by likening the whale shark to a daughter returning home to give birth, urging the people of Gujarat to honor and protect her rather than kill her. This imagery, rooted in the cultural ethos of Atithi Devo Bhavah (the guest is god) and Ahimsa Paramo Dharma (non-violence is the ultimate duty), became the emotional foundation of the campaign.

To bring this message closer to the grassroots, the campaign turned to creative mediums. School-level painting competitions were organized to introduce children to the species and its plight. A specially scripted street play in Gujarati, built around Morari Bapu's metaphor of the whale shark as a daughter named *Vhali* (meaning "beloved one"), carried the story to fishing communities. In the play, a fisherman's greed to hunt whale sharks for easy money endangers his own daughter, until the truth about the species' protected status is revealed, and the daughter extracts a vow that her father will never kill the whale shark again. Launched on International Theatre Day, 27 March 2004, at Mithapur, the play toured 12 coastal towns including Veraval, Beyt Dwarka, Somnath, and Okha, reaching large crowds of fishermen and their families. The Coast Guard and Forest Department extended support, with even a special performance requested inside Gir Lion Sanctuary—linking Gujarat's two symbols of wildlife pride

Fig. 178: Collaterals used for the whale shark awareness **campaign**

As the play toured, campaigners realized the need to give people a tangible sense of the whale shark's enormous size and magnificence. This led to the creation of a 40-foot-long inflatable replica, fabricated in Hyderabad using photographs, prototypes, and detailed drawings. When unveiled at Mithapur, the inflatable drew large crowds, sparking curiosity and awe. People were stunned to learn that such a fish could grow even larger than 40 feet. Combined with the street play, the inflatable model proved to be a powerful tool, visually anchoring the campaign's message. Over time, the inflatable itself was christened *Vhali*, shifting local terminology away from the earlier term "barrel," which was associated with hunting practices, and instead cultivating affection and endearment for the species.

Fig. 179: Street play for raising awareness among fishing community

Fig. 180: Creating community connect through whale shark inflatable at the beach in Gujarat

The coastal community at Rupen gather to see the whale shark inflatable model

The campaign quickly gathered momentum. On 23 May 2004, the city of Porbandar became the first to adopt the whale shark as its official mascot. At a colourful public event, the inflatable *Vhali* was paraded on a camel-drawn cart alongside banjara dancers, schoolchildren waving flags, and community leaders showering petals to welcome the whale shark as an honoured guest. Thousands joined hands in taking a pledge to protect the species. Soon after, other towns followed—Diu formally adopted the whale shark on 22 September 2004, with 1,000 schoolchildren pledging their commitment, and Dwarka and Okha did the same on 21 October 2004 in the presence of Morari Bapu and a crowd of 2,500. The momentum spread inland when Ahmedabad, a landlocked city, also adopted the whale shark as its mascot in March 2005.

Fig. 181: The mayor of Porbandar adopts the whale shark as the city mascot at the public event on 23rd May 2004. Also present are the Collector of Porbandar, PCCF, DG Coast Guard and leaders of the fishing community and boatmen's union

The inflatable *Vhali* also featured prominently in larger state-level events. It was displayed at the Vibrant Gujarat Navratri Festival in Ahmedabad in October 2004, an event inaugurated by President Dr. APJ Abdul Kalam and attended by key political leaders, including Chief Minister Narendra Modi and L.K. Advani. Over the next two years, the whale shark remained a centerpiece at the eco-tourism pavilion of Vibrant Gujarat, attracting hundreds of thousands of visitors, and solidifying the campaign's visibility with policymakers and the public alike.

Fig. 182: The adoption certificate: Porbadar, Diu, Dwarka, Okha, Ahemdabad and Veraval-Patan adopted the whale shark as the city mascot

While the street play, *Vhali* melas in schools and the inflatable made its rounds along coastal Gujarat, there was a need to sensitize the citizens inland as well as to solicit the participation of policy makers at the state level. It was time for *Vhali* to move inland, especially to the place that was included in the first dipstick survey on attitudes and awareness levels, Ahmedabad, the former capital of the state of Gujarat.

Fig. 183: The whale shark inflatable was showcased for nine days at Vibrant Gujarat, the festival of Navratri at the University grounds in Ahmedabad in October 2004. The nine-day event with a focus on eco-tourism.

The whale shark inflatable model on display at the Vibrant Gujarat pavilion for nine day was inaugurated on the evening of the 14th by the President, Dr APJ Abdul Kalam. Political leaders, ministers, MoEF officials and forest department officials visited the exhibition and were fascinated by the sheer size of the inflatable model. This event was an excellent opportunity to introduce the campaign inland, all earlier exposures having been in coastal towns and cities. The Chief Minister of Gujarat, Narendra Modi was personally briefed about the campaign. The leader of the ruling party in the state of Gujarat, L K Advani also showed interest in the model and was briefed on the campaign. This was the first exposure of the whale shark campaign to political leaders at the State and National level.

The following year, *Vhali* the whale shark stood proudly at the entrance to the eco-tourism pavilion at Vibrant Gujarat. Wildlife Trust of India (WTI) had participated in the celebrations welcoming the efforts of the state government to remodel the state into a favorite eco-tourism destination of the country. WTI's campaign to save the Whale Shark, Pride of Gujarat, which was extensively carried out in the coastal areas for protection of this species found prominence in the discussions on eco- tourism and the pavilions that drew crowds out of curiosity. As part of the vibrant Gujarat celebrations, a seminar on adventure and eco-tourism potential in the state was organized on 7th October 2005 at the town hall in Gandhinagar. It was attended by various officials from the Gujarat Forest Department, Tourism Department, member secretaries, Director General, Gujarat Sports Authority, and Director GEER Foundation. Dr M K Ranjitsinh, Chairman of Wildlife Trust of India was the Chairperson in the meeting. In 2006, the whale shark took centre stage again at the eco-tourism theme pavilion at the Vibrant Gujarat event for nine days.

By December 2004, the campaign had also expanded into rural Gujarat through events like Samvaad, organized by the Centre for Environmental Education near

Fig. 184: The Chief Minister of Gujarat, Narendra Modi at the Vibrant Gujarat pavilion evinces interest in the whale shark campaign

Gandhinagar, where representatives from 271 villages engaged with the inflatable whale shark and its message. Soon, the concept of "*Vhali* goes to school" was born, taking the inflatable to primary and secondary schools across Gujarat. From exhibitions in Ahmedabad to rain-soaked journeys through Anand district in 2005, the campaign reached more than 15,000 schoolchildren directly, inspiring curiosity, questions, and a sense of responsibility. Activities like painting competitions, quizzes, and interactive games kept the engagement lively and memorable. These efforts began to pay off in tangible ways.

Campaign results start rolling in:

Vhali, The Pride of Gujarat

The campaign to save the whale shark was a two-pronged affair, conducted along the coast, where whale shark fisheries existed and the mainland, where the

Fig. 185: The banjara dancers setting the rhythm at Porbandar

general populace was targeted. The approach used in campaigning amongst the coastal communities was though a street play in the local language that effectively communicated the protected status of the fish and repercussions of hunting it. The storyline of the street play touched a common chord among the audience which related instantly to the arrival of the whale shark as the homecoming of a daughter.

The support and physical presence of the revered spiritual leader, Morari Bapu proved to be most effective in catalyzing media hits and in bringing the stakeholders; community, state government officials and enforcement agencies under a common umbrella, all working towards the cause of saving the whale shark

The campaign approach inland was one of providing information to the general public with the aim of building pride in the existence of the world's biggest fish off the shores of the state. The campaign methodology was devised so as to extract the maximum involvement of all the stake holders at the local level. Above all, the support and physical presence of the revered spiritual leader, Morari Bapu proved to be most effective in catalyzing media hits and in bringing the stakeholders; community, state government officials and enforcement agencies under a common umbrella, all working towards the cause of saving the whale shark.

The series of street plays and adoptions of the whale shark as mascots at public events were documented on film. Some underwater footage shots of the whale shark was sourced from Suzy Quasnichka, a researcher on whale sharks. This was compiled into a short documentary titled The Homecoming with an originally composed theme song on the whale shark and this was also effectively used as a campaign tool in the latter part of the campaign. The film, later dubbed in Gujarati served to be a cost-effective campaign tool as it was eagerly taken up by local cable operators to telecast to masses in the targeted coastal towns and villages.

Vhali comes home

In three years of conducting the campaign, *Vhali* the whale shark was recognized as a city mascot by six heads of municipalities. The first recognition happened in Porbandar on 23rd May 2004, when the head of the Porbandar Nagarplaika adopted the whale shark as the city mascot and joined a public pledge to protect it. Following this, Diu (22 September, 2004), Dwarka (21 October 2004), Okha(21 October 2004), and Ahmedabad (12 March, 2005) also adopted *Vhali* as their mascot. Finally, Veraval, once the hub of whale shark fisheries adopted the whale shark as its mascot on 19th February, 2007.

Ahmedabad was the first land-locked city to have recognized this marine species. The event in Ahmedabad was marked by the city Mayor, Mrs. Aneesa Begum Mirza who declared the whale shark as a city mascot in the presence of dignitaries, such as DIG Rajshekhar, Commander Coast Guard of the Gujarat Area, Mr. M L Sharma, the Principal Chief Conservator of Forests, Mr. Thomas Matthew, the

Chairman of WTI, Mr. Sujit Gupta, the Vice-Chairman of WTI and Mr. Vivek Menon, the Executive Director. Among the distinguished guests present at this event were the Chief Wildlife Warden Mr. Pradeep Khanna and Mr. C L Pandey Director of GEER Foundation.

The public pledge to protect the whale shark was led by DIG Rajshekhar, who had traveled all the way from Porbandar to support the campaign while a special postal cover on the whale shark was released by the PCCF. Senior personnel from the Dept. of Posts and Telegraphs manned the philatelic counter to distribute the special cover.

A video recording of a message from Morari Bapu was aired, following which a short documentary film on the campaign was launched by Mr. Vivek Talwar of Tata Chemicals Ltd.

The First Release and then some

Within nine months of formally launching the campaign to save the whale shark, heartening news came in about fishermen turning protectors at the cost of cutting their fishing nets. A 40 ft whale shark was found entangled in the fishing nets of a trawler off the coast of Dwarka on the morning of 30th of September, 2004. The news came in a day later that the captain of the boat had ordered his crew to cut the nets to release the fish. This was the first incident that proved the reach of the campaign because the trawler owner had seen the life-sized inflatable model and the street play when he was ashore and was thus aware of the protected status of the fish. The captain and his crew together with the boat owners were honored with certificates of appreciation given out by Morari Bapu, in Dwarka on the 21st October before a 2500-strong crowd that was present at a public ceremony where the towns of Dwarka and Okha adopted the whale shark as the city mascot.

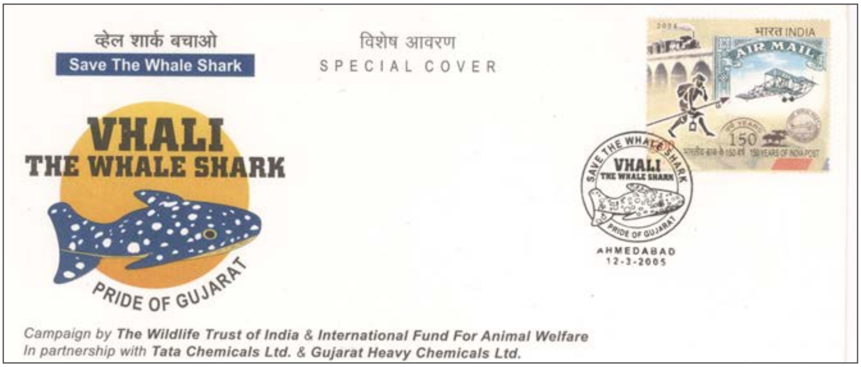


Fig. 186: The release of a special postal cover on the Whale Shark

In the years that followed, more releases were reported and as awareness among the fishing community grew, a few of the releases were even documented on film. Recognizing this sacrifice, the Gujarat government introduced a compensation scheme in December 2006. Fishermen who cut their nets to free a whale shark could claim ₹ 25,000 and receive a certificate of appreciation. The scheme not only

Fig. 187: Shri Morari Bapu and the Coast Guard honouring Kamlesh Chamadia, whose crew released the first whale shark by cutting their nets

reduced financial hesitation but also encouraged voluntary rescues, ensuring that protecting the whale shark was not seen as a burden but as an honorable act. This marked a turning point, transforming former hunters into active conservation allies.

Meanwhile, the campaign gained national and international recognition. It was showcased at the Whale Shark Conservation Conference in Perth in 2005, where it was praised as a model for using traditional values in conservation. That same year, Tata Chemicals Ltd received the prestigious Green Governance Award from Prime Minister Dr. Manmohan Singh for their role in the campaign. The campaign also continued to be a highlight at Gujarat Day rallies, Diu Liberation Day celebrations, and other cultural gatherings, drawing thousands into whale shark-themed events that blended conservation with community pride.

By 2007, Veraval—once the hub of whale shark slaughter—adopted *Vhali* as its mascot, a symbolic victory for the campaign. Awareness surveys confirmed the shift: knowledge of the whale shark's legal protection rose steadily, and its

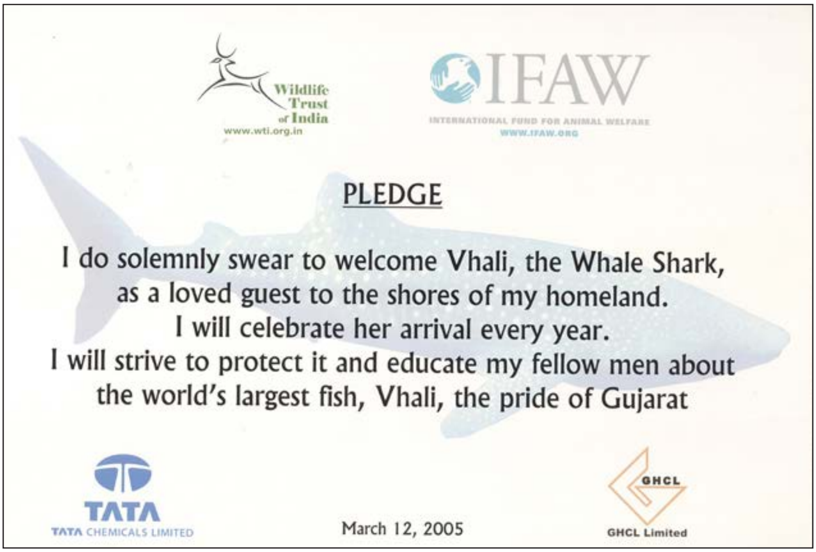
Fig. 188: Prasad Menon, Managing Director of Tata Chemicals Ltd receiving the Green Governance award for the whale shark campaign from the Prime Minister Dr Manmohan Singh

identity transformed from "barrel" the hunted to *Vhali* the beloved. Through a combination of cultural symbolism, corporate support, grassroots outreach, and government policy, the campaign had successfully turned the tide. What began as an awareness effort evolved into a true Pride Campaign, making the whale shark a living emblem of Gujarat's heritage and conservation values.

Veraval commemorates Vhali

Five thousand people comprising members of the fishing community of kharvas, school children, representatives of NGOs and government officials thronged to pledge protection to the whale shark at Veraval on 17th February 2007. The kharvas constitute the largest fishing community in Gujarat - spread across all major coastal towns and ports. At this event organized by the Gujarat Forest Department where Morari Bapu was the guest of honor, Kiranben Bhimjiani, the President of Veraval Nagarpalika (Local administration) adopted the whale shark as the mascot of Veraval. Two forest guards, two fishermen and three school children were honoured for their contribution for conservation of the whale

The compensation scheme was very well received by the fishermen and they supported the campaign with renewed enthusiasm, as demonstrated by the incident on 28 February 2007, when 40 nets had to be cut to release a trapped whale shark



shark. Besides the Kharva community, Principal Secretary of MoEF, P. N. Roy Chaudhary, CCF and Chief Wildlife Warden, Pradeep Khanna, Dr. M. K. Ranjitsinh, Chairman of WTI, and politicians took part in the event.

The State Forest Minister, Mangubhai Patel announced the "Kartak Amas" (the new moon day of the first month in the Hindu calendar) as the official date for the Whale Shark Day, to be celebrated every year in Gujarat.

Two days after the Veraval event, yet another whale shark was freed from fishing nets 50 nautical miles off Sutrapada, 20 km south of Veraval in a joint operation that lasted three hours. Sixteen fishing nets had to be cut in the process but this time the compensation scheme for fishermen was in place.

Despite their large size, whale sharks are solitary animals, rarely forming groups. I am also sharing the CRS credits and highlighted copy of where the edits are required.

10.2. Whale Shark Day and Whale Shark Mela

Although 30 August is celebrated as World Whale Shark Day, in Gujarat taking the Hindu calendar into consideration and conducting the Whale Shark day in multiple coastal towns and cities different dates have been used as 'Local Whale Shark Day. On February 17, 2007, the state forest minister declared the 'Whale Shark Day', for Gujarat designating Kartik Amas as the annual date. This marked a significant milestone in the campaign, making Whale Sharks the first animal in India with a day designated in its honour.

During this period, five Whale Shark Days and Melas were coordinated by the project in Porbandar, Dwarka, Mangrol, Sutrapada and Veraval.

Thousands of stakeholders including fishermen, school and college students, and government authorities participated in the events. The events saw talks and speeches by experts as well as street plays on the plight of the fish. Fun activities were also organised for the children and other stakeholders (Fig. 189, 190, 191 and 192).

10.2.1. Whale Shark Day – Porbandar, November 27, 2008

The event took place at the Chowpatti cricket ground in Porbandar. In addition

Fig. 189: Students create a Whale Shark at the sand art competition, Sutrapada, 2011

to the local stakeholders, the event saw the participation of international marine experts (Scientific Advisory Council members) and a filming crew from Australia.

'Whale Shark Day 2008 or '*Vhali* Utsav' began with a colourful procession, in support of '*Vhali*'- the dear one, as the fish is locally known. Led by the campaign's flagship life-size inflatable Whale Shark mounted on a camel cart, about 1000 students dressed in symbolic Whale Shark coloured T-shirts, and holding Whale Shark campaign flags, rallied across Porbandar from Kirti Nagar to Chowpatti cricket ground. At the venue, whale shark-coloured balloons brightened up the celebrations in honour of the species. Talks and street plays ensued.

10.2.2. Whale Shark Day – Dwarka, November 27, 2009

The event was held at the Sunset Point ground for the celebration. The event was chaired by Hon'ble Minister of State for Environment and Forests, Shri Kiritsinh Rana. Indian and international marine experts, government officials and conservationists participated in the event, along with hundreds of school students.

The celebrations began with a colourful rally by school children donning the campaign T-shirts and sun visors, waving Whale Shark flags, and chanting slogans for Whale Sharks. The rally was led by the inflatable Whale Shark and included talks and street plays centered around the world's largest fish.

Fig. 190: School children involved in kite flying in the Whale Shark Mela, Sutrapada, 2011

Fig. 191: Members of the Forest Department, Navy, TCL, WTI and the fishing community took part in the rally

Fig. 192: Children of the fishing community at the Mela

Fig. 193: Students from Choksey College and Fisheries College, along with some volunteers from private banks collaborated on a street play depicting the stress faced by Whale Sharks under current rescue practices.

Fig. 194: Students performing their first show at Sutrapada, which was lauded by all. Support from the Forest Department and the fishing community helped start this drive. Cameras were also distributed for self-documentation purposes.

Fig. 195: Street play at Jaleshwar, near Veraval

Fig. 196: Awareness campaign in coastal villages for awareness

10.2.3. Whale Shark Day – Mangrol, January 25 2011

Following multiple delays due to unavoidable circumstances, Whale Shark Day 2010 was organised on January 25, 2011, in Mangrol. The event marked the town adopting the fish as its mascot, making Mangrol the seventh in the state to do so.

The celebrations were kicked off with a rally by hundreds of children, following the 40-foot-long Whale Shark inflatable from Parmeshwar Vidyalaya to the event venue at the Town Jetty, Mangrol. The event was chaired by SK Chaturvedi, Chief Conservator of Forests and was attended by the local member of the legislative assembly (MLA) Rajgi Bhai Jatwa along with representatives from WTI and TCL.

10.2.4. Whale Shark Day and Mela – Sutrapada, November 25, 2011

With a number of distinguished guests, including the local MLA of Mangrol, Bhagwanbhai Kargatia; Rajsinh, MLA Somnath; Govindbhai Parmar, ex MLA of Mangrol; Jethabhai Fulbaria, sarpanch, Sutrapada bunder, and TCL Deputy General Manager Paresh Tank; the Whale Shark Day was organized at the Navdurga temple grounds. Over 250 school children from Vivekanand Vinay Mandir and Manas Vidyalaya took part in the event.

Several fun games based on the Whale Shark theme, such as snakes and ladders, and jigsaw puzzles, were organised for the children. A signature campaign in which the children drew the outline of their hand and left a message on the screen was also organised.

A short ceremony was organised by the forest department where its officials, local NGOs, and other groups shared their views on Whale Shark conservation. It was followed by a play by girls from the Navodaya school.

Fishermen who rescued Whale Sharks were given appreciation certificates and cheques for their participation in Whale Shark conservation, and monetary relief for their net loss.

10.2.5. Whale Shark Day and Mela – Veraval, December 17, 2012

The Veraval Forest Department organised Whale Shark Day celebrations at Chokshi College on December 17, 2012. The event saw participation from local schools and colleges, NGOs and volunteers. The Whale Shark film was screened during the session and a street play based on the self-documentation scheme was performed by volunteers.

10.2.6. Whale Shark Day and Mela – Dwarka, March 6-7, 2013

On March 6, 2013, the annual Whale Shark mela kicked off in Dwarka, with a cycle rally. Over 30 cyclists from the Rupen fishing community, Tata Chemicals Limited (TCL), Gujarat Forest Department, the Navy, college volunteers, and WTI started from the ISKCON gate. The rally went around the town through the main markets as well as residential areas, crossing the Dwarka temple, and moving 4-5 km to reach the cricket ground, where a cricket tournament was held.

The cricket tournament had six teams participating – two from the fishing community, and one each from TCL, the forest department, the Navy and Saradapith College. A fishing community team won the tournament, and the team from the Navy was the runner-up.

Day 2 of the mela saw various activities involving local school children including kite-flying, rangoli, tug-of-war, etc. Interaction with the children indicated a good awareness of the fish and its status.

10.3. Self-documentation scheme campaign

To reduce the stress on the Whale Shark during rescues, the project suggested and ensured changes in the rescue protocol. This mandated self-documentation by the fishermen to reduce the time taken for rescues. A rapid action project was implemented to provide water-proof cameras to over 1000 fishermen to facilitate the implementation of the updated protocol (Fig. 197).

The project carried out awareness campaigns to spread information on the new development, as well as to make the local fishermen aware of the self-documentation scheme and methodology. Numerous meetings and awareness activities were held with the communities on the issue.

The project deployed local volunteers (college students as well as corporate workers) to spread the word. A street play was devised along with the volunteers for the fishing communities, along with talks (Fig. 193, 194, 195 and 196).

Trainings were also held for the local fishermen on the use of the cameras. These focused on making the fishermen aware of the use of the camera, and the kind of photographs needed to claim a refund for their nets damaged during Whale Shark rescues. A training of trainers was organised in the various fishing villages, with around 15 fishermen participating in each to become ambassadors for the new scheme.

A series of interactive sessions with various schools, colleges and fishermen societies were conducted during the project period in Jaleshwar. In these sessions, the target audience was introduced to the importance of Whale Sharks and their conservation, using powerpoint presentations and active discussions. The school and college students were also urged to be volunteers in the Whale Shark conservation project, which led to their active participation during Whale Shark campaigns, with a few helping with Whale Shark science.

Fig. 197: Reusable waterproof film camera

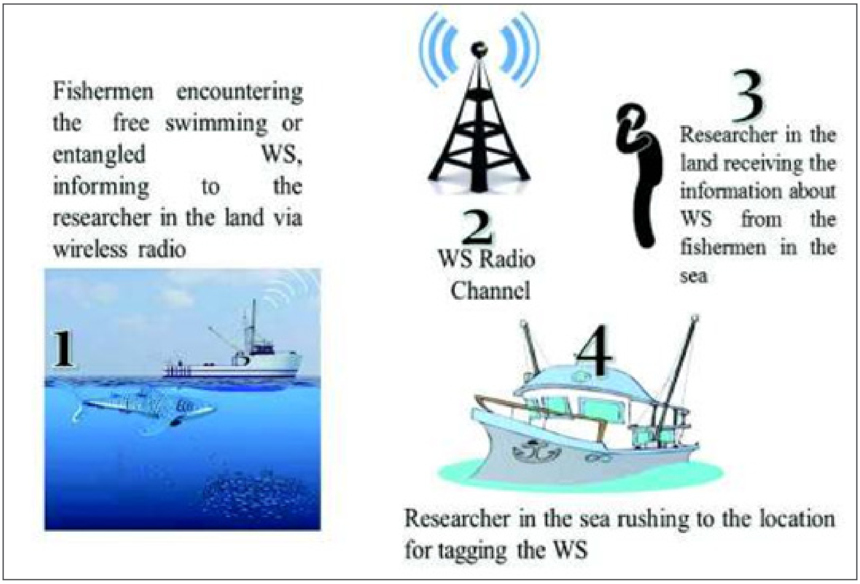


Fig. 198: An exclusive wireless canal intimates fishermen and Coast Guard personnel about presence of Whale Sharks

11. Post-campaign assessment of the Whale Shark conservation in Gujarat

After more than two decades of Whale Shark conservation efforts, a post-campaign study was conducted by independent professionals, Rahul Ranjan Sinha and Ankur Kumar, who were not involved in the campaign's implementation. The study evaluated the campaign's effectiveness and impact, examined its outcomes and long-term sustainability, and identified lessons that could inform other conservation initiatives. It also aimed to outline future directions for Whale Shark conservation. This survey presents the key findings and insights from that assessment.

1. Methodology

1.1 Study Objectives

The sustainability of efforts to conserve Whale Sharks depends on multiple stakeholder groups. Their interests and interactions with each other determine the future of Whale Shark conservation. The fishing community is the most important stakeholder as it directly impacts their livelihood. The Forest Department, the

Indian Coast Guards, and the Fisheries Department are responsible for law enforcement and, therefore, instrumental in checking poaching and supporting rescue activities. Schools and academic institutions, along with local media, support building awareness and empathy about the species. Hence, the Knowledge, Attitude, and conservation-related Practices (KAP) of all these stakeholder groups will contribute to the fate of Whale Sharks on Gujarat's coastlines.

Therefore, to help the project strategize future Whale Shark conservation efforts, this study attempted to address the following objectives:

To measure the KAP that impacts Whale Shark conservation of the different stakeholder groups

Conservation-related KAP Adoption of pro-conservation practicesGroups dynamics that affect conservation Motivation/Deterrents toInvolvement/ Adoption

To measure the perceived contribution of the conservation campaign in determining the KAP of different stakeholder groups

Campaign triggers and tools Recall of different campaign modalitiesPerceived effectiveness Areas of improvement

To determine factors that will influence the sustainability of the conservation efforts

Allocation of financial resources Community's KAPDonor motivation Government systems' adoption of conservation strategies

1.2 Study area and approach

The study was conducted in two coastal districts of Gujarat, Gir Somnath and Junagadh. Surveys were conducted in localities dominated by fishing communities (Gir Somnath: Veraval, Sutrapada, Jaleshwar, Hirakot, and Dhamlej and Junagadh: Chorwad and Mangrol). Interviews were also conducted in Gandhinagar with senior forest department officials and in Mithapur with a school teacher and TCL officials.

To address the above-mentioned objectives, the study adopted a mixed-method design that involved quantitative as well as qualitative data collection. The quantitative data collection was conducted by interviewing the fishing community members using a structured interview schedule. In addition to respondents' KAP, this interview schedule also inquired about their recall of the conservation campaign.

The qualitative data collection was done through in-depth interviews with a variety of stakeholder groups. These qualitative interviews were supported by pre-defined guidelines to ensure data quality. The guidelines were customized based on the stakeholders to be interviewed. The unstructured interviews with the different stakeholders inquired about their engagement with the campaign along with their motivation, processes, challenges, and their opinion on the sustainability of Whale Shark conservation.

1.3 Sampling Plan and Size

Quantitative survey

Since this is a cross-sectional study, the sample size of the study was decided to be 403 based on the large population size, the hypothesized proportion of 50%, (5% confidence limits), the design effect of 1, and a potential sample loss of 5% due to attrition or non-response.

The study employed a single-stage random sampling design with the proportional allocation of sample sizes to villages based on their population sizes. This approach improves precision and reduces sampling bias in estimates by reflecting the actual population distribution while maintaining statistical efficiency. Within a village, the required number of households were sampled systematically. From Gir Somnath District we have selected Jaleshwar, Veraval Bhidiya, Veraval Old Light House, Sutrapada, Hirakot Bunder and Dhamlej with total samples of 296. From Junagadh district we took Chorwad and Mangrol with total samples of 108 (Total Sample size is 404).

Qualitative survey

The sample selection for the qualitative interviews was made purposively based on the respondent's engagement with the campaign and her availability. However, the data collectors tried to ensure the adequate representation of all stakeholder groups and a high variety in the sample in terms of their roles and responsibilities.

Based on the secondary literature, resource constraints, and prior experience in conducting similar research, the stakeholder-specific sample size for the qualitative leg of the research is as follows: We selected 10 stakeholder groups (Central Marine Fisheries Research Institute (CMFRI); Central Institute of

Fisheries Technology (CIFT); Gujarat Forest Department, Fishermen Association Head, Fisheries Department of Gujarat, Teachers at Coastal Schools and academic institutions, Indian Coast Guard Officers, Media Partners, Donor, Fishermen) with a total sample size of 28.

1.4 Data Analysis

The data analysis of the quantitative data includes the calculation proportion of relevant indicators along with lower and upper confidence limits. All the analyses were carried out using SAS 9.4. The qualitative data analysis involved a manual, in-depth examination of the interview transcripts to identify recurring themes and patterns. This process includes a systematic review of participants' responses to uncover underlying motivations and perspectives. Key themes were identified and categorized, providing a rich understanding of the participants' experiences and viewpoints. Relevant quotes and narratives were selected to illustrate each theme, enhancing the depth and authenticity of the findings.

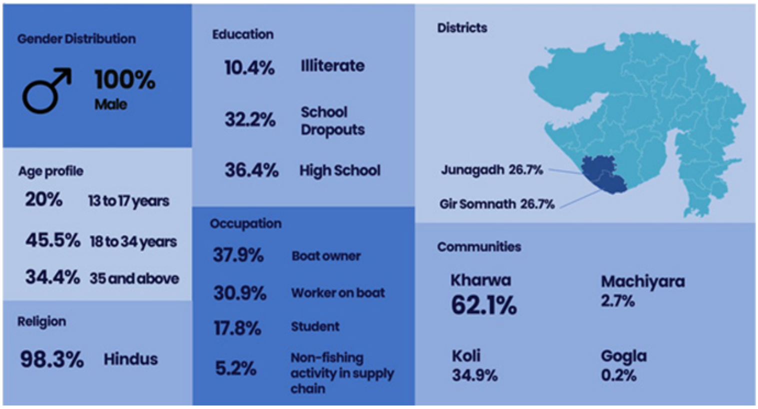
2. Research Findings

This section presents the findings of the study and interprets them within the context of the project. Detailing the findings of the quantitative and qualitative research, it is organized into the following subsections:

- Sociodemographic profile
- The Conservation Landscape: Where we stand today
- Beyond Awareness: The True Impact of the Conservation Campaign
- Sustainability of commitment to conservation

2.1 Sociodemographic profile

The Sociodemographic infographic represents the sociodemographic profile of the fishing community in Gir Somnath and Junagadh. 20% of the respondents were adolescents, 46% were aged between 18 and 34 years, and the rest 24% were 35 years or older. Almost all the respondents were Hindu males (98%). This high representation of Hindu males is because of the allocation of samples to villages proportional to their population sizes and the highly patriarchal social structure that discourages women from interacting with people outside their families. Jaleshwar, the only village dominated by Machiyara Muslims(marine fishing community), constitutes less than 3% of the total fishing community's population in Gir Somnath and Junagadh. Kharwa, the most dominant community in the region, accounts for 62% of the sample, followed by Koli (34%). 46% of the respondents were either illiterate or school dropouts (did not complete high school), reflecting low educational levels among fisher folk. 74% of the respondents were either owners of fishing boats or workers on them or involved in the fishing supply chain. A high representation of people directly or indirectly involved in fishing is crucial because they are the most important stakeholders in Whale Shark conservation.



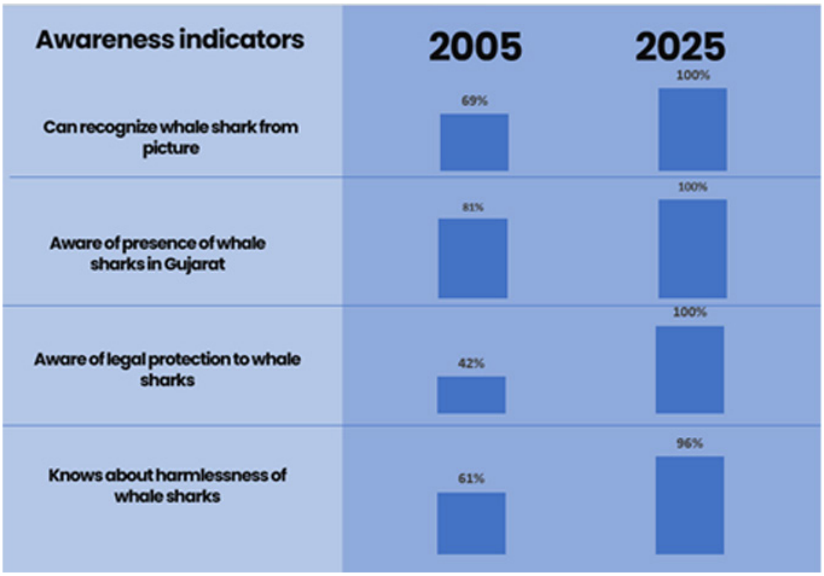
Infographic 1 Socioeconomic characteristics of quantitative Sample

2.2 The Whale Shark conservation landscape: Where we stand today

Over the past two decades, collaborative efforts by Gujrat Forest Department, Wildlife Trust of India, and Tata Chemicals have significantly reshaped the conservation landscape for Whale Sharks. This joint initiative has transitioned from addressing immediate threats to fostering long-term ecological and behavioural change, establishing itself as a model for community-driven conservation. The campaign's structured approach can be divided into three sequential phases. Phase I (2000s) can be seen as an era of urgency: confronting the direct threat of Whale Shark hunting through advocacy, policy nudges, and the raw power of storytelling. Phase II (2010s) saw compassion take centre stage— rescuing entangled sharks, compensating fishermen for losses, and embedding empathy into economic calculus. Phase III (the 2020s) has ushered in a golden age of science and systemic thinking, where habitat mapping, behavioural studies, and adaptive compensation models ensure that conservation is dynamic. All phases prioritized awareness generation, using culturally resonant tools (e.g., religious narratives, school programs, media) to shift public sentiment. A multi-tiered strategy—combining policy advocacy (macro), institutional partnerships (meso), and community-led actions (micro)—ensured cohesive implementation. The campaign has reaped significant dividends in terms of the improved knowledge, attitude, and practices of the stakeholders, including fishermen, and the results from this post-campaign survey bear testimony to that. Compared to the findings of the pre-campaign study conducted in Veraval and Ahmedabad in 2005, this study found improvements in the indicators of knowledge about Whale Sharks, awareness of their conservation status, and attitude toward them. This has been discussed in detail in the subsequent section of the report.

2.2.1 Knowledge about the Whale Shark

Two decades of consistent awareness interventions have significantly improved the community's knowledge about Whale Sharks. Results from this post-campaign study indicate a significant shift in the community's knowledge about the Whale Shark's recognition and legal awareness (100% in 2025), geographical presence (100% in 2025), and harmless nature (96% in 2025). Qualitative findings demonstrated that the conservation campaign effectively enhanced knowledge about Whale Sharks among fishermen, schoolchildren, and youth through targeted educational programs and community engagement initiatives. A high recall of street plays, life-sized inflatable Whale Shark dummies, and mass events such as rallies were reportedly driving the knowledge levels amongst the target groups.



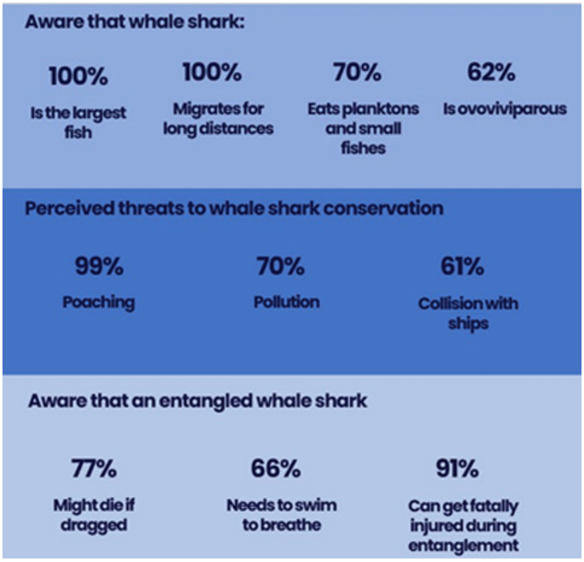
Infographic 2 Indicators of basic awareness about Whale Sharks

While only 69% of the community could identify the species from the picture in 2005, 100% of the respondents correctly identified the Whale Shark in 2025 which can be attributed to interventions to make the Whale Sharks more visible to the community, such as displaying life- sized inflatable Whale Shark dummy and pictures on signages. Similarly, in 2005, only 81% of the community was aware of its presence in Gujarat or India, and 42% knew about its legal protection under the Wildlife Protection Act. This study found that at present(2025), 100% of the fishing community is aware of its presence in Gujarat or India, and almost all the community members are aware of its legal protection. The campaign also seems to have debunked myths about Whale Sharks. The proportion of people who considered Whale Sharks to be harmless has increased from 61%(2005) to 96%(2025). This statistically significant shift has been shaped through regular communication and awareness generation about these gentle giants. The training materials focused on these behavioural aspects of Whale Sharks, and the improved awareness can be directly attributed to these initiatives.

This study also documents the high prevalence of knowledge about Whale Sharks' biology, behaviour, and threats to their population. Almost all of the community members are aware that Whale Sharks are the largest fish in the world and migrate to far-off places, which was one of the key messages of the campaign. 70% of the community knows that Whale Sharks feed on plankton and small fishes, and 62% are aware of their ovoviviparous reproduction. When asked about the threats to the Whale Shark population in Gujarat, 99% of the respondents mentioned poaching. However, a vast majority of respondents also mentioned pollution (70%) and collision with ships (61%) as threats to the Whale Shark population. Similar concerns were also raised during qualitative interviews with fishermen, heads of the fishing associations, and also by scientists at CIFT and CMFRI. With increasing ports and vessel movements, these problems are expected to compound in the coming future. Future conservation initiatives will need to focus on these aspects to improve the ecology and habitat of Whale Sharks.

While the statistics reflect the prevalence of knowledge about Whale Sharks and their protected status, the reasons behind it were revealed during the qualitative interviews with important stakeholders. Officials of GFD and TCL, leaders of fishing associations, and teachers at academic institutions vividly recall the attractive and attention-grabbing events that were organized as part of the campaign. These activities and events, such as street plays, painting competitions at schools, rallies, and displaying life-sized inflatable Whale Shark dummies, attracted the attention of community members of all ages(See Chapter 6 10.1). These platforms proved to be appropriate sources for educating the community about the Whale Shark, its legal protection, and threats to its population.

Since this study was conducted with the fishing community, their practical knowledge, which is crucial to saving an entangled Whale Shark, was also assessed. 66% were aware that Whale Sharks need to continue swimming to breathe, 77% were aware that dragging an entangled Whale Shark can kill it, and 91% were aware that entanglement can cause fatal injuries.



Infographic 3 - Indicators of nuanced awareness about Whale Sharks

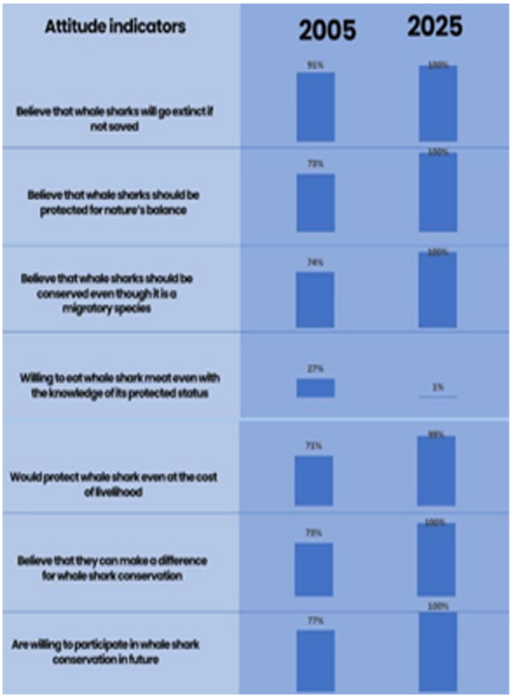
Qualitative interviews with the officials of GFD and TCL also corroborate the quantitative findings. The high awareness within the community is the implementation of innovative awareness measures backed by scientific facts and evidence. The campaign deployed strategies to attract people (such as displaying an inflatable Whale Shark), engaged their attention using emotional and culturally aligned storytelling, educated them about the species and the threats to it, and then made an appeal to give up Whale Shark hunting and support in the rescue of entangled ones.

2.2.2 Attitude towards Whale Sharks and their conservation

The study shows significant improvements in the community's attitude toward Whale Shark conservation between 2005 and 2025. 99% (from 71% in 2005) of the community mentioned willingness to protect Whale Sharks even at the cost of their livelihood and 100% of the community is presently willing to participate in the conservation efforts. 65% want to protect the species for future generations. Almost all the respondents attributed their positive attitude to the campaign and the compensation scheme. However, fewer positive attitudes were observed among the Machiyara community in Jaleshwar, highlighting the need for equitable development initiatives and addressing misconceptions to strengthen conservation efforts.

This study also shows significant improvements in the community's attitude toward Whale Sharks and their conservation. While a high prevalence of positive attitudes was documented in 2005, the present study recorded further improvements in the associated indicators in 2025. In 2005, 91% of the respondents felt that Whale Sharks might go extinct unless protected, 73% thought that conserving Whale Sharks is important to ensure nature's balance, and 74% supported their conservation, knowing that it is migratory.

All of these indicators increased to a 100% prevalence by 2025 indicating the development of community-wide pro-conservation sentiment. These indicators reflect a good understanding of the role of Whale Sharks importance and the threats to their population. While 27% of the respondents showed interest in consuming Whale Shark meat in 2005, it decreased to 0.5% in 2025 reflecting that the campaign's strategy to leverage the communities' religious values worked in the favour of Whale Sharks. In 2005 around 71% of the respondents mentioned that they would conserve Whale Sharks even at the cost of their livelihood which increased to 99% in 2025. (refer Infographic 4)



Infographic 4 - Improvement in indicators of attitude towards Whale Sharks between 2005 and 2025

This is a significant win for the Whale Shark conservation project as it truly reflects the conversion of hunters into guardians. In qualitative interviews with the fishermen and their association heads the theme of 'proud about 'Vhali" emerged repeatedly corroborating the findings from the quantitative survey. In 2005, 73% believed that they could make a difference and 77% were willing to participate in conservation efforts. Both indicators increased to 100% by 2025 indicating the campaign's success in encouraging involvement with the project at the grassroots which is crucial for the long-term sustainability of the conservation project.

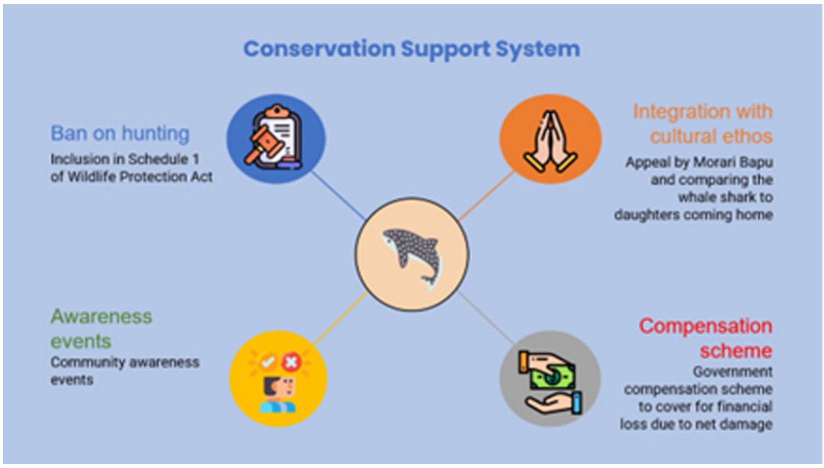
When asked about the drivers of the positive attitude toward Whale Shark conservation, 96% of the respondents attributed it to the conservation campaign and 100% attributed it to the compensation scheme. Officials at GFD and the Fisheries Department also highlighted that both awareness activities and compensation need to continue for the pro-conservation sentiment to persist in the long term.

2.2.3 Whale Shark Conservation Support System

Whale Shark conservation is thriving through a collaborative network of government and non-government stakeholders. Key elements of this system include strong legislative protection, cultural integration inspired by religious values, community education, and a compensation scheme that removes financial barriers for fishermen rescuing entangled sharks. This multi-stakeholder approach ensures Whale Sharks are safeguarded not only by law but also by the compassion and active participation of the local fishing community.

Whale Shark conservation along the Veraval and Junagadh coasts is supported by a well- coordinated network of government and non-government stakeholders working together to ensure the protection of these gentle giants. By leveraging their respective strengths, these organizations have successfully transformed fishermen—who once actively hunted Whale Sharks before 2001—into their guardians. The conservation system is driven by GFD, TCL, WTI, Indian Coast Guard, Marine Police, Gujarat Fisheries Department, fishermen's associations, coastal academic institutions, local media personnel, and most importantly, the fishing community itself, which directly interacts with these magnificent creatures.

At the core of this system are four key elements that ensure seamless coordination and effective protection of whale sharks.



Infographic 6 - Schematic representation of four major elements of Whale Shark conservation support system

2.2.4 Memories that Stick: Campaign recall

The Whale Shark conservation campaign in Gujarat successfully enhanced community awareness and transformed fisherfolk into protectors, with 63% of respondents attributing the cessation of hunting to the campaign. Morari Bapu's cultural appeal played a pivotal role, with 73% of the community recalling his association with the cause. The campaign's strong outreach is reflected in the 99% recall of its motto and the widespread recognition of key activities, such as Whale Shark Day celebrations (92%) and rescue training (76%), highlighting its deep impact and effectiveness.

Infographic 7 - Indicators of retention of memories of campaign

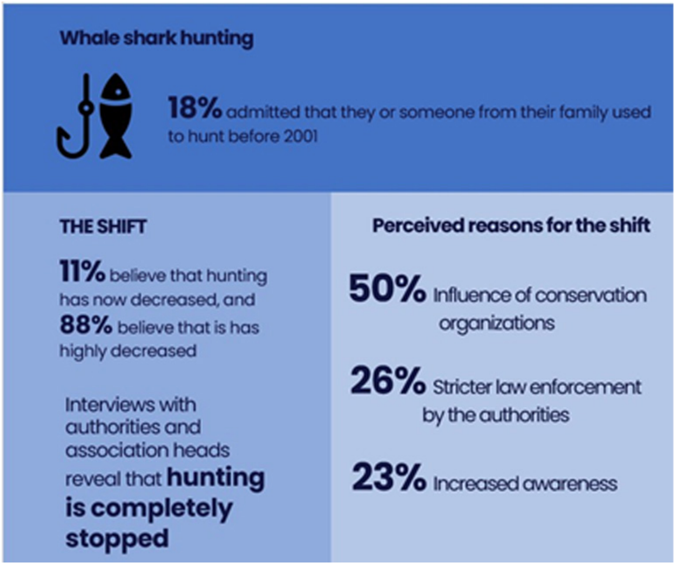
The Whale Shark conservation campaign aimed to significantly enhance the community's knowledge and attitudes toward protecting these majestic creatures. The findings of this study, reported in the previous sections, validate the exemplary achievement of these objectives. The effectiveness of the campaign in turning fisherfolk into protectors of Whale Sharks is reflected in the fact that all the respondents believe that the campaign was successful in raising awareness about Whale Sharks and 63% of those attributed it to the cessation of hunting.

The community mentioned that the appeal had a great impact on the community. Structured interviews with the community members revealed that 73% of them remembered Morari Bapu's association with the noble cause, validating the observations of important stakeholders in the state. This study also estimated the intensity of the outreach by asking the respondents to recall specific features and events of the campaign. 99% of the community remembers the motto "Āpanī vhālī āpana um gaurava, vahēla śārka chē gajarātana um gaura" that means "Our beloved Vhali is our pride, Whale Shark is Gujarat's pride". This motto was used to reach out to the masses. When asked to list the features of the campaign that they can recall (unprompted), the celebration of Whale Shark Day was remembered by the most (92%), followed by training on rescue (76%), sensitization events with fishermen (75%), training on 'Vhali watcher' app (74%), and inflatable whale replica (67%). Similarly, when asked about the activity they found most engaging, 52% of the people voted for the Whale Shark Day celebration.

2.3 Beyond Awareness: The True Impact of the Conservation Campaign

2.3.1 Conservation-related practices and shifts

The Whale Shark conservation campaign has led to a significant transformation in the practices of the fishing community with a complete cessation of hunting in the state. Fishermen now follow best practices during rescues, with 94% using tools to free entangled sharks and 91% confident the sharks survived. The introduction of the Self- Documentation Scheme (SDS) and the 'Vhali Watcher' app streamlined rescue reporting, with 86% of respondents familiar with the app. The study highlights a widespread shift toward responsible fishing practices, fostering a strong community commitment to Whale Shark conservation.



Infographic 8 - Indicators of the shift away from Whale Shark hunting and perceived reasons

18% of the respondents mentioned that they or someone in their family used to hunt Whale Sharks before 2001. The scenario have drastically changed for good, as 99% of the interviewees mentioned that Whale Shark hunting has stopped in the last ten years. The community members attribute the change to the efforts of WTI (50%), strict enforcement of the ban by the authorities (26%), and increased awareness (23%). The situation has become even better than as reflected in the quantitative interviews. WTI played a key role in directly training fishermen, school children, and youth in the community, raising awareness about Whale Shark conservation, its importance, and instilling pride in protecting the species. Whereas some sections of the populace, for example, the Machiyara community(marine fishing community), ceased Whale Shark hunting largely due to strict law enforcement.

Additionally, awareness generation through street plays, rallies, and demonstrations effectively reinforced the conservation message, contributing to the widespread cessation of Whale Shark hunting.

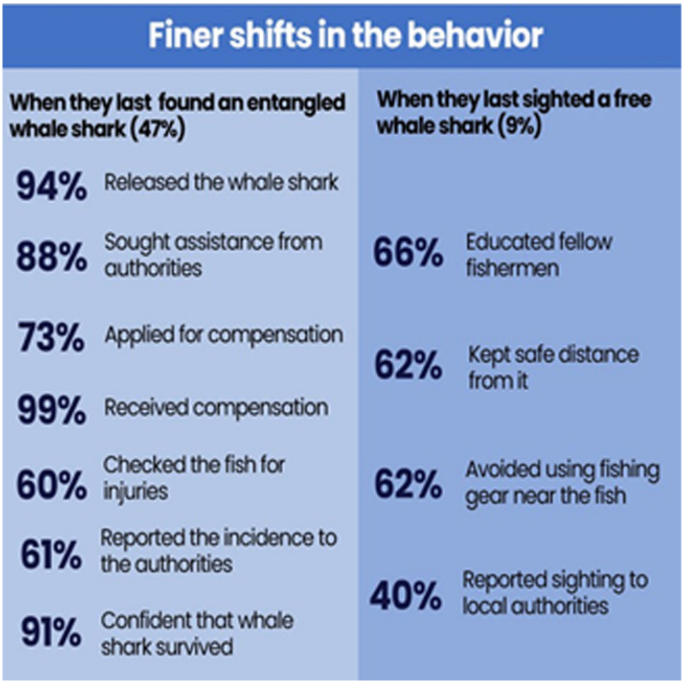
Qualitative interviews with fishermen and heads of fishing associations point to the complete stopping of Whale Shark hunting in the region. One of the association heads mentioned the fishing community strongly abides by the instructions and regulations of the fishing association heads, also called 'Patels'. All the fishing associations have not only accepted the ban on Whale Shark hunting but also instructed the community to abide by the regulations. This has created a strong 'social fencing' wherein even if someone manages to hunt a Whale Shark hidden from the surveillance of authorities, members of the community will report the perpetrator to the authorities.

Infographic 9 - Indicators of learnings drawn from training on rescue

WTI, in collaboration with the GFD, conducted a series of workshops with the fishermen to raise awareness about the species and train them on the process of rescuing entangled Whale Sharks. 84% of the respondents mentioned that either they or someone from their family attended these training- cum-awareness events. The respondents mentioned that these training sessions educated them with the skill for rescuing and releasing an accidentally netted Whale Shark, enhanced their knowledge of sustainable fishing practices, improved their ability to advocate for Whale Shark conservation, and strengthened their sense of responsibility toward the conservation of marine wildlife.

The study also recorded improvements in the finer practices of the fishing community. The respondents who reported themselves or someone from their family finding an entangled whale shark detailed the best practices they followed to rescue the fish, such as using a knife and other tools to cut open the net and release the whale shark (94%), seeking assistance from government or WTI officials (88%), applying for compensation (73%), checking for injuries to fish

(60%), and reporting the incidence to authorities (61%). More importantly, 91% of these respondents were confident that the whale shark survived and swam away. Validating the usefulness of the compensation scheme, 99% of the rescuers are reported to have received financial compensation from the government for the damage to their nets during the rescue. However, during qualitative interviews with association heads and fishermen, some reported that the compensation amount was too low compared to the actual loss incurred during the rescue, leading them to forgo applying. Others expressed discontent over delays in the disbursement process. In 2024, the GFD revised the maximum compensation limit from INR 25,000 to INR 50,000, which could potentially mitigate dissatisfaction with the compensation amount.



Infographic 10 – Finer shift in behaviour

2.4 Sustainability of Commitment to Conservation

The post-campaign assessment highlights a remarkable shift in fishermen's practices toward Whale Shark conservation. Beyond refraining from hunting, fishermen now actively ensure Whale Sharks are left undisturbed—educating peers (66%), keeping distance (62%), avoiding fishing gear nearby (62%), and reporting sightings (40%). Rescue protocols are well understood, with 99% prioritizing immediate release, 82% aware of photo documentation for compensation, and 91% knowing to cut nets from the mouth first. Tools like the Self-Documentation Scheme and the Vhali Watcher app have further strengthened trust and streamlined reporting, with 86% awareness of the app.

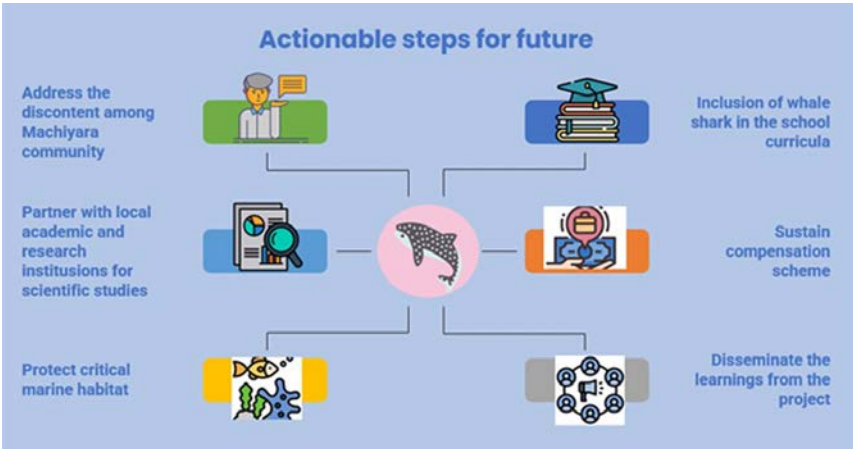
The campaign's sustainability rests on strong community ownership (93% committed to future conservation), cultural acceptance (deeply tied to local beliefs and Morari Bapu's metaphor of the Whale Shark as a daughter), effective governance (GFD-WTI partnerships, joint patrolling with Coast Guard, training with CMFRI/CIFT), and financial viability (compensation schemes, integration into education programs). However, long-term success will depend on addressing ecological threats such as industrial pollution, overfishing, climate change, and ship traffic. Embedding conservation into curricula, strengthening local stewardship, and advancing scientific research on Whale Shark ecology are critical next steps to secure this globally significant conservation success.

3. Conclusion and Recommendations

The Whale Shark conservation initiative in Gujarat has achieved remarkable success by integrating four key elements—government prohibition on hunting, cultural and religious alignment, financial compensation for net loss during rescues, and extensive community awareness programs. This holistic model has fostered strong community support and transformed fishermen's attitudes and behaviours, resulting in a complete cessation of Whale Shark hunting. Statistically significant improvements in knowledge, awareness, and attitudes were recorded, with community members demonstrating empathy, pride, and belongingness toward the species. Influential appeals, such as Morari Bapu's message equating Whale Sharks with daughters returning home to give birth, played a pivotal role in shaping positive perceptions. Fishermen now actively rescue entangled Whale Sharks, are well-versed in rescue protocols, and take pride in their conservation role. The campaign's success is widely attributed to improved awareness and education, with communities recalling key activities like Whale Shark Day celebrations, rescue training, and sensitization events.

As the project advances, sustaining the existing framework while expanding its scope is critical. Key priorities include embedding Whale Shark conservation to institutionalize awareness, ensuring timely compensation to fishermen for net damages, and strengthening scientific research in partnership with CMFRI, CIFT, and local institutions. Protecting critical marine habitats through pollution control and continuous monitoring, addressing community concerns such as those raised by the Machiyara community(marine fishing community), and sharing

Gujarat's success as a model for community-driven conservation nationally and internationally will be essential. By maintaining the four foundational elements and integrating scientific research with institutionalized awareness efforts, Gujarat can secure the long-term survival of Whale Sharks and foster sustainable coexistence with local communities.



Infographic 11 - Recommendations based on the findings of the study

12. Future Plans for Whale Shark Conservation in the Region

The success of the Whale Shark Conservation in India provides a strong foundation to envision and implement long-term strategies. Moving forward, several key areas are being contemplated to ensure the continued protection of this species:

1. **Institutionalising the Effort**

   Priority will be to firmly institutionalise the conservation programme by deepening collaborations with the Forest Department and donor partners. This will create a sustainable structure that ensures continuity, resource support, and long-term commitment to the species' protection.

2. **Sustained Campaigns and Outreach**

   The campaign that brought the Whale Shark to the forefront of marine conservation will be continued and strengthened. Persistent engagement with coastal communities, Academia, fisherfolk, Policy makers and the

Government will help reinforce awareness and support for conservation over time.

3. **Celebrating Conservation Wins**

   It is essential to recognise and celebrate milestones with primary stakeholders, including government, donors, communities, and conservationists. Celebrating successes not only honours collective achievements but also inspires continued participation and ownership of the programme.

4. **Scientific advancement**

   Expanding tagging and monitoring efforts will be crucial to better understand Whale Shark behaviour, migration, and habitat use. Scientific data generated through these efforts will guide evidence-based policy decisions, management measures, and international collaboration. Advanced scientific interventions including e-DNA and hormonal assay needs to be explored

5. **Continuing Compensation Policy**

   The compensation scheme that supports fishers who release Whale Sharks caught accidentally will be retained and reinforced. This policy has been pivotal in changing attitudes, ensuring community cooperation, and directly preventing harm to the species.

6. **International Collaboration and Knowledge Exchange**

   Given the Whale Shark's highly migratory nature, cross-border information exchange where the species occurs will remain a priority. Building cross-border partnerships will enable coordinated conservation action, contributing to the global effort to protect this endangered giant.

7. **Expanding the PPP Model to a Regional Collaborative**

   Building on the successful Public–Private Partnership (PPP) approach pioneered in Gujarat, the programme aims to expand across India, covering both of the country's Large Marine Ecosystems (the Arabian Sea and the Bay of Bengal). This pan-India model will foster regional collaboration, integrate diverse stakeholders, and align conservation efforts across states, making the project a model for large-scale marine species conservation in South Asia.

Together, these concerted efforts will ensure that whale shark conservation in India not only remains robust and sustainable but also contributes to global marine biodiversity protection.

Surface presence is common in whale sharks, especially in warm, plankton-rich waters where their feeding is most productive.

CHAPTER 7

CONSERVATION RESEARCH

Determining the Whale Shark habitat quality status along the Coast of Gujarat-Based on Plankton and Benthos

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Indian Institute of Science Education and Research Kolkata

Background

The coastline of Gujarat has gained international attention because of its importance as a major habitat for whale sharks. To ensure the long-term conservation of this species, listed under Schedule I of the Indian Wild Life (Protection) Act, 1972, it is equally important to monitor the habitat which is frequented by this enigmatic marine fauna. Planktonic communities, such as phytoplankton, and benthic communities, such as macrofauna and meiofauna, constitute the biotic assemblages of water and the underlying sediment in any coastal habitat. These organisms play a major role in ecosystem processes, including contributing to total production, thereby sustaining rich biodiversity such as the population of whale sharks. Additionally, planktonic and benthic communities can serve as excellent proxies for monitoring the health of coastal ecosystems (Austen 2004, Bhattacharjee et al. 2013). With this in mind, the study was initiated to assess the ecosystem health of habitats along the Gujarat coastline, which is frequented by whale sharks.

Objective of the proposed project

i.) Qualitative and quantitative information on plankton (phytoplankton and zooplankton) and benthic faunal communities, along with their seasonal dynamics in relation to environmental parameters, is being studied along the coast of Gujarat, frequented by whale sharks.

ii. Understanding the ecosystem health of whale shark habitats along the Gujarat coast by using plankton and benthic organisms as biological proxies.

Methodologies

Sediment sampling

To undertake water and sediment sampling for elucidating planktonic and benthic organismal communities, three transects were laid along one of the coastal sectors of Gujarat, known for sightings. Broadly, these transects represent the Sutrapada, Veraval and Mangrol coastlines, respectively. In the case of Sutrapada, sampling included a shallow station (SS4) and a relatively deeper station (SS7). At Veraval, one shallow station (VS3) and two deeper stations (VS8 and VS8A) were selected. At Mangrol three stations, namely MS1 (shallow), MS9 and MS10 (deep) were targeted as part of sampling strategy (see Fig. 199). Sampling was undertaken in November 2015 which broadly represented the post-monsoon season.

Fig. 199: Map showing the three transects along with earmarked stations targeted as part of this study.

Sediment samples were collected from each station using van Veen grab (biting area of 0.025m^2). At VS3, triplicate grab samples were collected while in SS4, SS7 and VS8 duplicate samples were collected; while at the remaining stations (MS1, MS2, MS9 and MS10, VS8A), only one grab could be successfully collected per station. From each successful grab, two sub-samples (approx. 250 gms wet weight each) were collected to analyze benthic faunal communities and their assemblage patterns in the laboratory. Immediately after sub-sample collection Rose Bengal solution (1 g/mL) was added, followed by addition of 5% neutral formalin to fix collected sediments. From the second grab, sub-samples (50 to 250 gms) were collected and fixed based on the analysis to be undertaken, including for sediment granulometry and nutrient analyses. Sediment samples collected in the third grab were fully sieved through 500 µm for qualitative and quantitative analyses of benthic macrofauna. For duplicate grabs representing the three stations, from the first grab, two sub-samples (approx. 250 gms wet weight each) were collected and fixed immediately, and the remaining sediment in the grab was sieved through 500 µm for qualitative analyses of benthic macrofauna. For the second grab, two sub-samples were collected following the above protocol for undertaking granulometry and nutrient analyses. For the single grab representing the remaining five stations, two-sub samples were collected and fixed immediately, while the remaining sediment was sieved through 500 µm for qualitative analyses of benthic macrofauna.

Measurement of in *situ* environmental parameters

At the time of sampling in each station, environmental parameters, namely surface water temperature, pH, salinity, Secchi depth and dissolved oxygen concentration, were measured *in situ* using handheld digital instruments. All the environmental parameters were measured in triplicate from each station. In addition, water samples (150 mL) were collected from 5 m and 10 m depth for each station, stored in dark bottles, fixed immediately based on standard methodology (Choudhury et al, 2015) and transferred to the laboratory for undertaking nutrient analyses. Collection of water was undertaken using a Niskin sampler. For zooplankton collection, a bongo net was towed in each station for approximately 5-7 minutes , and samples were subsequently collected and fixed with formalin.

Benthic fauna extraction, abundance count and taxonomy

In the laboratory, 10 gms (wet weight) of sediment from each sub-sample (250 gms) collected from the first grab at each station was processed for benthic faunal analyses. Briefly, sediments (10 gms) were passed through 500, 63 and 45 µm sieves to separate benthic macrofauna (retained in 500 µm) from meiofauna (retained in 63 µm). Abundance count and taxonomic identification of organisms retained in a 500 µm sieve were undertaken in a binocular microscope using standard taxonomic and pictorial keys. For meiofaunal analysis, two 10 gm sub-samples were passed through 63 µm sieve. One sub-sample was analyzed based on the flotation method (Somerfield and Warwick, 1996), where floating meiofauna were subjected to abundance count and morpho-taxonomy using standard keys.

Additionally, semi-permanent slides were prepared from a 63 µm fraction based on the Loeblich and Tappan (1988) method and subjected to abundance count and taxonomic analyses with a focus on benthic foraminifera. The outcome of this particular analysis based on Loeblich and Tappan (1968) method, has been detailed in the discussion section. All the analyses were undertaken using a compound microscope (Olympus, BX43 series).

Measurement of nutrient concentration from water samples

Dissolved nitrate, ortho-phosphate, silicate, and ammonium concentrations from water samples collected from 5 m and 10 m depths were analyzed based on standard published protocols. Dissolved nitrate was estimated using the Finch et al. (1998) protocol, while for the estimation of ortho-phosphate, the Strickland and Parsons (1972) protocol was followed. Ammonium and silicate concentrations were determined using the protocols of Liddicoat et al. (1975) and Turner et al. (1998), respectively. d.

Results

The measured in situ environmental parameters showed patterns that are commonly observed along the Gujarat coast during the post-monsoon season. In general, surface water temperature ranged from 28.5-33.1°C while the air temperature ranged from 28.3 to 40.9°C during the same period (Fig. 200).

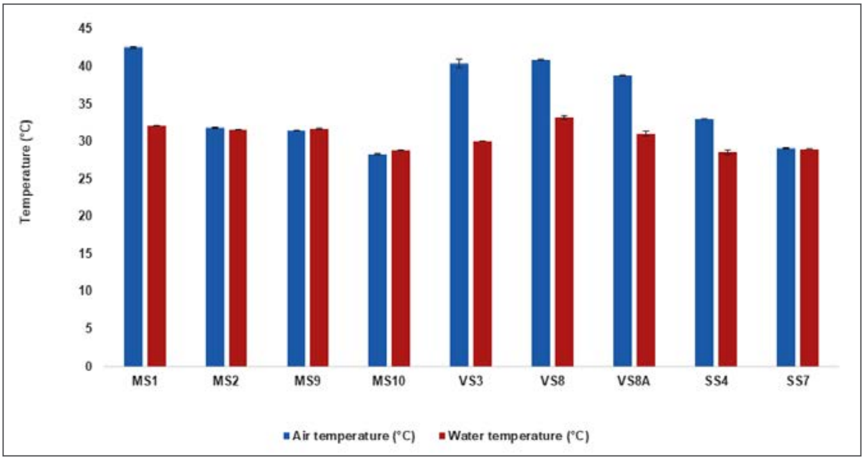


Fig. 200: In situ trends of air temperature and water temperature (surface water) measured across nine stations representing the three transects along the Gujarat coast

Salinity values showed a range of variation across the targeted stations during sampling. Salinity values ranged from 25-35.5, with shallower stations having comparatively lower salinity, while deeper stations reflected trends closer to open ocean surface water salinity (Fig. 201).

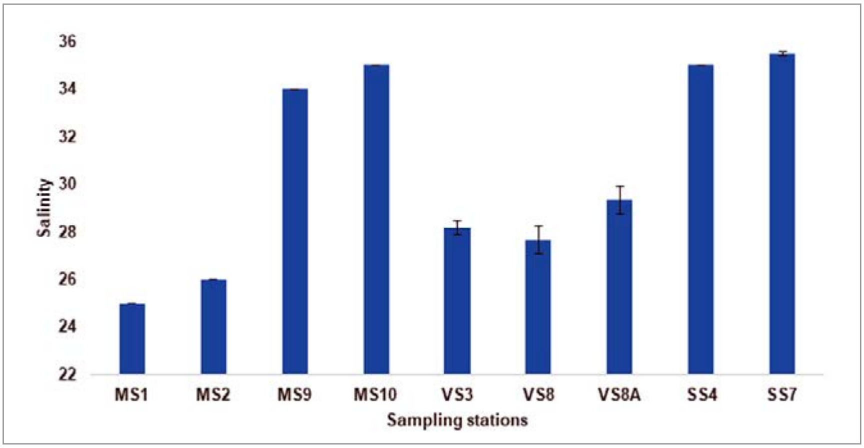


Figure 201: In situ trends of surface water salinity measured across nine stations representing the three transects along the Gujarat coast

In the case of surface water pH, the values were found to be relatively stable across all the stations. The values ranged from 8.03 to 8.2, which is characteristic of coastal water pH (Fig. 202).

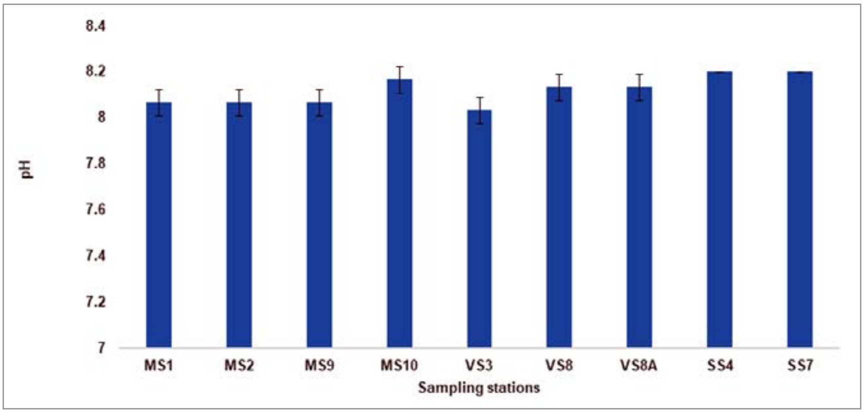


Fig. 202: In situ trends of surface water pH measured across nine stations representing the three transects along the Gujarat coast

Dissolved oxygen concentrations in surface waters across the studied stations ranged from 5.81-7.27 mg/L (Fig. 203). Overall, dissolved oxygen profiles exhibited spatial variability in the Veraval transect compared to the remaining two transects.

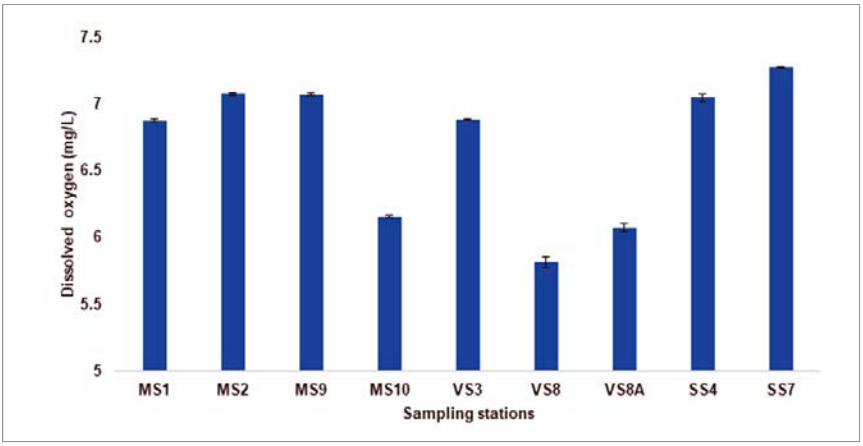


Fig. 203: In situ trends of surface water dissolved oxygen concentration measured across nine stations representing the three transects along the Gujarat coast

Benthic macrofauna

The benthic macrofauna abundance ranged from 0-62 individuals/0.025m2 across the study area (see Fig. 204). In case of MS1 station (Mangrol), not a single macrofaunal specimen was encountered, whereas, the highest number of macrofauna was encountered in SS7 station (Sutrapada), as also evident from Fig. 204.

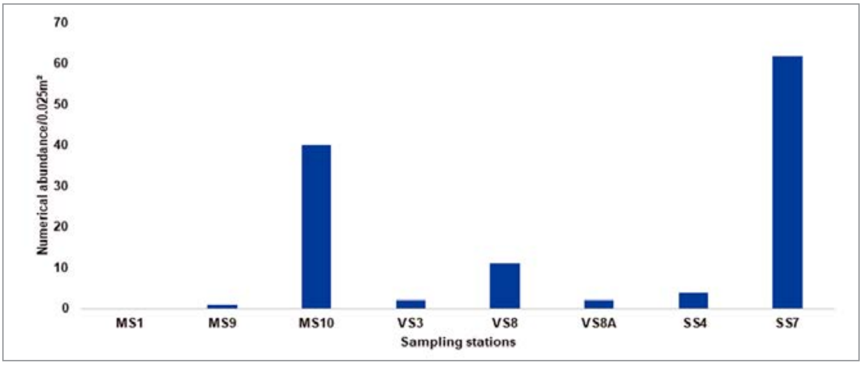


Fig. 204: Numerical abundance of benthic macrofauna in studied stations along the Gujarat coast.

The major benthic macrofaunal groups encountered from the sampled stations includes the Polychaetes, Gastropods, Bivalves and Amphipods. Based on group-wise relative abundance, Gastropods were encountered in most of the stations (6 out of 8 stations), followed by Polychaetes (5 out of 8 stations) (Fig. 205). On the contrary, in MS9 station, only Gastropods were encountered while Polychaetes were encountered only in SS4 station. Among all the stations, MS10 was found to be represented by all the four groups of benthic macrofauna (relative abundance). Based on transect, Sutrapada transect was overwhelmingly dominated by Polychaetes while in Veraval, bivalves dominated the macrofauna and in Mangrol all the groups were encountered in almost equal proportion.

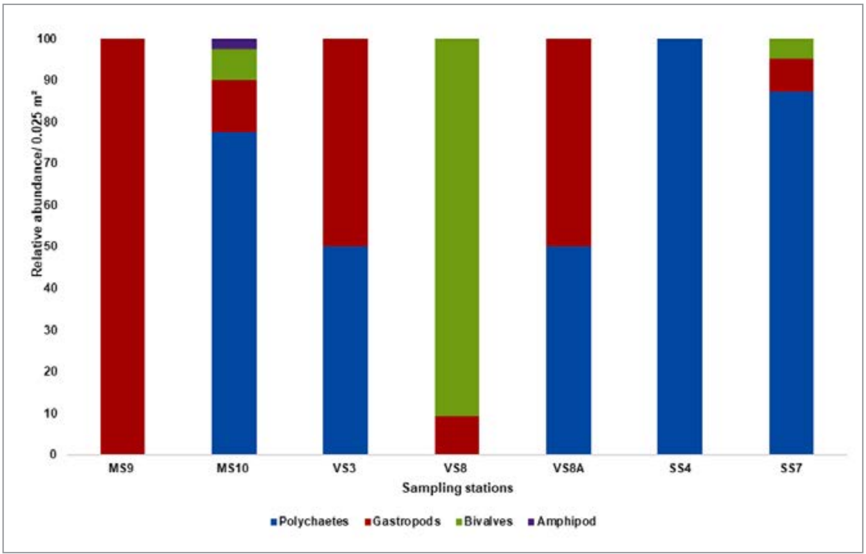


Fig. 205: Relative abundance of encountered benthic macrofaunal groups in studied stations along the coast of Gujarat (in percentage).

Composition of benthic macrofaunal assemblages

In the case of Gastropods, four valid species belonging to the genera *Nassarius, Surcula* and *Umbonium* were encountered from the study area (see Plate 1). Out of four valid species, three species were encountered exclusively at station MS10, representing the Mangrol transect. In station SS4, representing the Sutrapada transect, not a single specimen of Gastropod was encountered. For Bivalves, seven valid species belonging to five genera– *Anadara, Mactra, Psammobia, Pecten* and *Paphia* were encountered from the study area (see Plate 2). In VS8 (Veraval transect), six species were encountered, while in stations SS4 (Sutrapada), VS3 and VS8a (Veraval transect), not a single specimen of Bivalve was encountered. Four valid species of polychaetes belonging to three genera (*Diopatra, Nephthys* and *Prionopsio*) were also recorded from the study area (see Plate 3). In SS7 (Sutrapada transect), all four valid species of Polychaetes were encountered, while in VS8 (Veraval transect), not a single polychaete specimen was encountered. Only a single valid species belonging to the genus Gammarus represented the Amphipods in the study area. This species was encountered exclusively at the station MS10 (Mangrol transect).

Benthic meiofauna

In case of benthic meiofauna, the abundance ranged from 66-971 individuals/10 gms based on the flotation method. Lowest meiofauna abundance was found in the MS1 station while highest abundance was encountered in the VS8 station as evident from Fig 206. It is important to mention that in VS8A meiofaunal communities could not be studied since only a small fraction of sediment was successfully collected following deployment of grab.

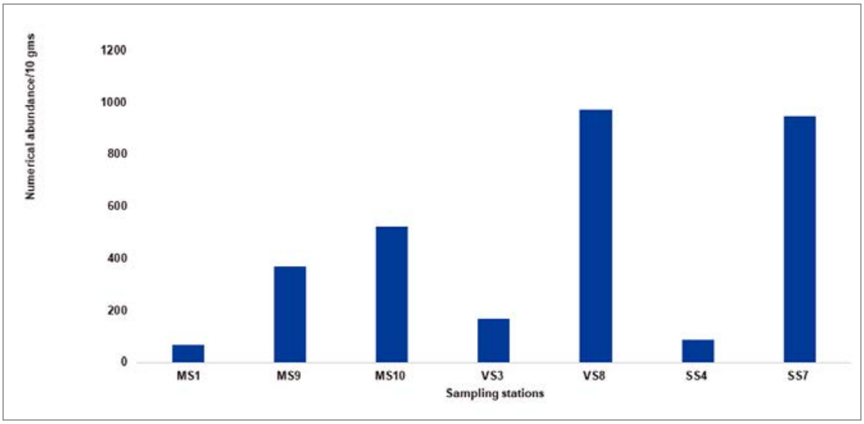


Fig. 206: Numerical abundance of benthic meiofauna in studied stations along the Gujarat coast based on the flotation method.

The major benthic meiofaunal groups encountered from the sampled stations based on the flotation method include the Foraminifera (live foraminifera marked as rB stained along with dead foraminifera), Ostracods and Nematodes (Fig. 207). Based on group-wise relative abundance, Foraminifera overwhelmingly dominated the sedimentary habitat, representing all the studied stations. In SS7 and MS1 stations, live foraminifera were encountered, while the remaining stations were represented by dead foraminifer tests. Incidentally, Ostracod shells were encountered exclusively in the SS7 station. Nematodes were found to be highest in SS4, while their relative abundance was lowest in MS10 and VS3 stations. In general, Nematodes were the second most abundant group after Foraminifera.

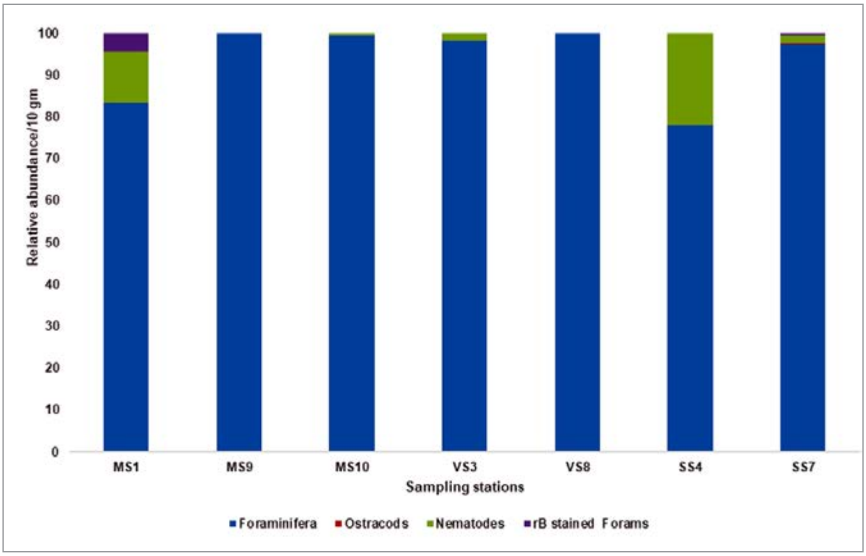


Fig. 207: Relative abundance of major benthic meiofaunal groups encountered in studied stations along the coast of Gujarat based on the flotation method. rB stained Forams stand for Rose Bengal stained foraminifera.

Based on the slide count method, meiofauna abundance ranged from 1594 individuals/10 gm (encountered in SS4 station) to 13271 individuals/10 gm (MS9 station) (Fig. 208). Based on the relative abundance of encountered meiofaunal groups, it was found that Foraminifera overwhelmingly dominated the studied stations (Fig. 209). In addition to foraminifera, the relative abundance of Ostracod shells was frequently encountered in SS7 and VS3 stations. Nematodes were also encountered in some of the stations, although their relative abundance was much less compared to Foraminifera.

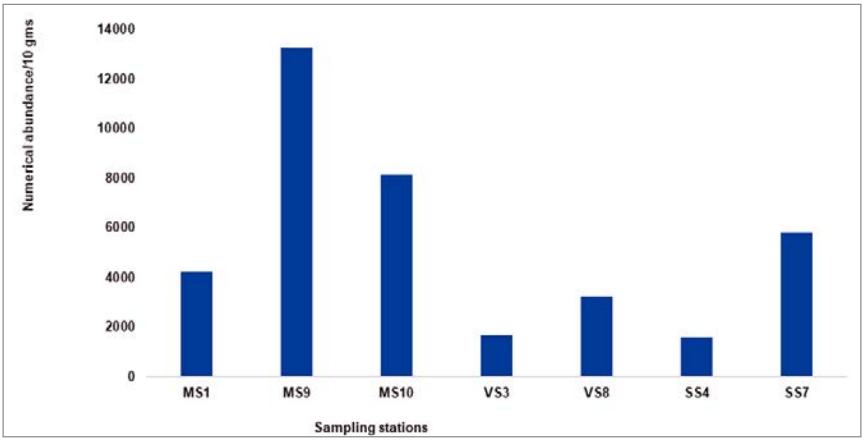


Fig. 208: Numerical abundance of benthic meiofauna in studied stations along the Gujarat coast based on slide count method.

Based on slide count method, relative abundance of live foraminifera tests (rB stained) were found to be highest at station SS7, followed by MS9, and least in VS8. In addition to benthic meiofauna, empty frustules of diatom (photosynthetic eukaryotes) were also encountered in collected sediments from the study area (Fig. 209).

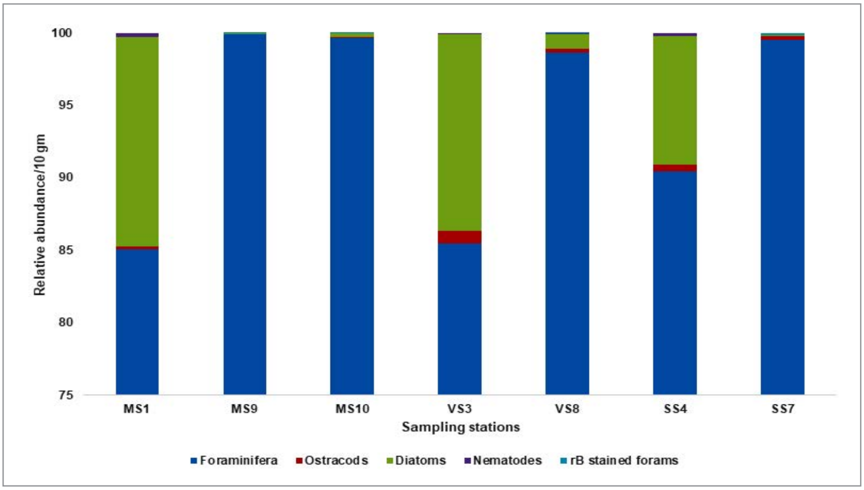


Fig. 209: Relative abundance of major benthic meiofaunal groups encountered in studied stations along the Gujarat coast based on slide count method. rB stained Forams stand for Rose Bengal stained foraminifera.

Benthic meiofaunal assemblages

Among benthic meiofauna, foraminifera abundance was found to be much higher compared to other groups. In total, 19 valid species of foraminifera belonging to 14 genera were encountered from the study area (see Plate 4). The list of foraminifera species encountered is detailed in Appendix 6A. Given that the toxonomic complexity of foraminifera, identifications was reconfirmed using the SEM approach (see Plate 5). Of these 14 genera, 13 genera represented the calcareous form, while the remaining one belonged to the agglutinated form. In total, 14 families of foraminifera were accounted for from the studied stations. The most abundant foraminifer genera were found to be *Ammonia* and *Hanzawaia*, both of which occurred in all studied stations. The planktonic foraminifer genus *Globiginera* was also encountered as part of this study, but it was restricted to MS9 and MS10 of the Mangrol transect. Incidentally, some of the foraminifer species namely, *Leptohalysis* sp. and *Lagena* sp. are new reports from the West Coast of India. In the SS4 station, *Leptohalysis* sp. was encountered, while Lagena sp. was found in the VS3 station. It is also important to highlight that all the 19 species of foraminifera were encountered only in the SS7 station, while the lowest species diversity was encountered in the SS4 station (4 species). For the second most abundant group, the Nematodes, 8 valid species belonging to 7 genera were accounted for from the study area (see Appendix 6B, Plate 6). These 8 species belonged to 6 families in the case of Nematodes. Within Nematodes, the most abundant genera were *Desmodora* and *Trichoma* and *Halalaimus*. The genus *Desmodora* was encountered in SS4, SS7 and VS3, while *Trichoma* was encountered in SS4, SS7 and MS1; *Halalaimus* was found only in stations SS4 and SS7. The nematode abundance ranged from 3 (VS3 station) to 19 (SS4 station) individuals/10 gms across these four stations based on the flotation method. The highest nematode species diversity was found in SS7 station (6 species), while the lowest species diversity was found in SS4 (2 species). Besides these two groups, shells of Ostracods were encountered across all stations. In the case of the SS7 station, Ostracod abundance was found to be highest (flotation method: 4 individuals/10 gm; slide count method: 15 individuals/10 gm). The identification of encountered Ostracod shells is presently underway.

Plankton communities

In addition to sediments, water samples were also collected, representing two depth profiles (5 m and 10 m) from eight stations except VS8A, to get an idea about plankton communities. For 5 m depth, phytoplankton cell density ranged from 25-50 cells L-1,whereas, for 10 m depth, cell density ranged from 25-75 cells L-1. Only in stations SS4 (5 m: 25 cells L-1; 10 m: 25 cells L-1 and VS8 (5 m: 50 cells

L-1; 10 m: 50 cells L-1) phytoplankton cells were encountered, representing both the depths. At stations SS7, MS9 and MS10, no phytoplankton cells were found at either depth . In general, phytoplankton cell density was considerably lower than previously reported for this part of the Gujarat coast. The phytoplankton cells encountered were found to be represented by diatoms (centric), in addition to dinoflagellates. The centric diatoms were represented by *Thalassiosira* sp. and *Odontella* sp (see Plate 7). Notably, the diatom frustules encountered in sediments previously as part of benthic faunal counts were also represented by *Thalassiosira* and *Odontella,* along with other diatom species belonging to 9 genera (see Plate 8). In the case of zooplankton, their abundance was negligible in both the water depths and in agreement with phytoplankton cell density. Zooplankton communities were encountered in the SS4 (5 m depth) and VS8 (5 m and 10 m) stations. Presently, identification is underway to confirm the taxonomic affiliations of encountered zooplankton specimens.

Discussion

In general, the measured *in situ* environmental parameters in shallow and deeper stations representing Sutrapada, Veraval and Mangrol transects showed some spatial level variability, as also previously reported from the coastlines of India, including the west coast (e.g. Choudhury et al, 2015; Singh et al, 2015). This is particularly evident for salinity and dissolved oxygen values, where the shallower stations closer to the coast showed lower values as compared to offshore stations, which have greater depth. This is mainly due to freshwater influences coming from the land-ocean boundary, which can result in observed variability. Overall, the observed environmental variables showed a trend as found in the post-monsoon season along the Indian coastline. Additionally, the initial dataset from ongoing dissolved nutrients measurement shows that dissolved ammonia concentration is relatively higher in shallower stations (2-4 µM,) which are indicative of episodic urban inputs from coastal land boundaries.

The analyses of benthic fauna from collected sediment samples showed assemblage patterns, some of which were notably distinct from the studied coastal areas of Gujarat. It was generally observed that macrofaunal abundance and diversity were highest in Sutrapada transect , followed by Mangrol and least in Veraval. Offshore stations had higher abundance and species diversity, with polychaete showing particularly higher abundance and diversity in deeper stations compared to shallower ones. In general, benthic macrofauna abundance and diversity patterns recorded in these three transects were consistent with previous studies undertaken along the west coast of India. In the case of benthic meiofauna, the overwhelming dominance of foraminifera highlights the importance of this group in controlling coastal ecosystem processes. Some of the encountered species of foraminifera, including *Leptophalysis* have not been previously reported from the Indian coast.

The presence of live foraminifera (rB stained) in the study site indicates their importance in contributing to secondary production and remineralisation processes, which can ultimately enhance total coastal production. It was also found that in deeper stations, foraminifera species diversity was higher compared to shallower stations, and many of these stations are usually frequented by whale sharks. Similarly, nematodes species diversity was higher in deeper stations compared to shallower stations. Such trends confirm higher benthic production along Gujarat's coastlines, which is frequented by whale sharks. Presently, sediment grain size analysis and total organic carbon (TOC) content of sediment are being undertaken, which will provide an improved view in terms of the role of abiotic factors in shaping observed benthic faunal community structure. It has also been shown in published literature that whale sharks feed on dense plankton communities including sergestids, calanoid copepods, chaetognaths and fish larvae (Motta et al, 2010).

Plankton communities were examined across three transects based on depth profiles. It was found that phytoplankton cell density was lower at 5 m and 10 m depth, and in the majority of the stations, they were not encountered. However, evidence of a high abundance of empty diatom frustules in underlying sediments indicates that primary production was previously significant in this ecosystem. The low cell density is also being reconfirmed using chlorophyll estimation. The initial chlorophyll dataset from 5 m depth indicates concentration ranging from 0.1-0.56 mg/m3, , which is generally in agreement with observed phytoplankton cell density as recorded in this study. At present, chlorophyll estimation of 10 m water depth is underway, which may provide an improved understanding of phytoplankton communities and observed abundance patterns. Overall, the phytoplankton communities were found to be dominated by the centric diatom genus *Thalassiosira,* which is known as a key contributor to coastal primary production. In the case of zooplankton, their abundance was very low, and some copepods were encountered at 5 m and 10 m depth.

The observed low density of plankton communities could also be due to seasonal patterns. The plankton communities, particularly those collected from zooplankton as part of bongo net towing, are being analyzed, and the findings are expected to offer a more comprehensive understanding of overall zooplankton communities in the study area. It would also be important to investigate how plankton community composition and abundance change in the upcoming spring season, , as during this time of the year whale shark sightings are also much higher.

Although only one round of sampling has been undertaken so far,with another set of sampling proposed at the end of February 2016, the benthic and planktonic biotic assemblages indicate that the ecosystem health of each transect is generally good. The long-term ecological monitoring of these habitats will also provide a clearer understanding in terms of biology and the resulting habitat preference of whale sharks along the Gujarat coastline.

Plate 1

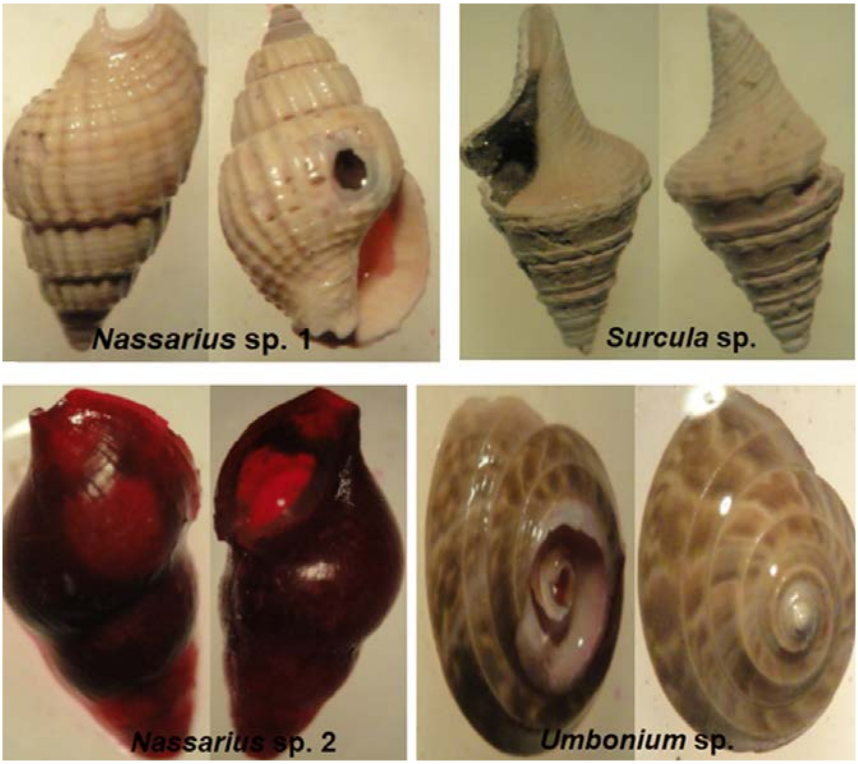


Plate 2

Plate 3

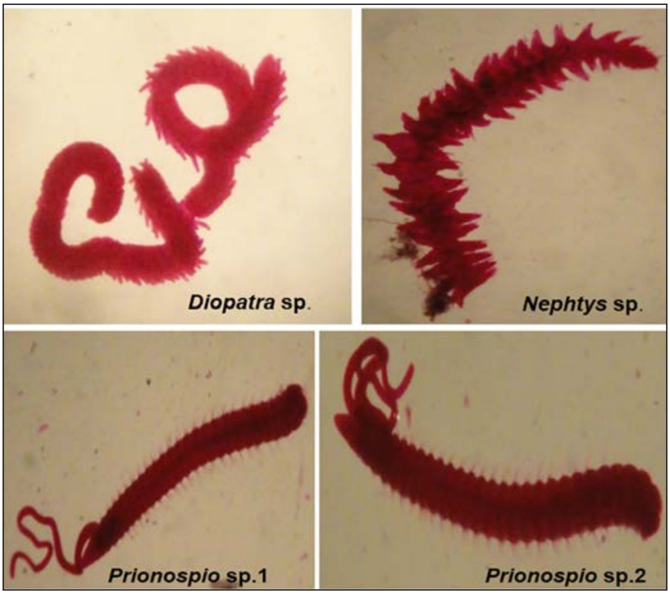


Plate 4

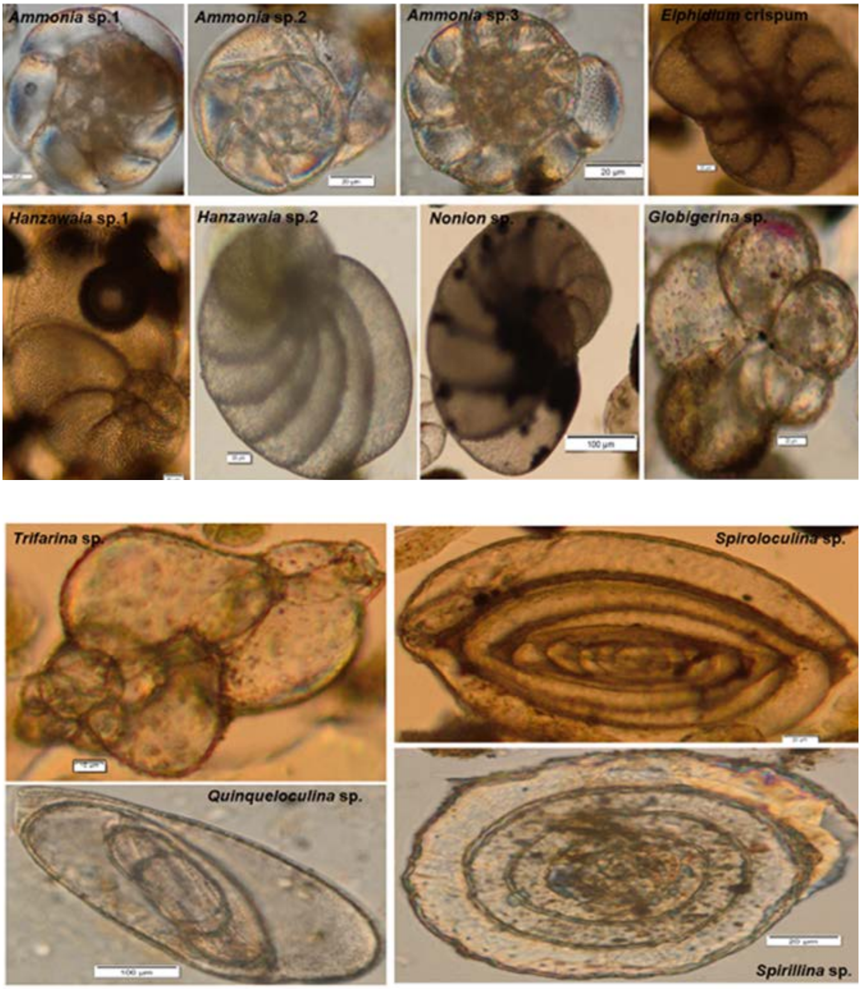

Ammonia sp.1
Ammonia sp.2
Ammonia sp.3
Elphidium crispum
Hanzawaia sp.1
Hanzawaia sp.2
Nonion sp.
Globigerina sp.
Trifarina sp.
Spiroloculina sp.
Quinqueloculina sp.
Spirillina sp.

Plate 5

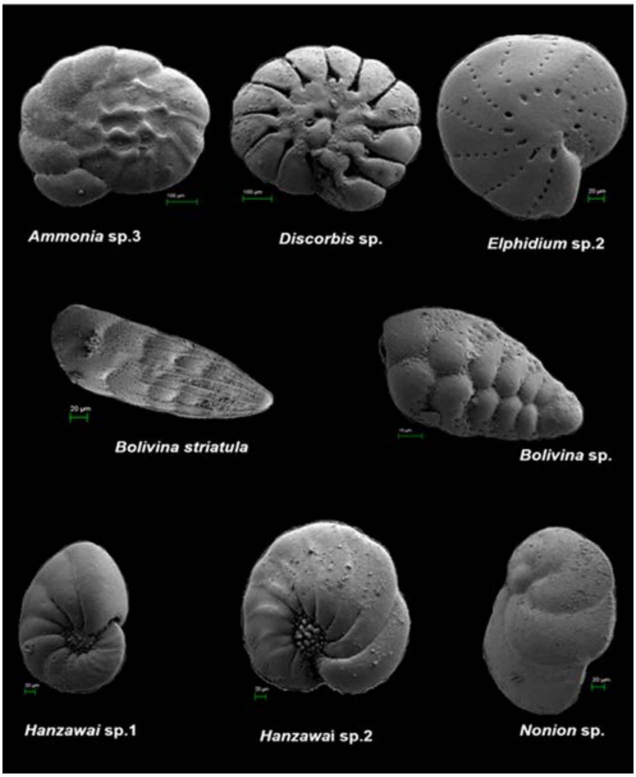


Plate 6

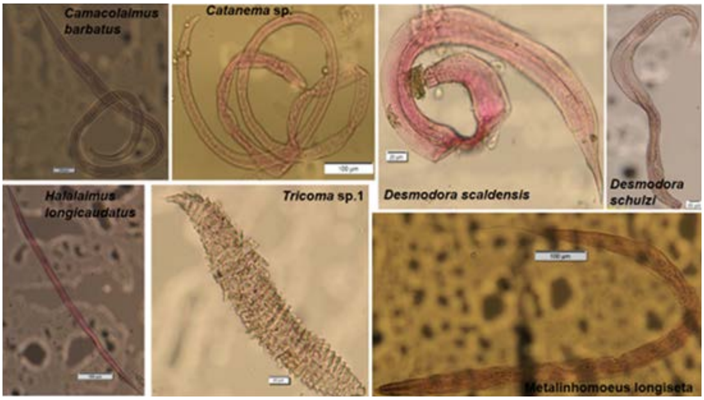
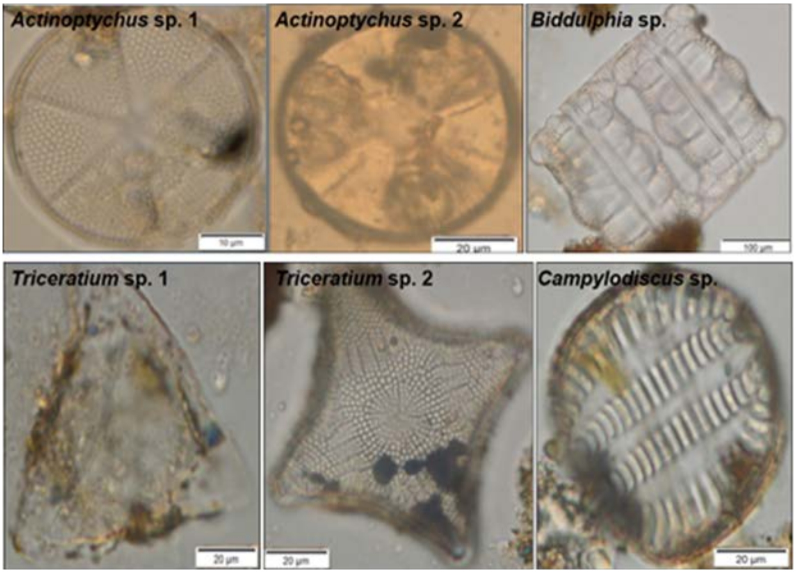


Plate 7

Plate 8



CHAPTER 8

CONSERVATION RESEARCH

Habitat and Ecology of Whale Shark in Veraval

Gulshad Mohammad

Veraval Regional Centre of Central Marine Fisheries Research Institute.

March 2011 The Whale Shark is a relatively recent addition to the human record of the ocean and its inhabitants. However, the ancestry of this shark goes back to the Jurassic and Cretaceous periods 245-65 million years ago, when the present groups of sharks began to appear. It was not until 1828 when the first Whale Shark specimen known to science was discovered off the South African coast. Like many other shark species, the Whale Shark has innate biological characteristics, such as large size, slow growth, late maturation and extended longevity, which probably limit recruitment and make it particularly susceptible to exploitation. International conservation status of the species is unclear–it is listed as having an 'Indeterminate' status on the World Conservation Union's Red List of Threatened Animals. This category applies to animals known to be 'Endangered', 'Vulnerable' or 'Rare', but there is not enough information available to say which of these three categories is appropriate.

The accessibility of the seasonal aggregation of Whale Sharks in the Veraval regions provide an excellent opportunity for researchers to undertake studies of this rarely encountered and poorly understood shark. Initial research efforts lacked clearly defined objectives and were often hampered by limited scientific research of Whale Shark biology and ecology. Some aspects of this research should seek to provide information to environmental management bodies in order to minimize possible detrimental impacts. In general, occurrences of Whale Sharks appear to be sporadic and unpredictable, which is partly a reflection of the lack of knowledge about the animal's habitat and ecology.

In order to study the habitat and ecology of Whale Shark in the Veraval region the present study has been designed (Site selection and Sample collection were carried out by WTI, Sample analysis and data compilation were carried out by Regional

Center of CMFRI, Veraval). Three experimental sites were selected based on the information available on the Whale Shark citation. The experimental sites include 1.Veraval- A (0Km), B (5km), C (10Km), D (20Km), 2. Diu- A (0Km), B (5km), C (10Km), D (20Km) and 3. Mangrol- A (0Km), B (5km), C (10Km), D (20Km). All the sampling stations were clearly plotted in the map (Fig. 210). All the water sampling, water quality analyses were carried out according to the standard sea water analyzing protocols (Strickland & Parsons, 1968). The methods used for the analysis of various parameters were tabulated in Table-39. The parameters like Sea surface temperature, Salinity, pH, Visibility, DO, Gross and Net Primary Productivity, Ammonia, Nitrate, Phosphate, Silicate, Chlorophyll concentration, Photo and Zooplankton biomass and diversity were recorded in Veraval for a period of January-2010 to December-2010. The same parameters were started to analyses in the sites of Diu and Mangrol from October-2010 to December-2010.

Result of the analysis is given in Table-40 to Table-87 and Figure-211 to Figure-258. During the sample collection hydrological parameters of the selected sits were also recorded. Sea surface water temperature in the selected study areas were fluctuated with seasons and between stations, it's ranging form 20.50C to 31.^{0}C. The highest temperature during the study period was recorded in Diu and the lowest was recorded in Veraval (Table-40, 50, 61; Fig. 211, 222, 233). Sea water pH in the study areas ranged from 7.11 to 8.65. Except Madhavpur site the level of pH showed a normal trend of fluctuations with very miner changes in all the study areas. During the study period the highest pH level of 8.3 was recorder in Mangrol and lowest pH level was recorded in Diu site during (Table-41, 51, 62; Fig. 212, 223, 234). The salinity in the study areas were ranged from 33.6ppt to 36.3ppt. Fluctuation in salinity level was noticed between stations to station. This deviation from normal pattern can be attributed to the de-linking of the water flow from the sea and the absence of freshwater outflow during the summer period (May, 2010). But this highest deviation in salinity level in this region occurred during October 2010 is due to the mixing of huge volume of fresh water resulted during the monsoon period. But this case was not occurred in all other sampling location is due to the high mixing rate of sea water with rainy water and also the buffering activity of sea water. Whale Sharks appear to prefer locations with surface water temperatures between 21 -25 degrees, where cool nutrient-rich upwelling mingle with warm surface waters of salinities between 34-34.5%. These conditions may well be optimal for the production of the planktonic and nektonic prey upon which the sharks feed. The level of Dissolved Oxygen (DO) content during the study period was ranging from 2.13ml/L to 6.27ml/L. In DO level high fluctuation was noticed in the area of Veraval when compare to all other sites (Table-43, 53, 64; Fig.214, 225, 236). The high amount of DO level recorded in this site is may resulted due to the activities of Ship breaking yard. In the present investigation the Gross productivity level was ranged from (Table-45, 56, 67; Fig. 217, 228, 239) 0.01mg C/L/Hr to 0.22mg C/L/Hr. The productivity level was very low in all the selected study areas except the control site. The Net productivity level was ranged from 0.01 mg C/L/Hr to 0.22 mg C/L/ Hr (Table-45, 56, 67; Fig. 217, 228, 239). The highest Gross productivity level of 0.22 mg C/L/Hr was recorded in the control site. This results show that the site is fully free from pollution and having enormous primary producers.

In concerned with the nutrient level, the amount of ammonia was ranged from 0.000µg atom to 12.318µg atom. A high value of 12.318µg atom was recorded in the area of Veraval (Table-46, 57, 68; Fig. 218, 229, 240). The value was unusual, this may be resulted by the anthropogenic activities leading to discharge of industrial effluents, fertilizers from agricultural farms and domestic sewage causing increase in organic load in the waters have a major influence on the levels of ammonia in this water body. In the present study period, nitrate levels were found to be higher in the areas of Veraval site when compare to all other sites (Table-48, 59, 70; Fig. 220, 231, 242). The domestic sewage mixing in this region is the most important source of nitrates. Phosphate level was varying with 0.001µg atom to 0.217µg atom (Table-47, 58, 69; Fig. 219, 230, 241). Phosphorus particularly in the form of phosphates is an important component of domestic and industrial wastes and is cycled within the environment through aquatic transport. Poor flushing and increased accumulation of industrial, agricultural and domestic wastes in this area results in an imbalance in the relative nutrient levels. Zooplankton samples were collected from surface hauls by employing standard plankton net. The plankton net is towed horizontally from the boat for 10 minutes using three bridles (suspension lines), which are tied to the ring at equidistance from each other. While making the collections the speed of the vessel is maintained at 1 to 2 nautical miles per hour. After the 10 minutes haul, the net is taken out of water and is washed from outside by jetting seawater to bring down all the plankton into the collecting bucket. After all the excess water is drained off from the net and through the window of the collecting bucket, the bucket is carefully removed from the net and the plankton, along with the water is poured into wide mouthed polythene bottle of 500 ml capacity. The collected sample was preserved in 5% formaldehyde solution. With regard to phytoplankton, one litre of water from each station is collected in wide mouthed 1000 ml capacity polythene bottle and preserved in 5% formaldehyde solution.

The gross and net primary production rate, by the light and dark bottle oxygen technique (Grarder & Gran, 1927). The value of chlorophyll contents of the water studied following the methods of Strickland & Parsons (1968). For the studying phytoplankton , one litre of the water sample were collected from surface of stations studied. The phytoplankton organisms were enumerated by the settling method and qualitative and quantitative evaluation of the flora. For the quantitative estimation of zooplankton in the samples, displacement method was used and the zooplankton volume was determined. As it is not possible to analyze the entire zooplankton

sample collected during a haul, sub sample of the minimum 2 ml of zooplankton was used for qualitative analysis of plankton groups. The sub-sampled plankton was fully analyzed by counting in a plankton counting chamber under a microscope. The results of diversity and density of Phytoplankton were provided in Table- 72 to 74 and 75 (a), (b), (c), and Fig. 244 to 246 .The results of zooplankton Group vise density were provided in the Table- 76 to 87 and Fig.247 to 258. Whale Shark rescue data during the study period of February-2010 to February -2011 was provided in Table-87. The Whale Shark is reported as a filter feeder. Although passive filter feeding has been documented and was previously considered characteristic behavior, recent studies now indicate that Whale Sharks feed primarily at night and at depth. It is under cover of darkness that the deep scattering layer of planktonic and nektonic prey moves up the water column in the densest concentrations. For most of the year, at least during the day, the amount of food taken in during subsurface cruising is equivalent to snacking, while the main meal comes after dark in deeper water.

Comparison of various habitat parameters with the Zooplankton and Phytoplankton biomass and diversity will help in identification of high productive zones with the seasonal Whale Shark catch location. Further deep assessment is required to understand the seasonal changes in the nutrient levels and it affect on the primary and secondary productivity in particular attention on the Whale Shark arrival in the selected places (Veraval, Diu and Mangrol). Further in-depth study is very essential to predict the seasonal shifts in the productive zones in relation with the Whale Shark appearance.

Table 39. Methods of analysis of various parameters.

Sl.No.	Parameter	Method	Instrument
1.	Temperature	-	Thermometer
2.	pH	-	pH meter
3.	Salinity	-	Salinometer
4.	Dissolved Oxygen	Winkler's	-
5.	Visibility	-	Secchi Disk
6.	Nitrate	Strickland & Parsons (1968)	Spectrophotometer
7.	Phosphate	Strickland & Parsons (1968)	Spectrophotometer

8.	Ammonia	Strickland & Parsons (1968)	Spectrophotometer
9.	Silicate	Strickland & Parsons (1968)	Spectrophotometer
10.	Chlorophyll	Strickland & Parsons (1968)	Spectrophotometer
11.	Primary productivity	Gaarder & Gran, 1927 (Light & Dark Bottle)	-
12.	Phyto and Zoo-plankton analyses	Standard phyto and zooplankton sample collection and analysis method	Hemocytometer, Microscope

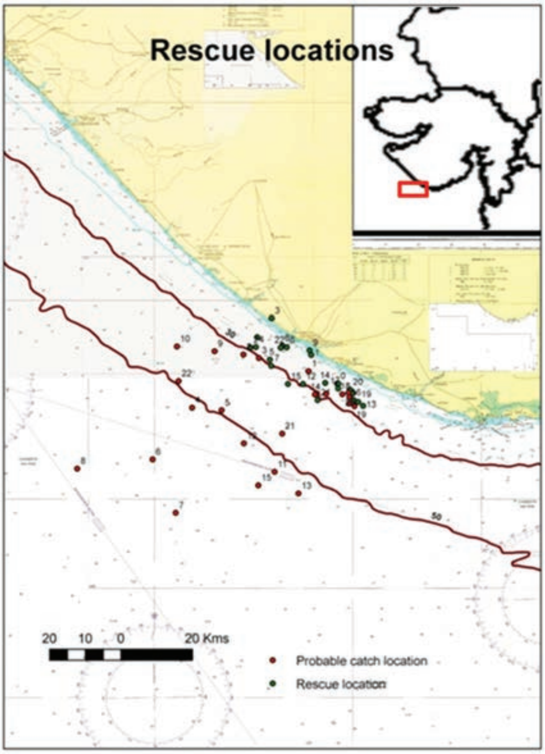


Fig. 210. Map showing the sampling and whale shark rescued locations.

Table 40. Temperature (°C) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	25.20	25.7	25.3	25.5
Mar_2010	26.6	25.60	25.90	25.70
Apr_2010	26.60	26.9	27.8	27.8
May_2010	27.20	28.4	28.6	29.1
Oct_2010	30.00	30.9	30.7	31.1
Dec_2010	24.10	24.9	25.1	25.6

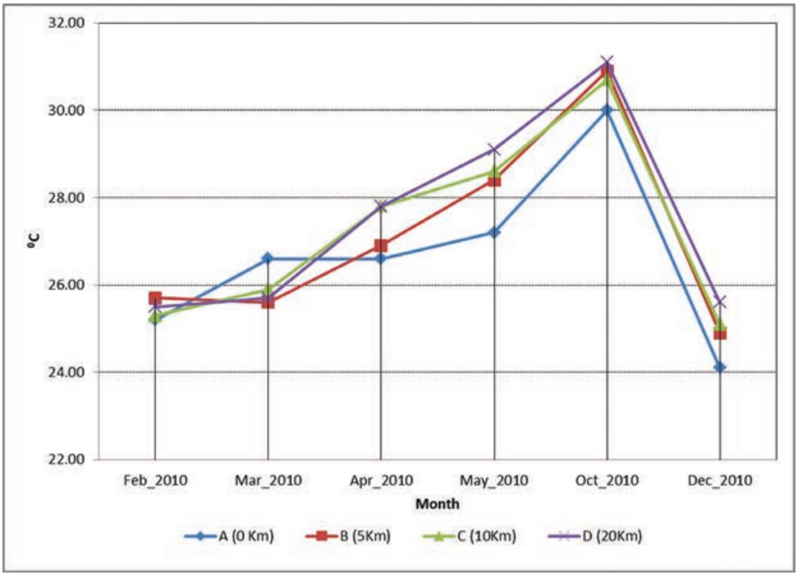


Fig. 211. Temperature (°C) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 41. pH flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	6.70	7.40	8.10	7.90
Mar_2010	6.7	6.60	6.70	6.60
Apr_2010	6.70	6.9	7.2	7.1
May_2010	7.60	6.9	7.6	7.3
Oct_2010	7.80	8.2	8.2	8.3
Dec_2010	8.00	8.3	8.3	8.4

Fig. 212. pH flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 42. Salinity (ppt) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	35.30	35.8	35.6	35.4
Mar_2010	34.6	34.8	34.5	34.8
Apr_2010	34.60	35.2	37.1	36.6 error/see hard copy
May_2010	34.10	36.2	36.6	35.4 error/see hard copy
Oct_2010	34.40	34.2	35.2	35.2
Dec_2010	34.90	34.9	34.7	34.7

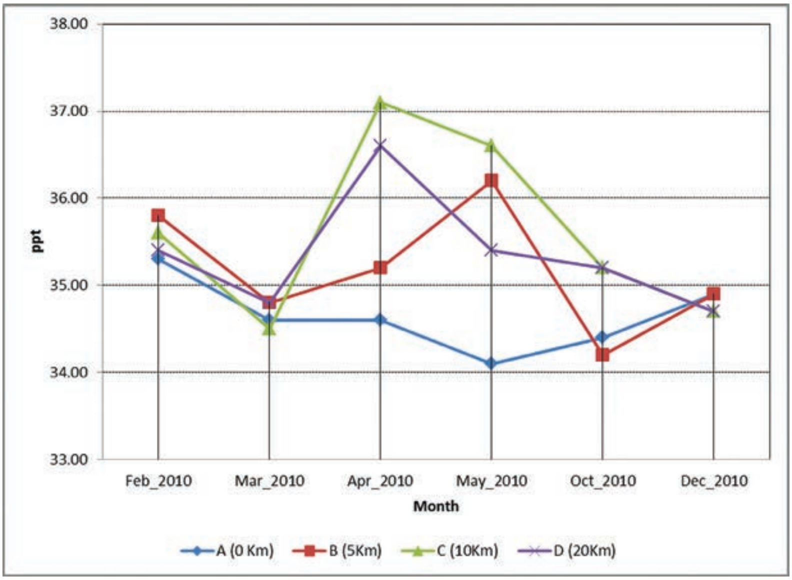


Fig. 213. Salinity (ppt) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 43. Dissolved Oxygen (ml/L) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	2.430	5.31	6.33	6.39
Mar_2010	3.51	4.89	4.89	4.56
Apr_2010	3.510	4.64	5.26	4.81
May_2010	4.300	5.26	5.71	5.88
Oct_2010	6.440	7.18	7.35	7.46
Dec_2010	5.310	5.71	5.43	5.37

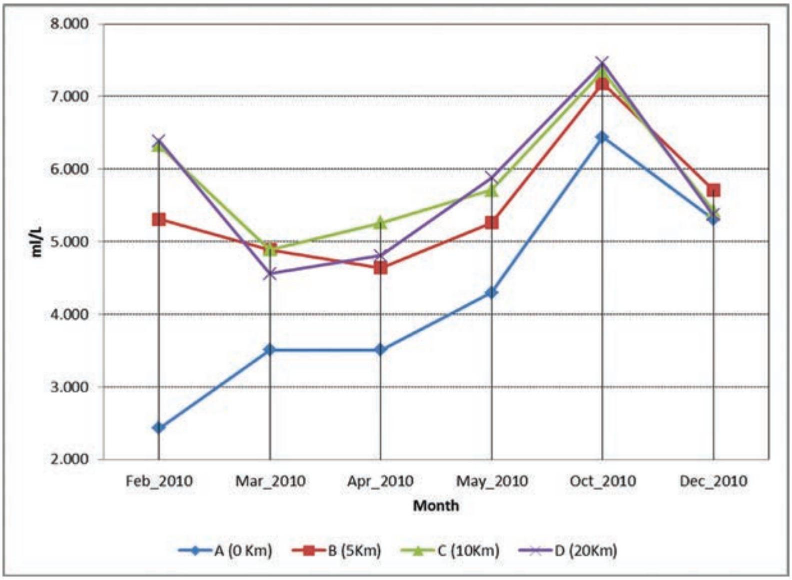


Fig. 214. Dissolved Oxygen (ml/L) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 44. Chlorophyll (mg m-3) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	0.186	0.0986	0.0863	0.0643
Mar_2010	0.2076	0.0512	0.0679	0.0339
Apr_2010	0.208	1.7068	0.2196	0.3124
May_2010	2.887	0.2686	2.2844	1.4196
Oct_2010	1.080	3.0164	1.1476	2.0058
Dec_2010	1.317	3.1592	4.5072	2.0082

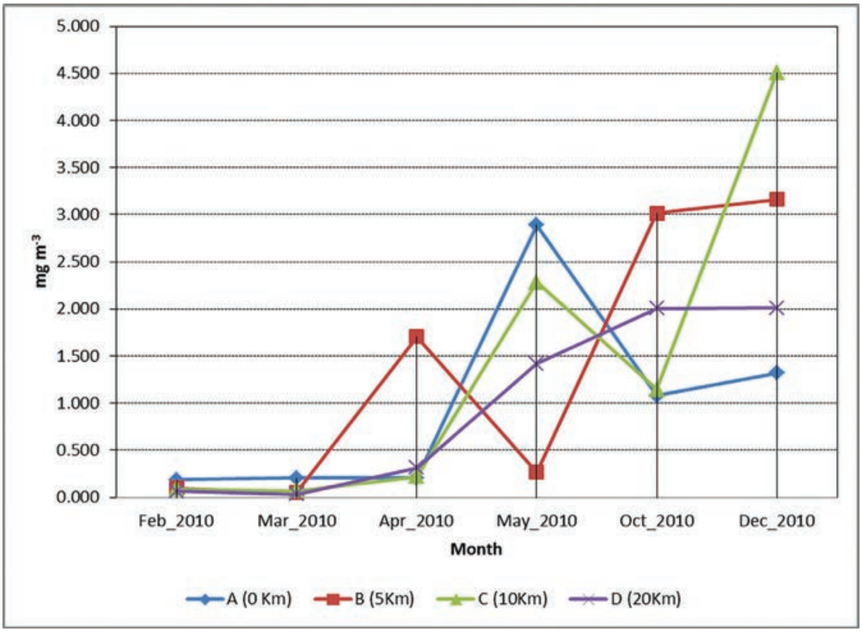


Fig. 215. Chlorophyll (mg m-3) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 45. Visibility (m) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	1.10	1.10	1.23	1.20
Mar_2010	1.40	1.15	1.22	1.21
Apr_2010	1.40	2.15	4.10	5.85
May_2010	1.87	8.45	10.05	8.05
Oct_2010	1.16	4.85	9.25	10.35
Dec_2010	3.25	4.50	3.12	6.45

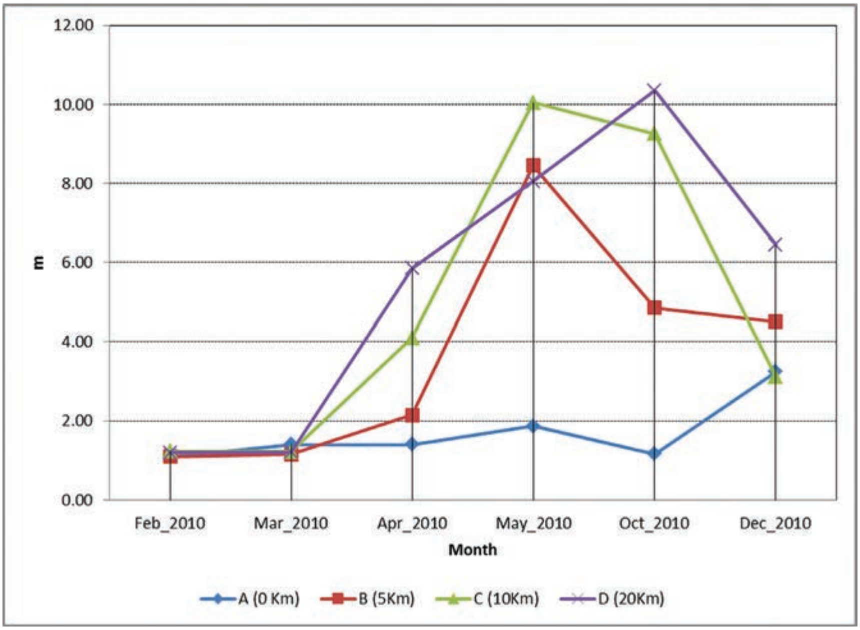


Fig. 216: Visibility (m) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 45. Gross and Net Primary Productivity (mg C/L/Hr) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)		B (5Km)		C (10Km)		D (20Km)	
	GPP	NPP	GPP	NPP	GPP	NPP	GPP	NPP
Feb_2010	0.080	0.060	0.17	0.07	0.01	0.02	0.06	0.05
Mar_2010	0.04	0.03	0.03	0.02	0.02	0.01	0.02	0.01
Apr_2010 error	0.040	0.030	0.09	0.08	0.05	0.04	0.03	0.02
May_2010 error	0.030	0.020	0.04	0.07	0.12	0.09	0.11	0.09
Oct_2010	0.270	0.010	0.08	0.03	0.09	0.03	0.08	0.03
Dec_2010	0.080	0.070	0.05	0.1	0.08	0.1	0.03	0.03

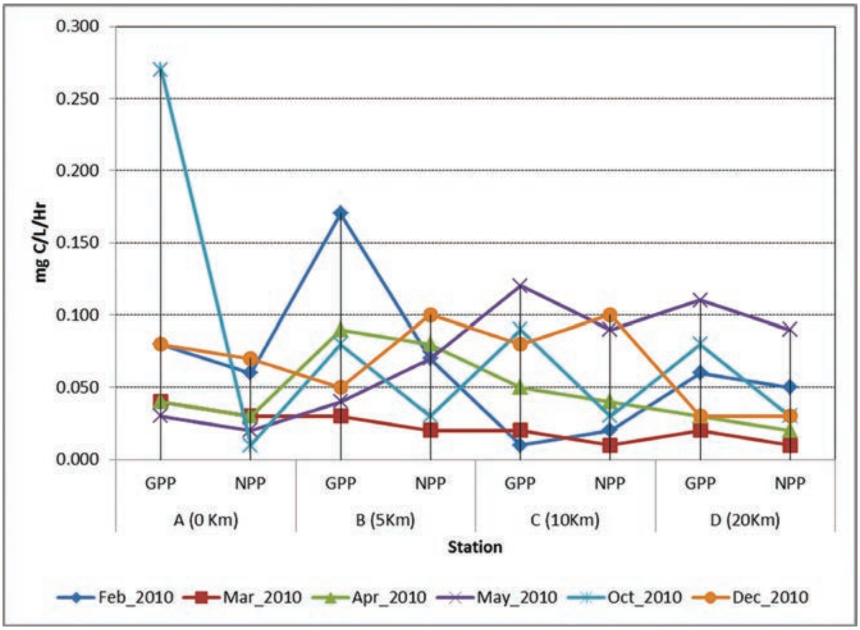


Fig. 217: Gross and Net Primary Productivity (mg C/L/Hr) flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 46. Ammonia concentration flux in selected sites of Veraval during the Study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	0.189	0.098	0	0
Mar_2010	0.013	0.221	0.183	0.186
Apr_2010 error	0.013	0.105	0	0
May_2010 error	0.011	0.009	0	0.002
Oct_2010	0.235	0.102	0.057	0.11
Dec_2010	0.086	0.018	0.004	0.071

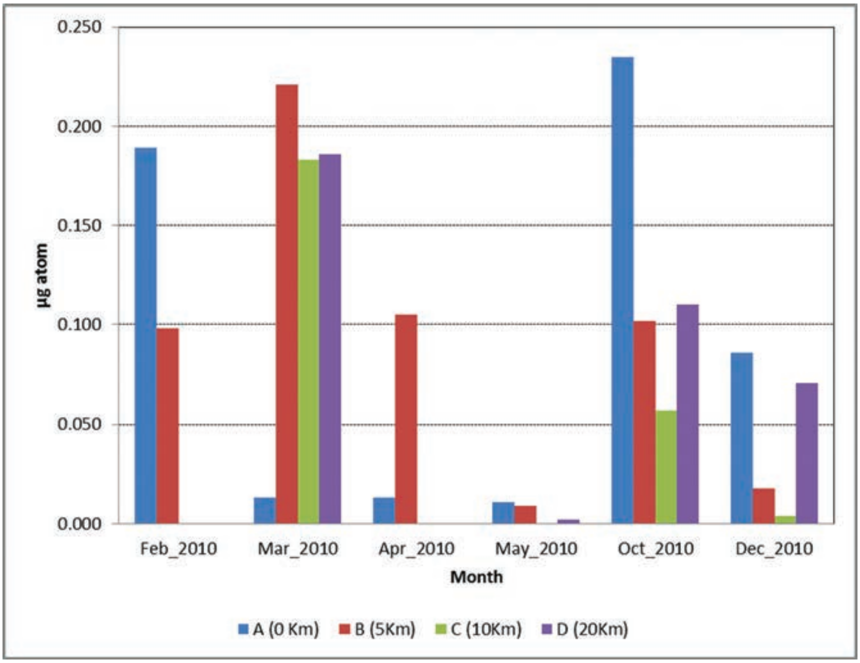


Fig. 218: Ammonia concentration flux in selected sites of Veraval during the Study period January-2010 to December-2010.

Table 47. Phosphate concentration flux in selected sites of Veraval during the study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	0.071	0.056	0.088	0.005
Mar_2010	0.099	0.007	0.005	0
Apr_2010	0.099	0.047	0.001	0.039
May_2010	0.071	0.031	0.112	0.051
Oct_2010	0.136	0.057	0.054	0.059
Dec_2010	0.048	0.052	0.05	0.039

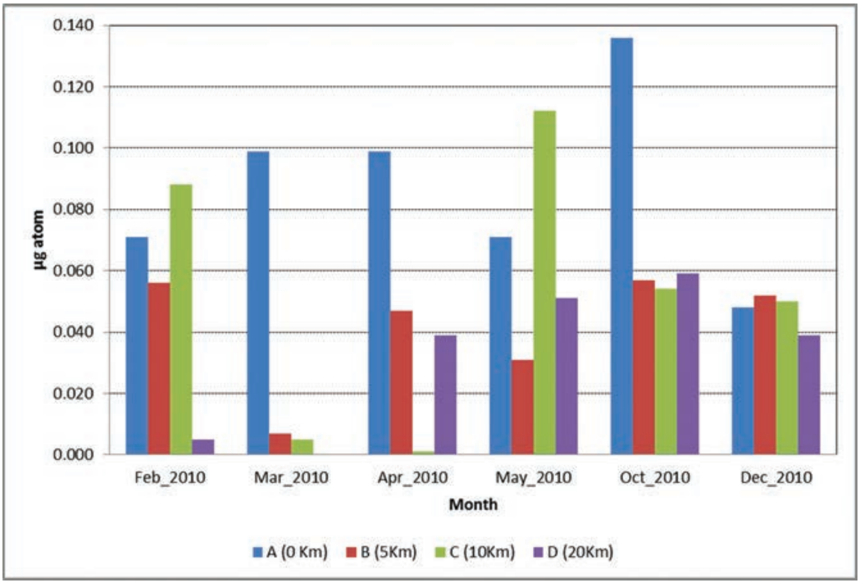


Fig. 219: Phosphate concentration flux in selected sites of Veraval during the study period January-2010 to December-2010.

Table 48. Nitrate concentration flux in selected sites of Veraval during the study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	6.181	4.655	2.327	4.655
Mar_2010	5.189	4.112	3.123	5.021
Apr_2010	5.189	4.12	4.731	4.159
May_2010	4.230	4.165	3.118	3.126
Oct_2010	7.886	6.914	8.11	6.391
Dec_2010	5.681	5.793	3.438	2.728

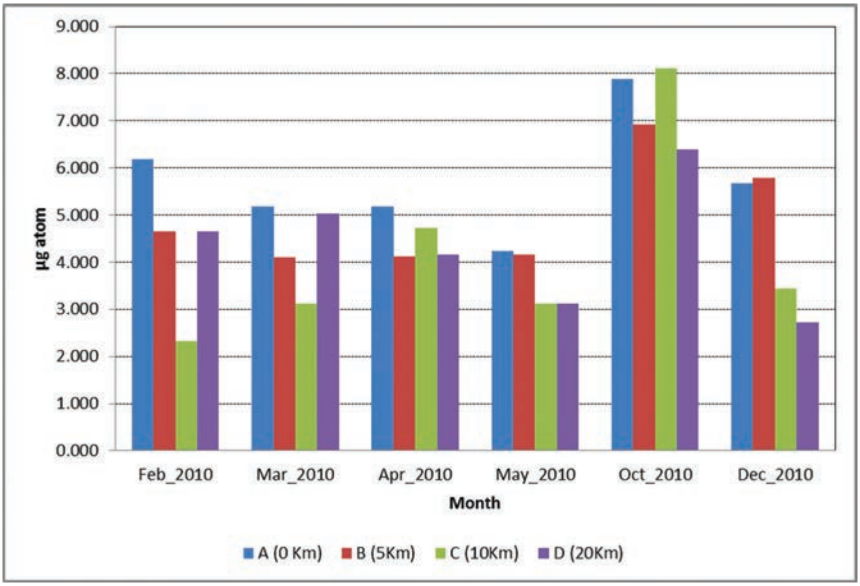


Fig. 220: Nitrate concentration flux in selected sites of Veraval during the study period January-2010 to December-2010.

Table 49. Silicate concentration flux in selected sites of Veraval during the study period January-2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	0.359	0.302	0.331	0.302
Mar_2010	0.735	0.184	0.183	0.189
Apr_2010	0.735	0.504	0.591	0.619
May_2010	0.639	0.622	0.461	0.342
Oct_2010	0.974	0.729	0.81	0.77
Dec_2010	0.729	0.892	0.729	0.157

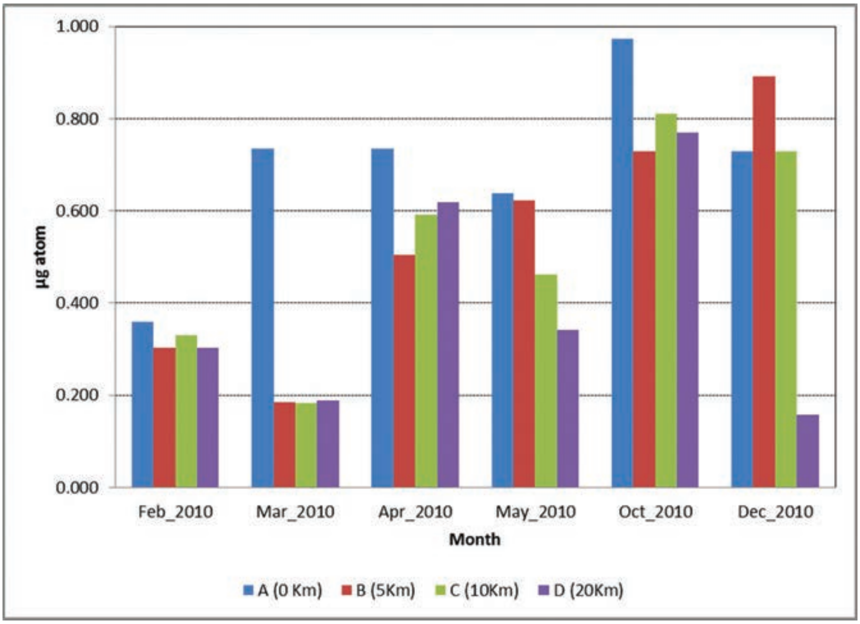


Fig. 221: Silicate concentration flux in selected sites of Veraval during the study period January-2010 to December-2010.

Table 50. Temperature (°C) flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	30.9	31.4	30.6	31
Dec_2010	23.6	23.9	24.9	24.8

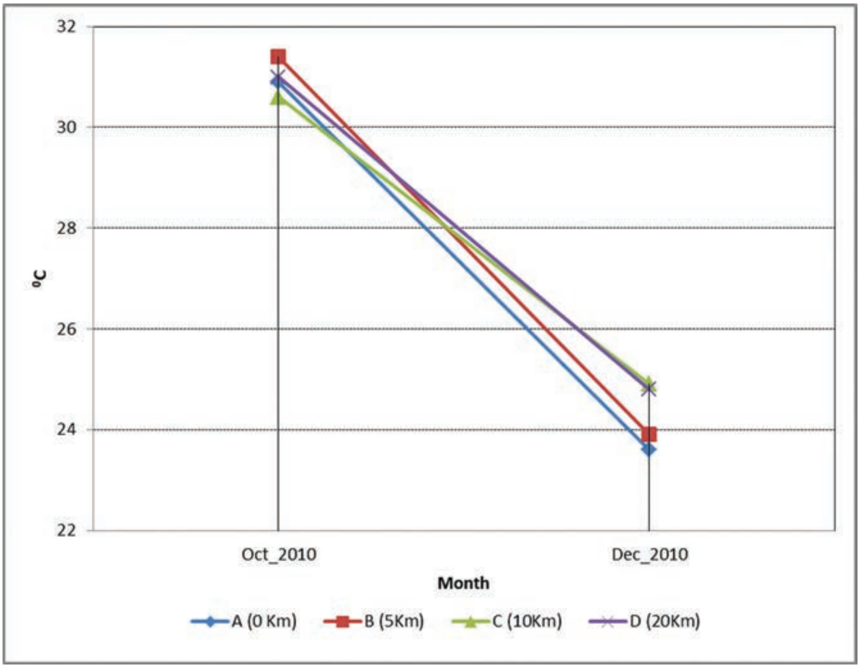


Fig. 222: Temperature (°C) flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 51. pH flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	8.2	8.2	8.4	8.4
Dec_2010	7.9	8.2	8.2	8.3

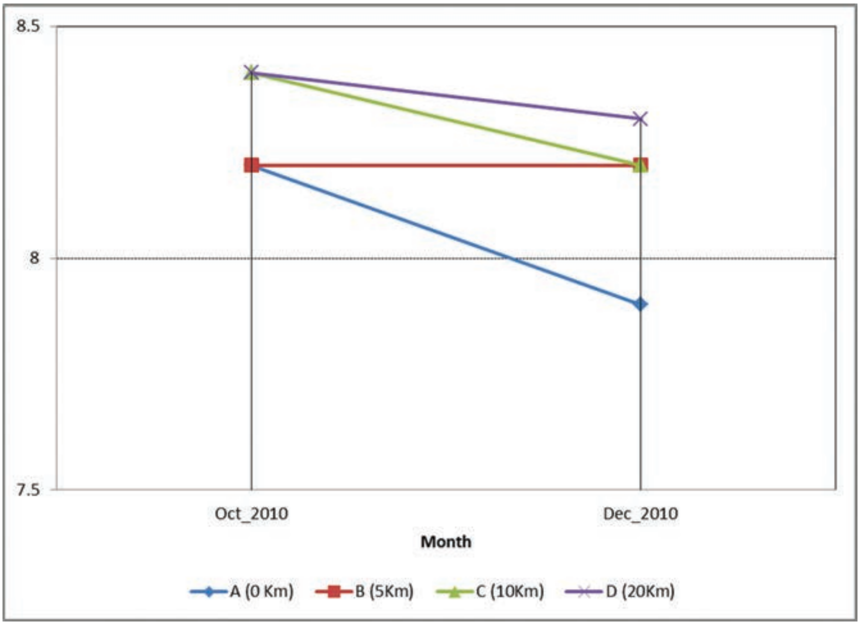


Fig. 223: pH flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 52. Salinity (ppt) flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	32.2	34.1	33.4	35
Dec_2010	35.1	36.2	36.6	35.7

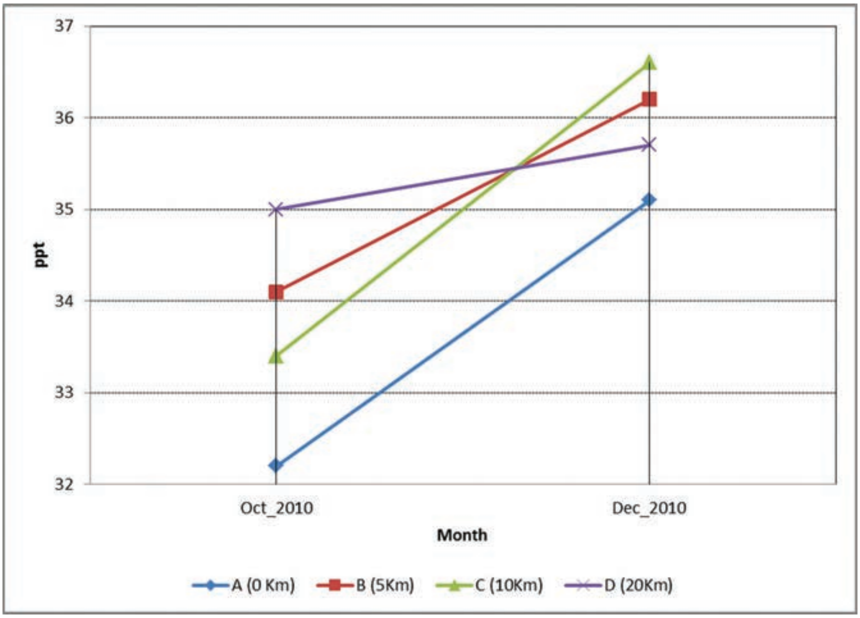


Fig. 224: Salinity (ppt) flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 53. Dissolved Oxygen (ml/L) flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	8.7	8.7	8.4	7.86
Dec_2010	5.2	5.2	5.48	5.31

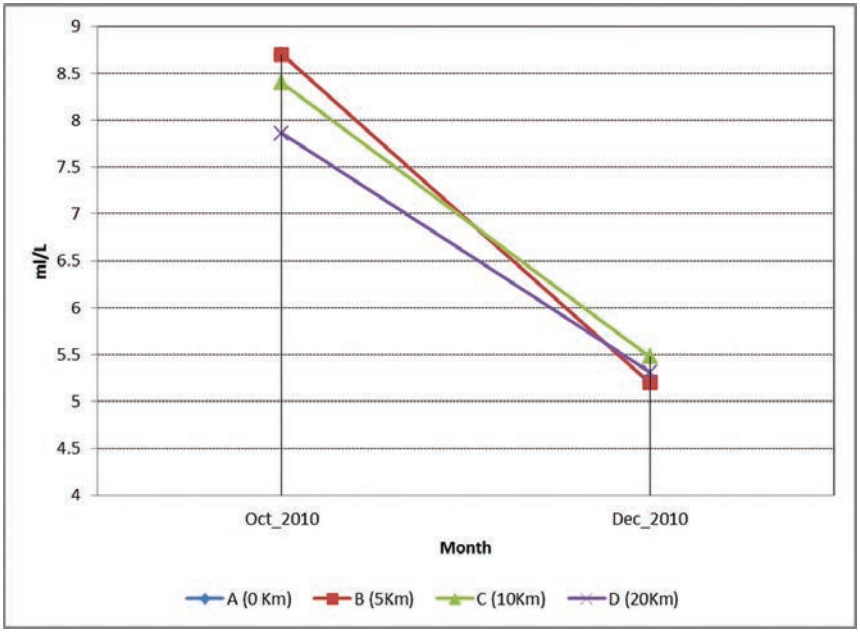


Fig. 225: Dissolved Oxygen (ml/L) flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 54. Chlorophyll (mg m-3) flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	1.5942	0.8864	0.8632	1.0154
Dec_2010	0.474	0.4016	0.4016	0.197

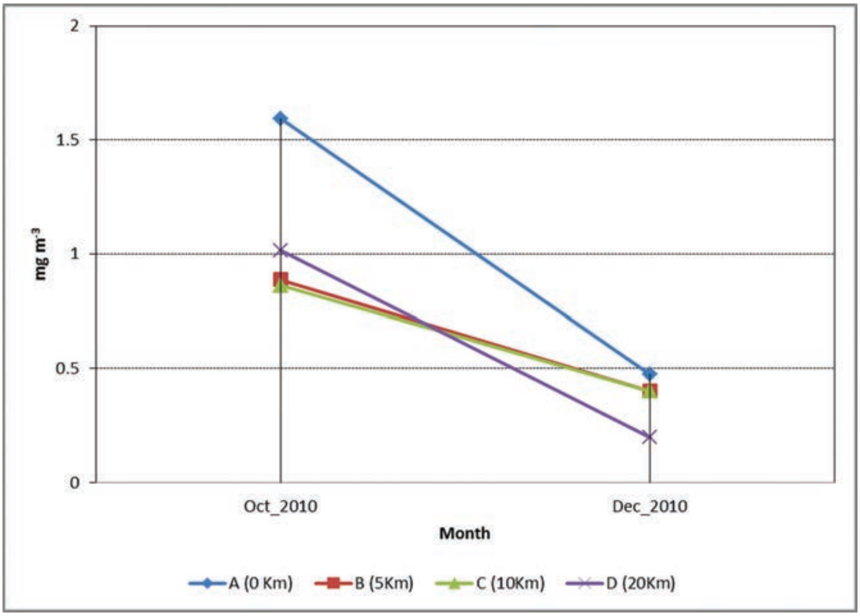


Fig. 226: Chlorophyll (mg m-3) flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 55. Visibility (m) flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	2.97	3.15	3.8	3.33
Dec_2010	0.87	0.57	1.57	1.62

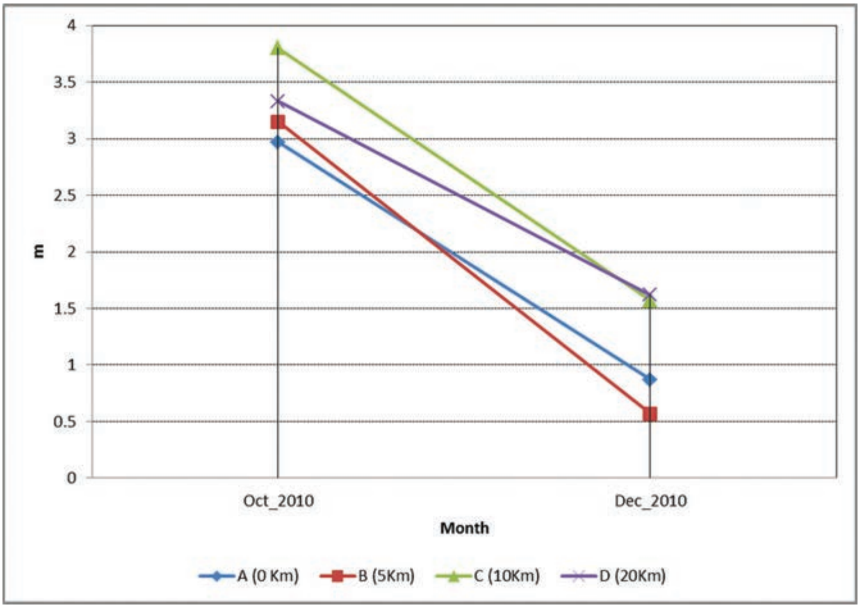


Fig. 227: Visibility (m) flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 56. Gross and Net Primary Productivity (mg C/L/Hr) flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)		B (5Km)		C (10Km)		D (20Km)	
	GPP	NPP	GPP	NPP	GPP	NPP	GPP	NPP
Oct_2010	0.02	0.02	0.08	0.11	0.01	0	0.01	0.05
Dec_2010	0.05	0.04	0.02	0.02	0.08	0.02	0.04	0.01

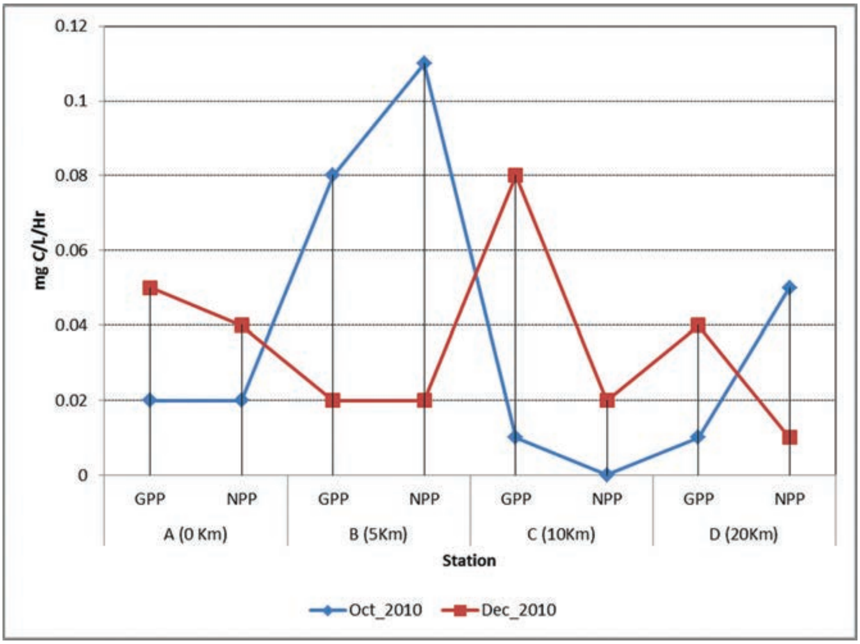


Fig. 228: Gross and Net Primary Productivity (mg C/L/Hr) flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 57. Ammonia concentration flux in selected sites of Diu during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	0	0.158	0.089	0.052
Dec_2010	0	0	0.01	0.02

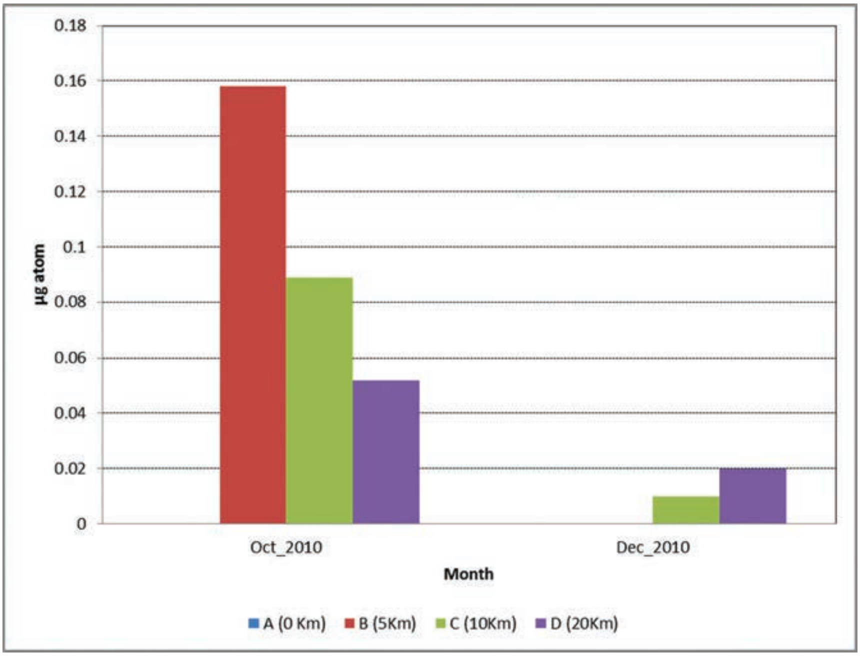


Fig. 229: Ammonia concentration flux in selected sites of Diu during the Study period October -2010 to December-2010.

Table 58. Phosphate concentration flux in selected sites of Diu during the study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	0.048	0.081	0.068	0.054
Dec_2010	0.074	0.065	0.057	0.072

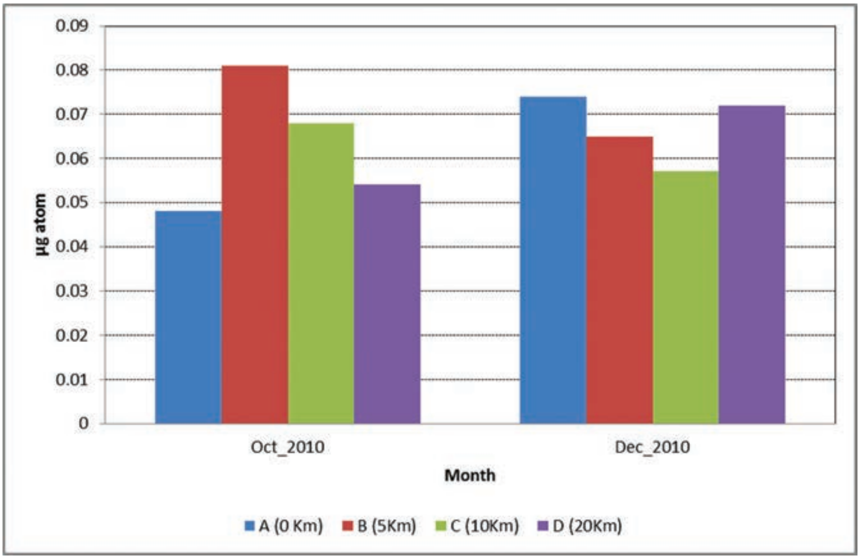


Fig. 230: Phosphate concentration flux in selected sites of Diu during the study period October -2010 to December-2010.

Table 59. Nitrate concentration flux in selected sites of Diu during the study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	4.373	4.448	4.448	3.663
Dec_2010	6.952	9.194	5.158	5.083

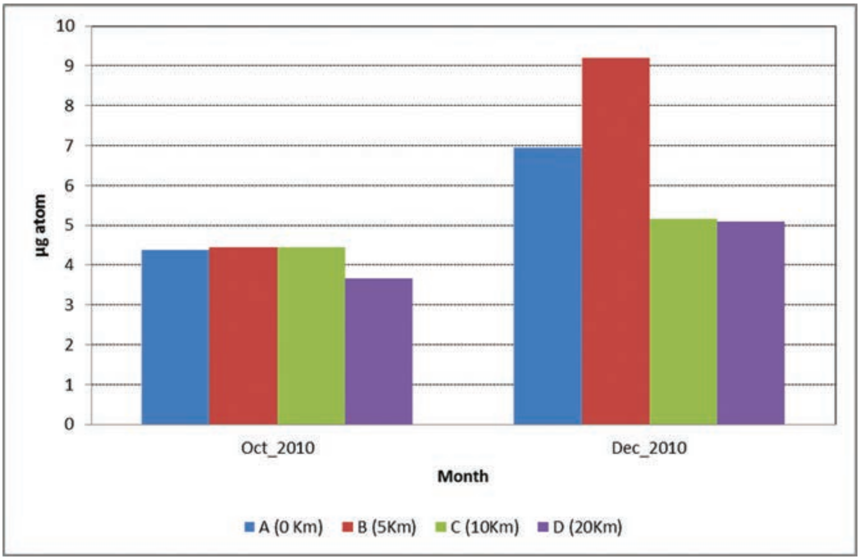


Fig. 231: Nitrate concentration flux in selected sites of Diu during the study period October -2010 to December-2010.

Table 60. Silicate concentration flux in selected sites of Diu during the study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	0.566	0.443	0.157	0.402
Dec_2010	1.055	1.178	0.892	0.974

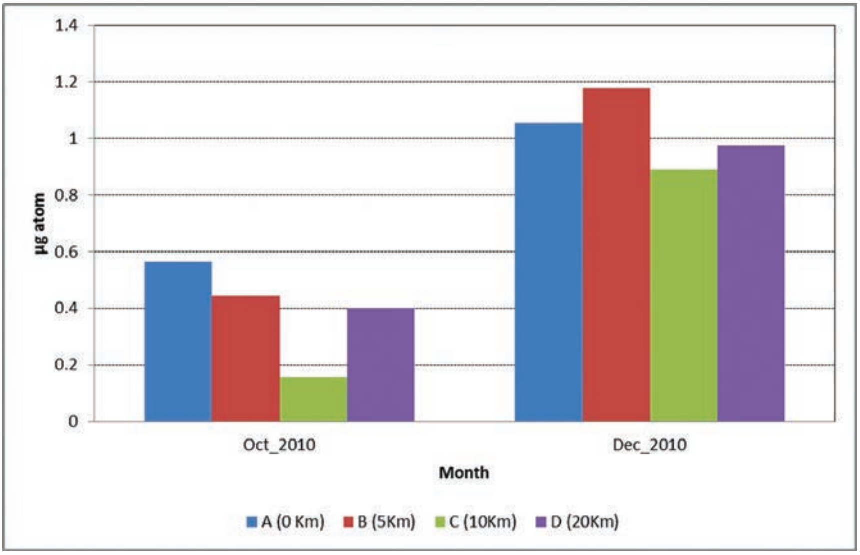


Fig. 232: Silicate concentration flux in selected sites of Diu during the study period October -2010 to December-2010.

Table 61. Temperature (°C) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	29.46	29.3	29.5	30.9
Dec_2010	24.4	24.6	24.9	25.7

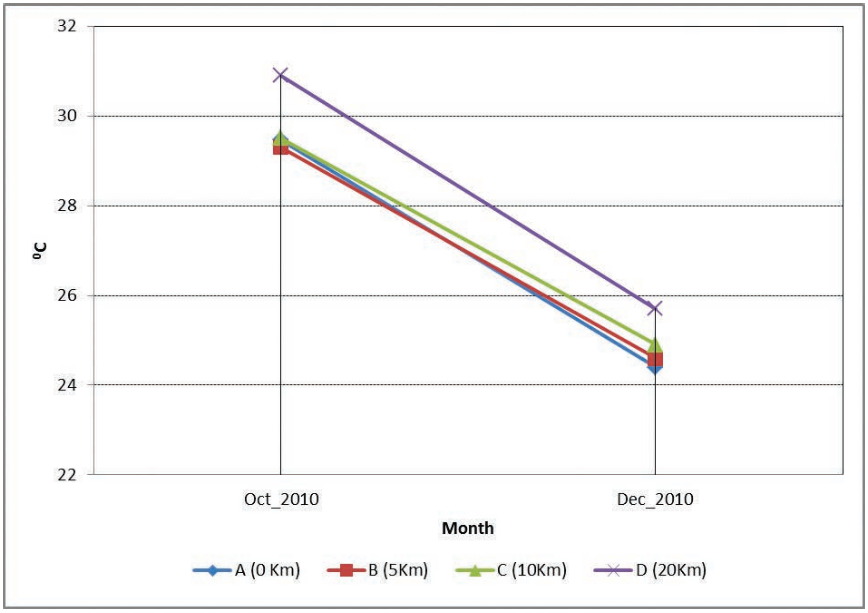


Fig. 233 Temperature (°C) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 62. pH flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	7.4	7.9	7.8	7.3
Dec_2010	7.9	7.9	8	8.2

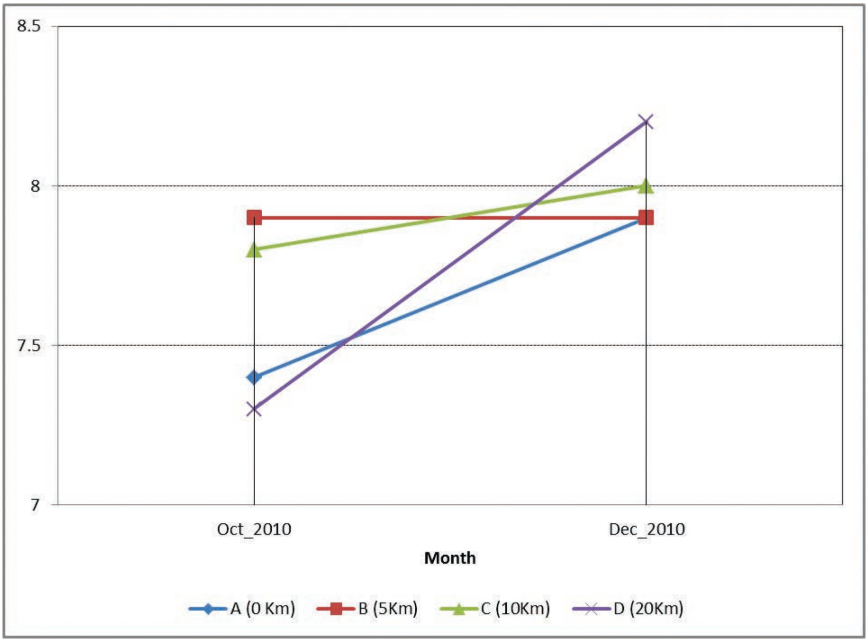


Fig. 234: pH flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 63. Salinity (ppt) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	33.6	33.8	34.7	35.3
Dec_2010	34.4	34.3	35.1	35.3

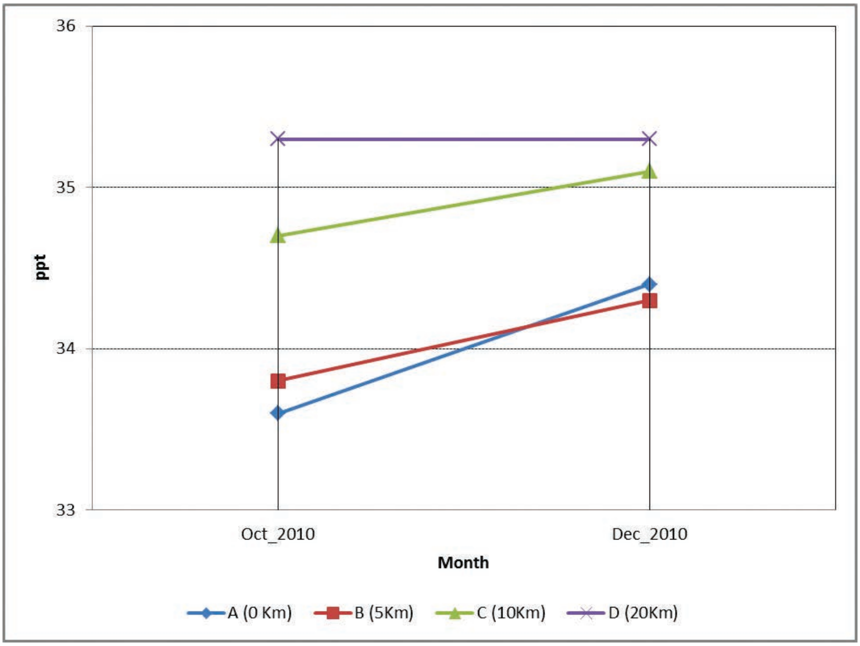


Fig. 235: Salinity (ppt) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 64. Dissolved Oxygen (ml/L) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	5.15	5.54	5.77	4.81
Dec_2010	5.31	5.15	4.97	4.75

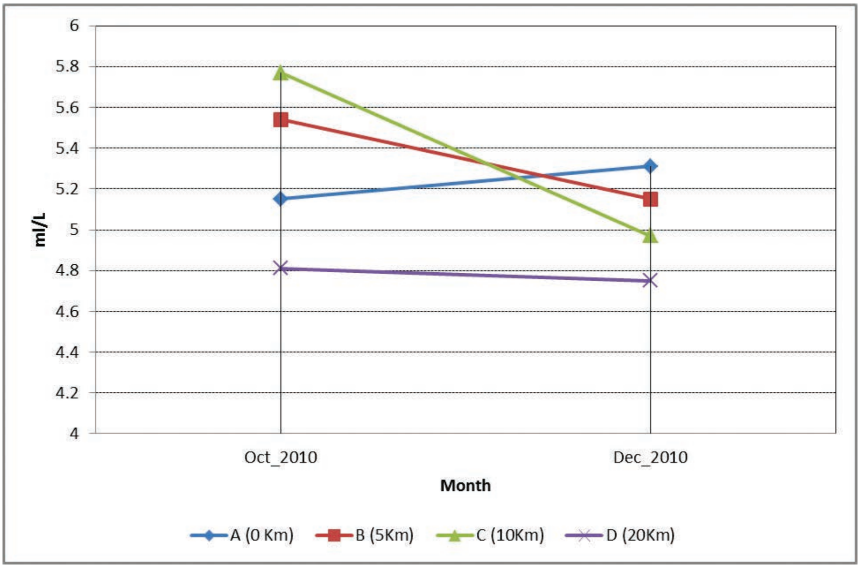


Fig. 236: Dissolved Oxygen (ml/L) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 65. Chlorophyll (mg m-3) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	1.9402	0.183	0.657	0.149
Dec_2010	1.7912	1.9774	1.051	0.943

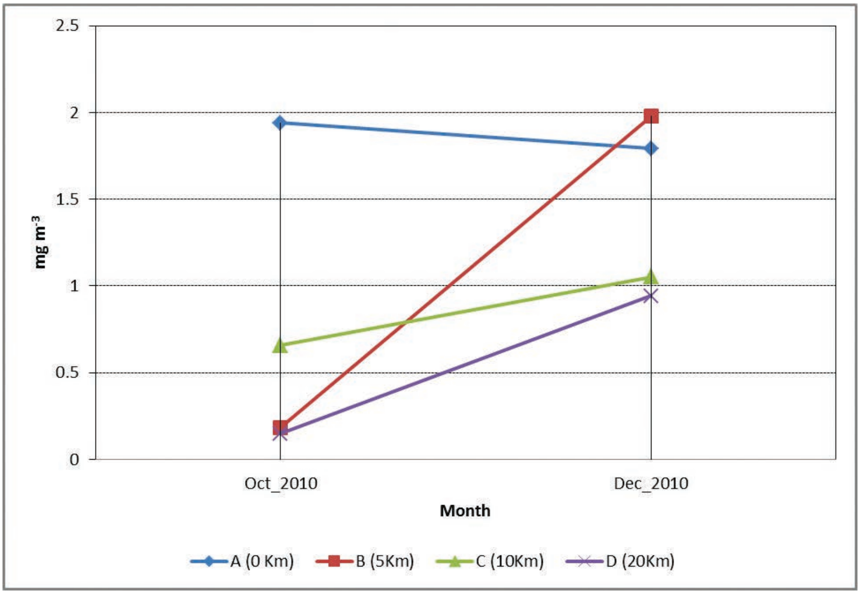


Fig. 237: Chlorophyll (mg m-3) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 66. Visibility (m) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	5.25	7.25	7.25	10.3
Dec_2010	3.05	3.07	3.05	6.05

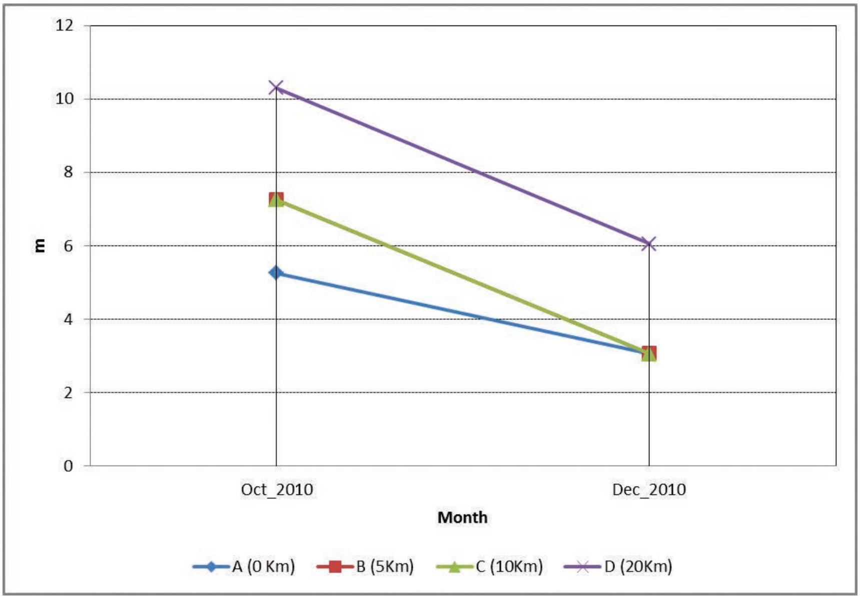


Fig. 238: Visibility (m) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 67. Gross and Net Primary Productivity (mg C/L/Hr) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

	A (0 Km)		B (5Km)		C (10Km)		D (20Km)	
	GPP	NPP	GPP	NPP	GPP	NPP	GPP	NPP
Oct_2010	0.12	0.06	0.06	0.02	0.11	0.04	0.11	0.09
Dec_2010	0.07	0.13	0.29	0.03	0.11	0.03	0.08	0.06

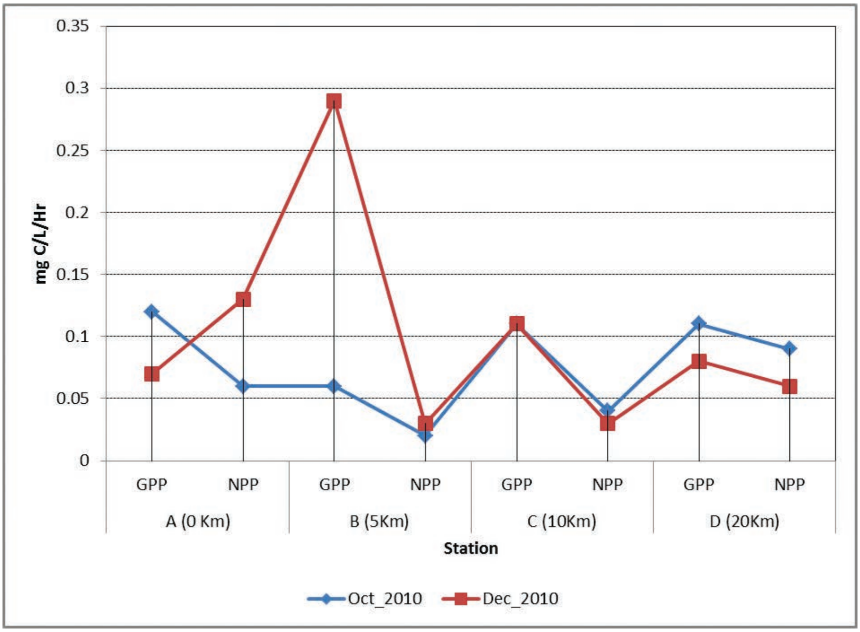


Fig. 239: Gross and Net Primary Productivity (mg C/L/Hr) flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 68. Ammonia concentration flux in selected sites of Mangrol during the Study period October- October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	0.37	0.116	0.171	0.065
Dec_2010	0	0	0.015	0

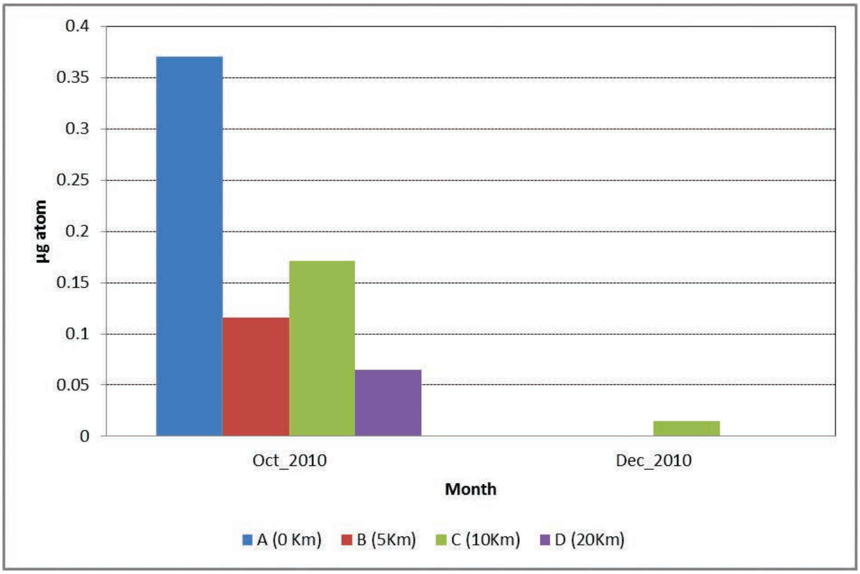


Fig. 240: Ammonia concentration flux in selected sites of Mangrol during the Study period October -2010 to December-2010.

Table 69. Phosphate concentration flux in selected sites of Mangrol during the study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	0.061	0.052	0.048	0.046
Dec_2010	0.052	0.043	0.054	0.032

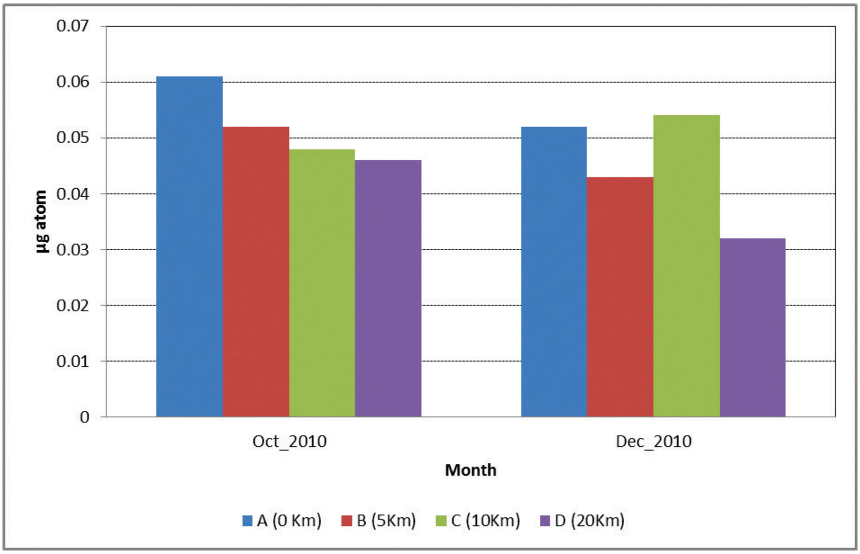


Fig. 241: Phosphate concentration flux in selected sites of Mangrol during the study period October -2010 to December-2010.

Table 70. Nitrate concentration flux in selected sites of Mangrol during the study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	6.129	3.85	4.485	5.345
Dec_2010	0	0	0.822	0.822

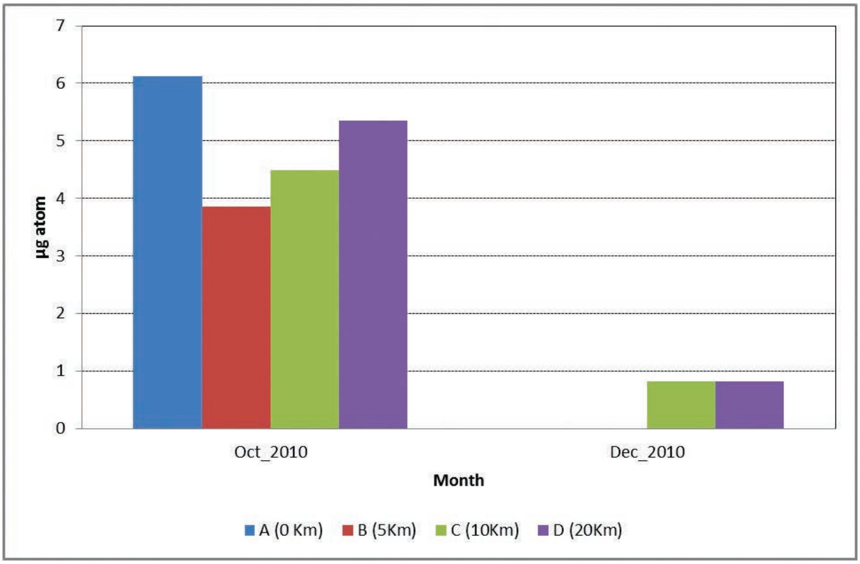


Fig. 242: Nitrate concentration flux in selected sites of Mangrol during the study period October -2010 to December-2010.

Table 71. Silicate concentration flux in selected sites of Mangrol during the study period October -2010 to December-2010.

	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	0.647	0.647	0.321	0.296
Dec_2010	0.402	0.402	0.525	0.28

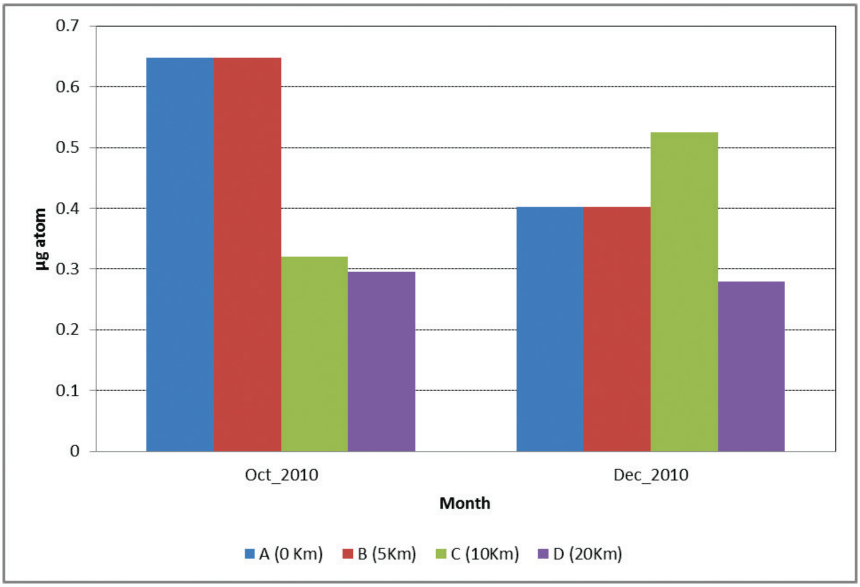


Fig. 243: Silicate concentration flux in selected sites of Mangrol during the study period October -2010 to December-2010.

Table 72. Abundance (in no of cells l-1) and pattern of monthly variations of phytoplankton in the selected sites of Whale Shark habituate at Veraval coast.

Month	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Feb_2010	54300	53800	53700	43400
Mar_2010	44300	33800	23700	13400
Apr_2010	5300	38000	37000	30400
May_2010	33300	13800	9700	84400
Oct_2010	55300	33800	23700	12600
Dec_2010	36400	13800	3700	3400

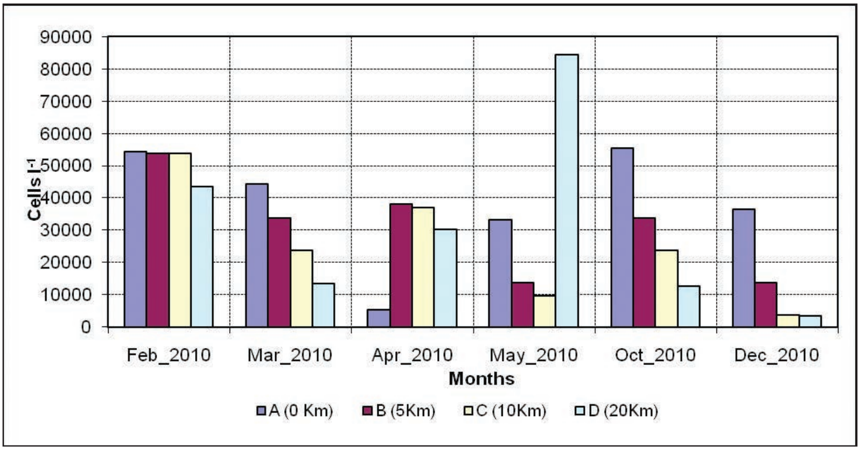


Fig. 244: Abundance (in no of cells l-1) and pattern of monthly variations of phytoplankton in the selected sites of Whale Shark habituate at Veraval coast.

Table 73. Abundance (in no of cells l-1) and pattern of monthly variations of phytoplankton in the selected sites of Whale Shark habituate at Diu coast.

Month	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	12000	5000	2500	2500
Dec_2010	9000	5000	1600	2300

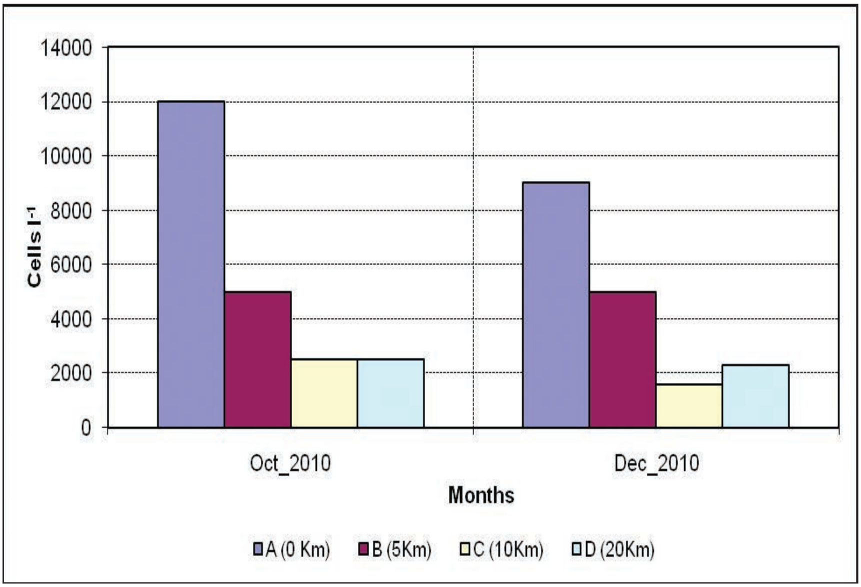


Fig. 245: Abundance (in no of cells l-1) and pattern of monthly variations of phytoplankton in the selected sites of Whale Shark habituate at Diu coast.

Table 74. Abundance (in no of cells l-1) and pattern of monthly variations of phytoplankton in the selected sites of Whale Shark habituate at Mangrol coast.

Month	A (0 Km)	B (5Km)	C (10Km)	D (20Km)
Oct_2010	26000	23000	10000	11000
Dec_2010	13000	6000	4500	2100

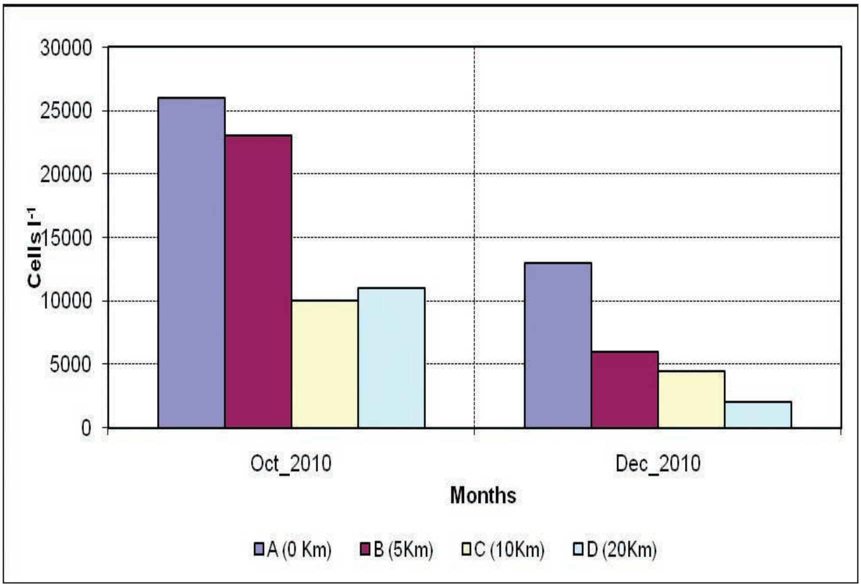


Fig. 246: Abundance (in no of cells l-1) and pattern of monthly variations of phytoplankton in the selected sites of Whale Shark habituate at Mangrol coast.

Table 75(a) Diversity of Phytoplankton in the selected sites of Whale Shark habituate at Veraval, Diu and Mangrole.

Sl. No.	Name	Veraval (VRL)				Diu (DIU)				Mangrole (MGR)			
		A	B	c	D	A	B	c	D	A	B	c	D
	Diatoms- Centrales												
1.	*Skeletonema costatum*	+	++	++	-	-	+	+	-	-	-	-	-
2.	*Thallassiophyxix palmeriana*	-	+	-	+	-	-	+	+	+	+	-	-
3.	*Thallassiosira subtilis*	++	-	-	+	-	-	+	+	-	-	+	-
4.	*Coscinodiscus excentricus*	+++	++	++	++	++	++	+	++	++	++	++	+
5.	*Planktoniella sol*	-	+	+	-	-	-	-	-	++	+	-	-
6.	*Rhizosolenia robusta*	+	-	++	-	+	-	-	+	++	+	+	+
7.	*Eucampia cornuta*	-	+	-	-	-	+	-	-	-	-	+	+
8.	*Biddulphia mobiliensis*	++	+	+	-	+	-	-	-	++	+	-	-
9.	*Ditylum brightwelli*	-	-	-	-	-	-	+	+	+	++	+	-
10.	*Biddulphia sinensis*	++	+	+	-	-	-	-	-	+++	++	+	-
11.	*Cerataulina bergonii*	+	++	++	-	-	-	-	++	-	+	+	+
12.	*Cyclotella sp.*	+++	+	+	+	++	+	+	-	-	-	-	-
13.	*Chaetoceros sp.*	++	++	++		+	+	-	-	-	+	++	++
14.	*Llthodesmium sp.*	-	-	+	+	-	-	-	+	++	+	-	-
	Diatoms- Pennales												
1.	*Grammatophora undulate*	++	+	-	-	-	-	-	+	++	+	+	-
2.	*Licmophora delicatula*	-	-	+	+	-	-	-	+	+	-	-	+
3.	*Fragilaria oceanic*	+	+	-	-	-	-	-	+	-	++	+	-
4.	*Rhaphoneis discoides*	-	-	-	++	-	-	-	++	-	+	++	-
5.	*Thallasiothrix frauenfeldii*	++	+	+	+	+	+	++	+	++	++	++	++
6.	*Asterionella japonica*	-	-	-	+	-	-	+	+	-	+	+	-
7.	*Mastogloia exilis*	+	+	+	-	+	++	+	-	+	+	++	-

***Abundant = + + +; Average = + +; Less in Number = +; Absent = -**

Table 75 (b) Diversity of Phytoplankton in the selected sites of Whale Shark habituate at Veraval, Diu and Mangrole.

Sl. No.	Name	Veraval (VRL)				Diu (DIU)				Mangrole (MGR)			
		A	B	c	D	A	B	c	D	A	B	c	D
8.	*Cocconeis littoralis*	-	-	++	+	-	-	++	+	-	-	-	-
9.	*Gyrosigma balticum*	-	+	++	+	-	+	++	+	+	+	++	-
10.	*Bacillaria paradoxa*	+	-	-	-	+	-	-	-	-	-	-	-
11.	*Nitzschia closterium*	+	++	+	+	++	+	-	+	+	++	+	+
12.	*Nitzschia sp.*	+++	++	+	+	-	+	++	++	++	++	++	+++
13.	*Surirella fluminensis*	-	-	+	+	-	-	-	+	-	++	-	-
14.	*Campylodiscus iyengarii*	-	-	-	+	-	-	-	+	-	-	++	+
15.	*Navicula sp.*	-	-	+	+	+	++	-	-	-	-	+	++
16.	*Thalassionema nitzschioides*	-	-	-	+	-	-	-	-	++	++	-	-
Dinoflagellates													
1.	*Ceratium sp.*	++	+	+	+	-	-	++	++	++	+	++	+
2.	*Cochlodinium citron*	-	+	-	-	++	-	+	-	+	-	-	-
3.	*Amphisolenia bifurcate*	+	+	++	-	-	-	-	+	-	+	+	-
4.	*Ceratium declinatum*	-	-	+	-	-	-	+	-	-	-	-	+
5.	*Dinophysis caudate*	+	-	-	-	-	+	++	-	-	-	-	+
6.	*Peridinium claudicans*	-	-	-	+	-	-	++	+	-	-	+	+
7.	*Podolampas bipes*	-	-	-	-	-	-	-	-	-	-	-	-
8.	*Pyrophacus horologium*	-	-	-	-	-	-	-	-	-	-	-	-
9.	*Diplopsalis sp.*	-	-	-	-	-	-	-	-	-	-	-	-
10.	*Ornithocercus magnificus*	++	++	+	-	-	++	+	-	++	++	++	+++
11.	*Prorocentrum sp.*	-	-	-	-	-	-	-	-	-	+	+	-

Table 75(c) Diversity of Phytoplankton in the selected sites of Whale Shark habituate at Veraval, Diu and Mangrole.

S.No.	Name	Veraval (VRL)				Diu (DIU)				Mangrole (MGR)			
		A	B	c	D	A	B	c	D	A	B	c	D
Silicoflagellates, Blue-Green algae & Nannoplankton													
1.	*Blue green algae*	+++	+	-	-	++	+	-	-	+++	+	-	-
2.	*Spirulina sp.*	-	-	-	-	-	-	-	-	-	-	-	-
3.	*Pavlova sp.*	-	-	-	-	-	-	-	-	-	-	-	-
4.	*Dunaliena sp.*	-	-	-	-	-	-	-	-	-	-	-	-
5.	*Nanno Chloropsis*	-	+	-	-	-	-	-	+	-	-	+	-
6.	*Chlorella sp.*	+	-	-	-	+	-	-	-	-	-	-	-
7.	*Tetraselmis sp.*	-	-	-	-	-	-	-	-	-	-	-	-

***Abundant = + + +; Average = + +; Less in Number = +; Absent = -**

Table 76. Group vise zooplankton population density in Station-A of Whale Shark habituate sites at Veraval.

Group	Feb_2010	Mar_2010	Apr_2010	May_2010	Oct_2010	Dec_2010
Hydromedusae	0	0	30	0	0	0
Siphonophora	0	0	0	0	0	0
Chaetognatha	0	0	10	2	2	1
Copepod	1.2	1.3	0	3	24	12
Sergestidae	13	3	1.3	13	4	0
Invertebrate larvae	33	3	0.3	3	12	7
Thaliacea	2	0	0	0	0	0
Fish eggs	23	3	3	4	7	32
Fish larvae	1	2	1.7	7	2	50

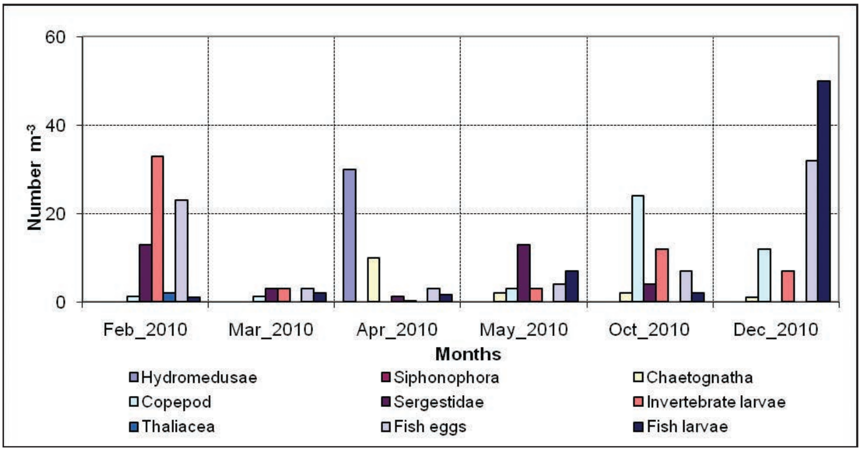


Fig. 247: Group vise zooplankton population density in Station-A of Whale Shark habituate sites at Veraval.

Table 77. Group vise zooplankton population density in Station-B of Whale Shark habituate sites at Veraval.

Group	Feb_2010	Mar_2010	Apr_2010	May_2010	Oct_2010	Dec_2010
Hydromedusae	12	2	21	0	5	0
Siphonophora	0	0	0	0	0	0
Chaetognatha	0	0	7.5	0	3	1
Copepod	11	123	2.2	1	27	25
Sergestidae	0	0	0.9	13	3	1
Invertebrate larvae	13	3	0	3	17	5
Thaliacea	0	0	0	0	0	0
Fish eggs	0	0	2.2	2	0	36
Fish larvae	25	5	2.5	7	0	12

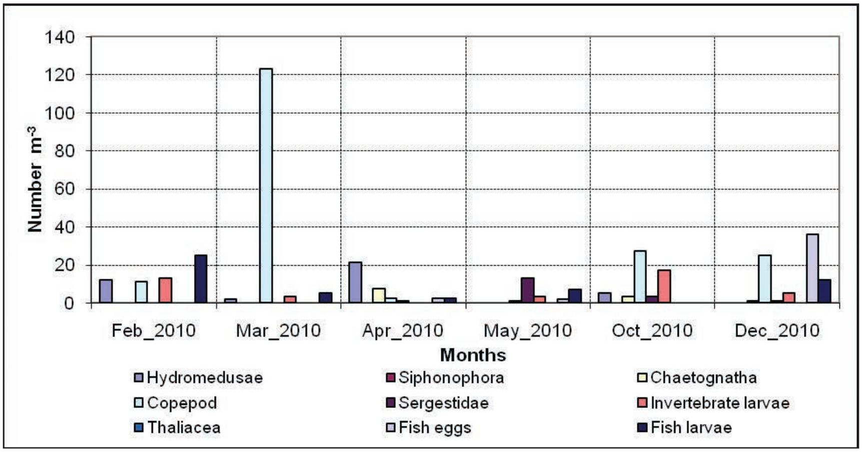


Fig. 248: Group vise zooplankton population density in Station-B of Whale Shark habituate sites at Veraval.

Table 78: Group vise zooplankton population density in Station-C of Whale Shark habituate sites at Veraval.

Group	Feb_2010	Mar_2010	Apr_2010	May_2010	Oct_2010	Dec_2010
Hydromedusae	11	1	27.5	0	3	2
Siphonophora	0	0	0	0	0	0
Chaetognatha	11	1	5.2	0	2	3
Copepod	14	156	2.5	14	17	22
Sergestidae	0	0	6	0	2	0
Invertebrate larvae	12	2	1.5	21	13	6
Thaliacea	0	0	0.7	0	0	0
Fish eggs	20	0	1.2	22	4.2	27
Fish larvae	22	2	0	32	1.3	4

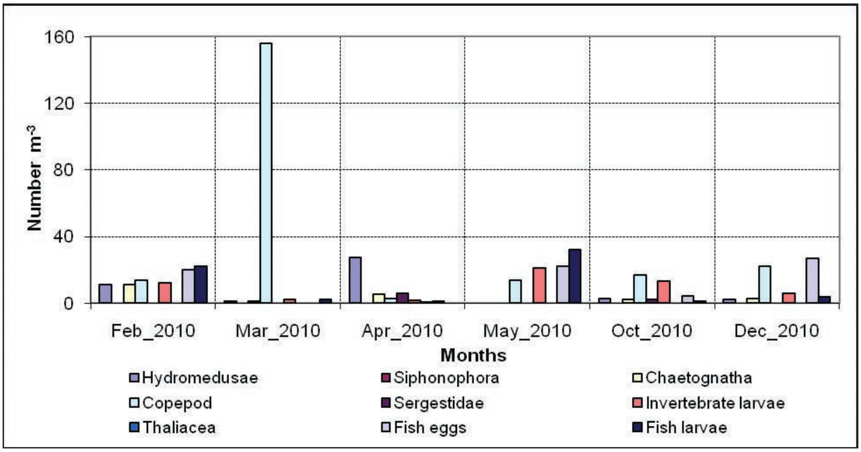


Fig. 249: Group vise zooplankton population density in Station-C of Whale Shark habituate sites at Veraval.

Table 79. Group vise zooplankton population density in Station-D of Whale Shark habituate sites at Veraval.

Group	Feb_2010	Mar_2010	Apr_2010	May_2010	Oct_2010	Dec_2010
Hydromedusae	0	0	21.3	0	8	0
Siphonophora	0	0	0	0	0	1
Chaetognatha	0	0	1	34	1	5
Copepod	42	133	3.1	19	15	23
Sergestidae	27	7	1.1	0	2	1
Invertebrate larvae	33	3	0.5	32	8	9
Thaliacea	0	0	0	0	2	2
Fish eggs	12	2	1	12	0	18
Fish larvae	13	3	0	18	0	7.9

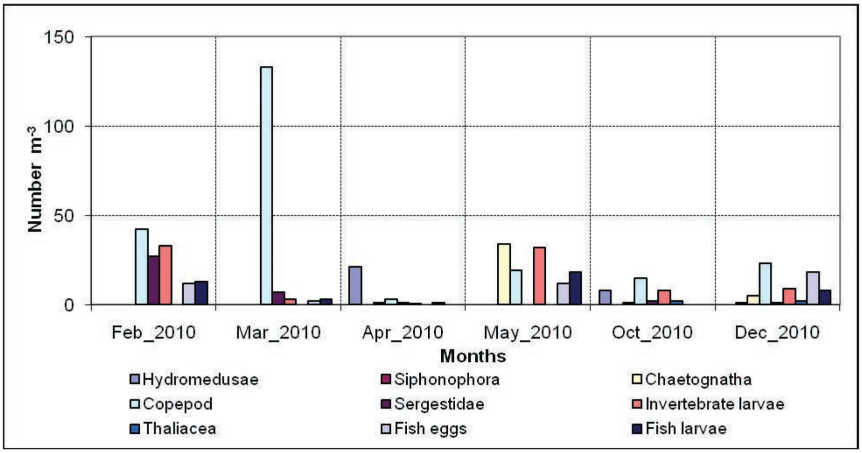


Fig. 250: Group vise zooplankton population density in Station-D of Whale Shark habituate sites at Veraval.

Table 80. Group vise zooplankton population density in Station-A of Whale Shark habituate sites at Diu.

Group	Oct_2010	Dec_2010
Hydromedusae	0	1
Siphonophora	0	0
Chaetognatha	0	0
Copepod	25	26
Sergestidae	0	5
Invertebrate larvae	12	8
Thaliacea	0	0
Fish eggs	7	38
Fish larvae	1	0

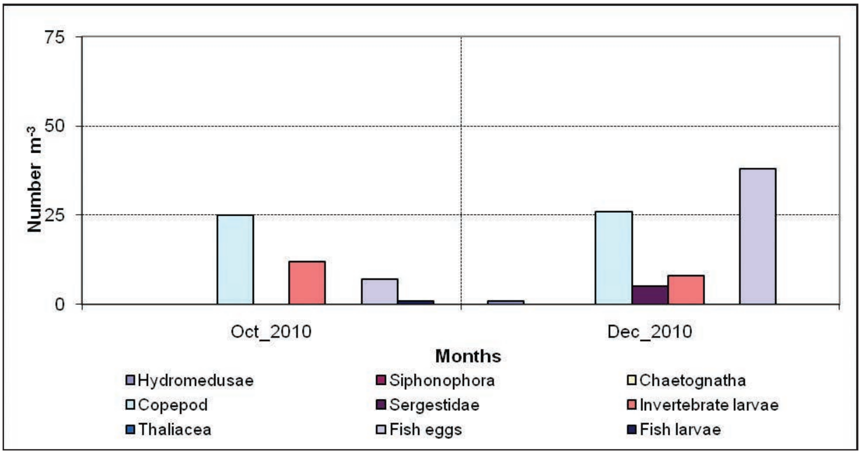


Fig. 251: Group vise zooplankton population density in Station-A of Whale Shark habituate sites at Diu.

Table 81. Group vise zooplankton population density in Station-B of Whale Shark habituate sites at Diu.

Group	Oct_2010	Dec_2010
Hydromedusae	0	0
Siphonophora	0	0
Chaetognatha	0	2
Copepod	17	12
Sergestidae	0	0
Invertebrate larvae	11	5
Thaliacea	0	0
Fish eggs	8	43
Fish larvae	1	0

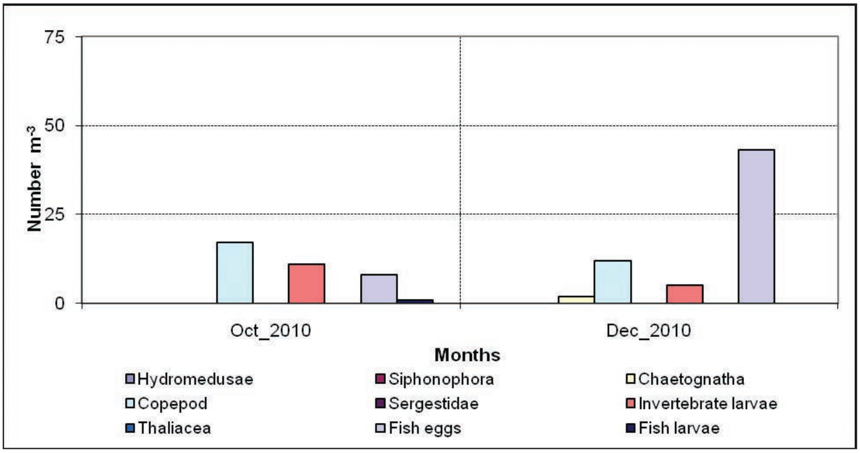


Fig. 252: Group vise zooplankton population density in Station-B of Whale Shark habituate sites at Diu.

Table 82. Group vise zooplankton population density in Station-C of Whale Shark habituate sites at Diu.

Group	Oct_2010	Dec_2010
Hydromedusae	0	0
Siphonophora	0	0
Chaetognatha	1	0
Copepod	21	36
Sergestidae	0	2
Invertebrate larvae	13	9
Thaliacea	0	0
Fish eggs	4	55
Fish larvae	0	0

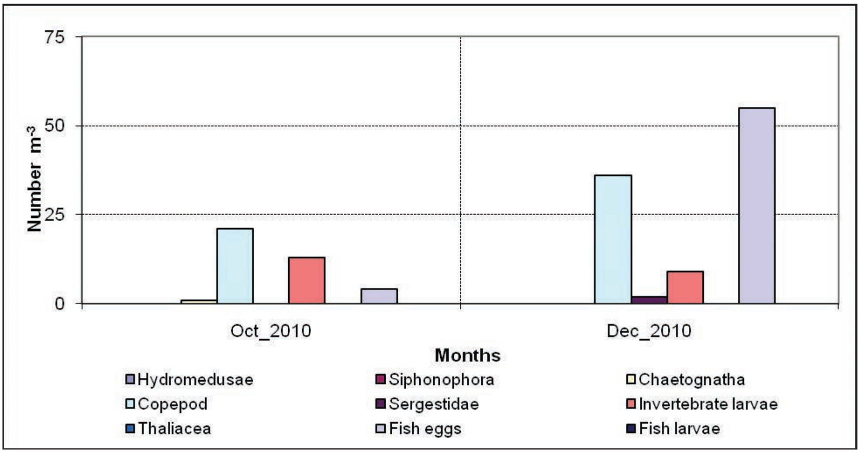


Fig. 253: Group vise zooplankton population density in Station-C of Whale Shark habituate sites at Diu.

Table 83. Group vise zooplankton population density in Station-D of Whale Shark habituates sites at Diu.

Group	Oct_2010	Dec_2010
Hydromedusae	0	1
Siphonophora	0	0
Chaetognatha	0	3
Copepod	22	29
Sergestidae	0	2
Invertebrate larvae	14	0
Thaliacea	0	0
Fish eggs	13	68
Fish larvae	0	0

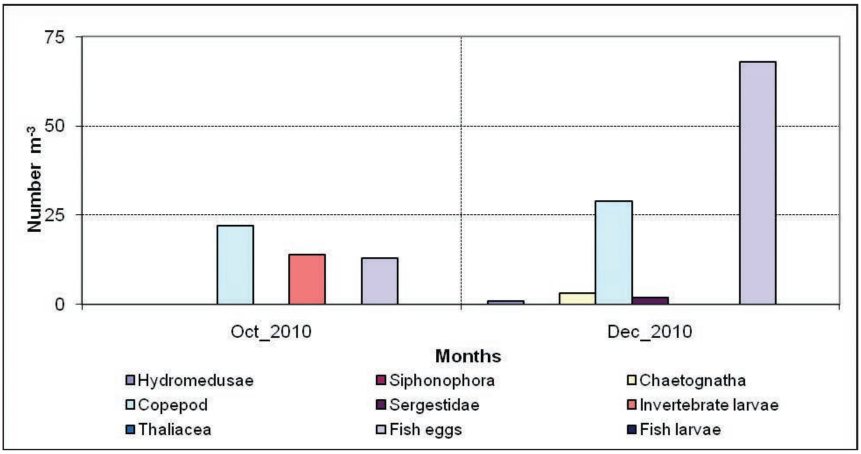


Fig. 254: Group vise zooplankton population density in Station-D of Whale Shark habituate sites at Diu.

Table 84. Group vise zooplankton population density in Station-A of Whale Shark habituate sites at Mangrol.

Group	Oct_2010	Dec_2010
Hydromedusae	11	0
Siphonophora	0	0
Chaetognatha	2	2
Copepod	31	39
Sergestidae	0	1
Invertebrate larvae	6	3
Thaliacea	3	0
Fish eggs	0	52
Fish larvae	0	0

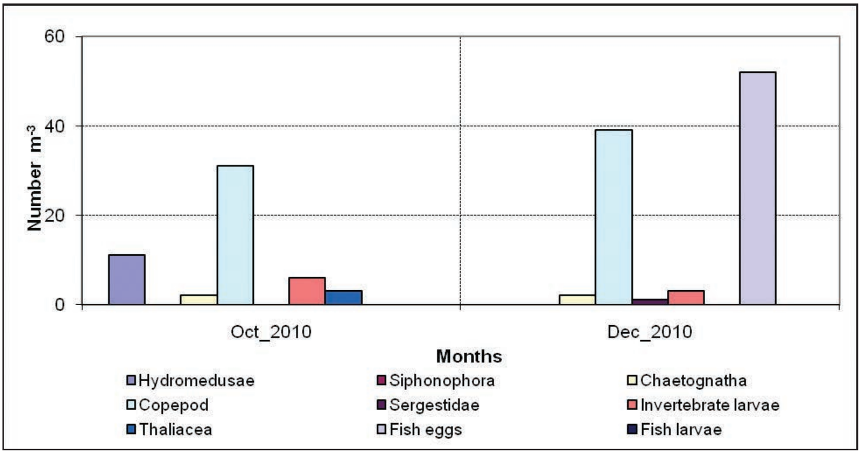


Fig. 255: Group vise zooplankton population density in Station-A of Whale Shark habituate sites at Mangrole.

Table 85. Group vise zooplankton population density in Station-B of Whale Shark habituate sites at Mangrol.

Group	Oct_2010	Dec_2010
Hydromedusae	7	0
Siphonophora	0	0
Chaetognatha	2	0
Copepod	23	55
Sergestidae	7	0
Invertebrate larvae	8	14
Thaliacea	5	0
Fish eggs	16	21
Fish larvae	0	1

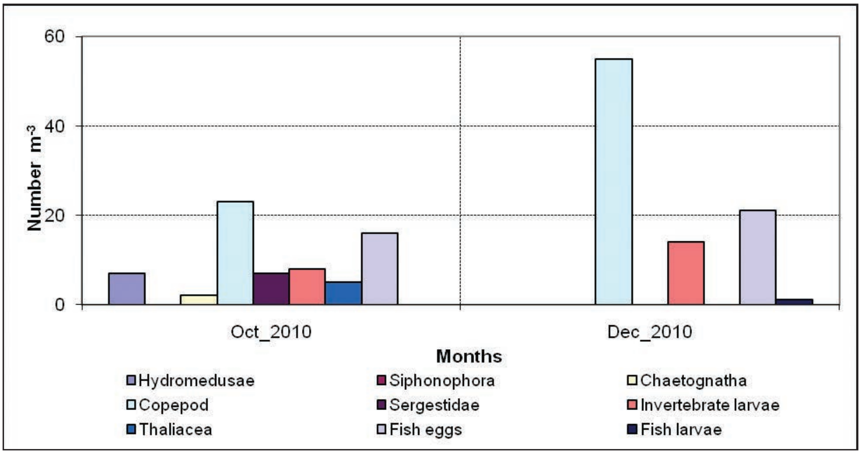


Fig. 256: Group vise zooplankton population density in Station-B of Whale Shark habituate sites at Mangrol.

Table 86. Group vise zooplankton population density in Station-C of Whale Shark habituate sites at Mangrole.

Group	Oct_2010	Dec_2010
Hydromedusae	8	0
Siphonophora	0	0
Chaetognatha	0	2
Copepod	27	59
Sergestidae	3	1
Invertebrate larvae	9	13
Thaliacea	4	0
Fish eggs	15	52
Fish larvae	0	0

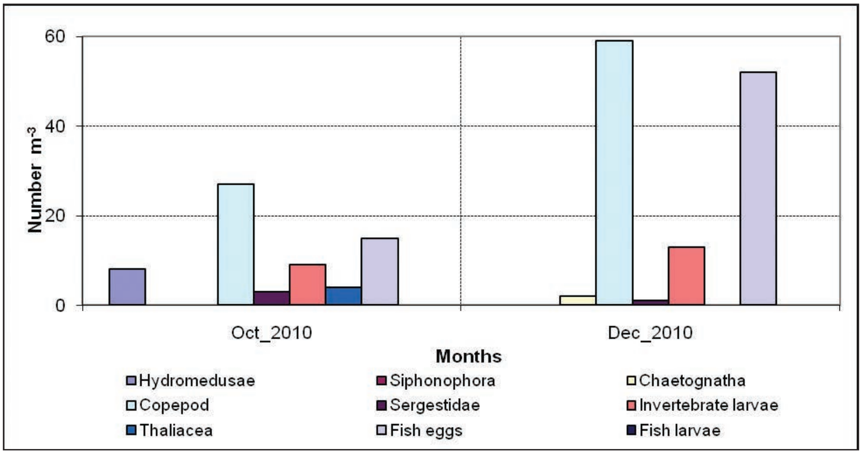


Fig. 257: Group vise zooplankton population density in Station-C of Whale Shark habituate sites at Mangrole.

Table 87. Group vise zooplankton population density in Station-D of Whale Shark habituate sites at Mangrole.

Group	Oct_2010	Dec_2010
Hydromedusae	6	0
Siphonophora	0	0
Chaetognatha	2	2
Copepod	33	64
Sergestidae	0	0
Invertebrate larvae	11	15
Thaliacea	4	0
Fish eggs	0	24
Fish larvae	0	1

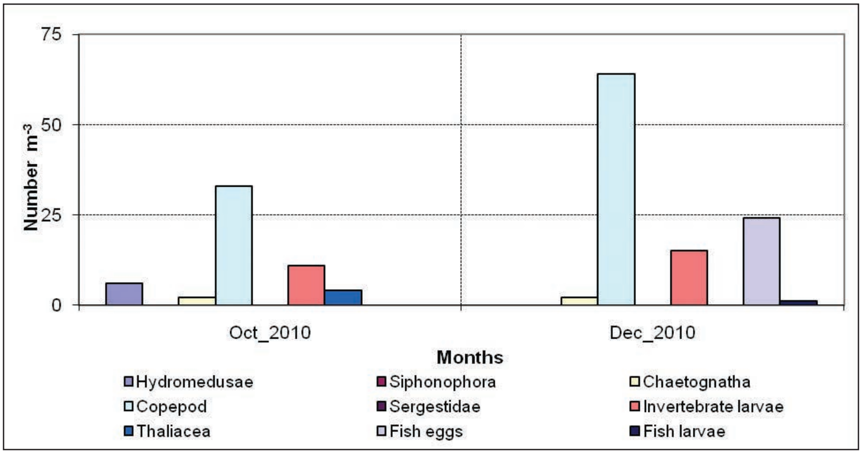


Fig. 258: Group vise zooplankton population density in Station-D of Whale Shark habituate sites at Mangrole.

CHAPTER 9

CONSERVATION RESEARCH

Report on phylogeography and population structure of Whale Shark in Gujarat coast

[1]S.P. Goyal, [2]K. Sivakumar, [3]J.A. Johnson, [4]Bheem Dutt Joshi, [5]B. C. Choudhury, [6]Sajan John

[1,2,3,4]:Wildlife Institute of India and

[5,6]: Wildlife Trust of India

Introduction

Whale Shark *(Rhincodon typus)*, one of the world's largest aquatic fish, is of high conservation priority due to several threats reported for this species (UN FSA, 1995; White and Cavanagh, 2007). It is,found in all tropical and warm temperate seas except the Mediterranean (Wolfson 1986, Last and Stevens 1994) and temperature stimulated sighting have reported at a different latitude which is probably higher up to 44^0 N than their nominal range (eg., 30^0 N) and sometimes 30^0 S (Turnbull & Randell, 2006; Sa, 2008) (Fig. 259). Genetic evidence suggests that globally two populations existed that differentiated into the Indo-Pacific and Atlantic oceans, and mixing of these species rarely happened (Vignaud et al., 2014). A declining pattern of genetic diversity has been reported; however, no satisfactory region has been identified for the loss of genetic diversity (Vignaud et al., 2014). The combined use of microsatellites and mitochondrial markers is a reliable tool for understanding population genetics, demography, and phylogeography, with applicability in the field of conservation biology (Castro et al., 2007; DiBattista et al., 2012). These primers provide excellent resolution for assessing intraspecific genetic variability and differentiation (Xue et al., 2014; Schmidt et al., 2012). Therefore, in the present study, we aimed to generate a DNA profile of the population of the Indo-Pacific whale shark from the Gujarat coastal area, using the mitochondrial and nuclear markers. Present data sets will help to identify regional genetic diversity and its relationship with other extant populations.

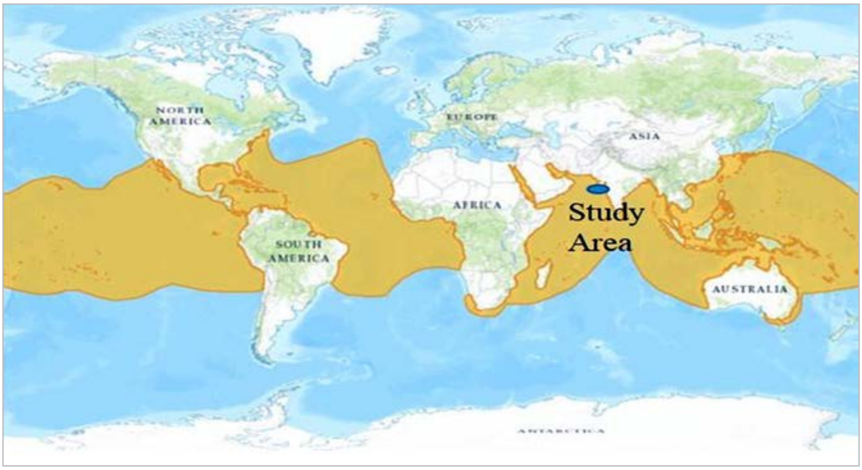


Fig. 259: Global distribution of whale sharks based on IUCN and collection of samples from the study area in the Gujarat coastal area, India.

Material and Methods

A total of 18 samples from the Wildlife Trust of India were received, of which 16 were whale samples and two were of the Bryde's Shark (Table 88). These samples were catalogued and stored in -80 ˚C for storage. DNA was extracted from these samples using the commercially available kit (Qiagen, Germany) with slight modification. These samples were incubated at 70 ˚C for the lysis to yield a high amount of DNA. After the DNA extraction, these samples were checked on a 0.8% agarose gel (Fig. 259) and subjected to the PCR amplification of the Control region (CR) gene. We tested the CR gene designed for the fish species (Joshi, 2016) of 600bp to find an amplifiable amplicon size present in the extracted DNA. Further, some samples were tested with an amplicon size of ~400bp of Cyt b (Verma and Singh, 2003). PCR was performed in a reaction mixture of 10μl containing, 5μl of 2X PCR Master Mix (Fermantas), 2μl template DNA (50ng), 1μl primers (0.2 μM each) and 2μl distilled water. The amplification conditions were 94 ˚C for 5 min followed by 35 cycles at 94 ˚C for 30 s, 55 ˚C for 45 s, and 72 ˚C for 45 s, and a final extension was done at 72°C for 10 min. PCR amplification was checked on the 2 % (w/v) agarose gel by loading a mixture of 3 μl PCR product and 1 μl loading dye. The bands of amplified product were observed under the UV light.

Table 88. List of samples collected from the Gujarat coastal area, India.

SN	Species	WII-SID	WTI-SID	Date	Place	Size	Sex
1	Whale Shark	5306	Rty2a	25.09.11	-	-	F
2	Whale Shark	5307	Rty2b	25.09.11	-	-	F
3	Whale Shark	5308	Rty2c	25.09.11	-	-	F
4	Whale Shark	5309	Rty3	20.10.10	-	3.80M	F
5	Whale Shark	5310	Rty4	30.11.10	Sutrapada	23ft	M
6	Whale Shark	5311	Rty5	12.12.10	-	-	M
7	Whale Shark	5312	Rty6	14.12.10	-	-	F
8	Whale Shark	5313	Rty7	05.03.11	Veraval	5.3M	F
9	Whale Shark	5314	Rty8	-	Sutrapada	6.5M	-
10	Whale Shark	5315	Rty09	03.03.11	-	6.5M	M
11	Whale Shark	5316	Rty10	-	Somnath	24Ft	M
12	Whale Shark	5317	Rty11	10.10.11	Veraval	20Ft	M
13	Whale Shark	5318	Rty12	09.05.15	Sutrapada	20Ft	F
14	Whale Shark	5319	Rty13	-	-	-	-
15	Whale Shark	5320	Rty14	23.12.13	-	-	F
16	Whale Shark	5321	Rty15	03.01.14	-	-	M
17	Bryde's Shark	5322	-	08.05.15	Vadodara	-	-
18	Bryde's Shark	5323	-	-	-	-	-

Details are not available at present;

WII-SID: Wildlife Institute of India samples ID;

WTI-SID: Wildlife Trust of India samples ID

Primer selection of microsatellite

Total 17 microsatellite markers were selected that are designed by Schmidt et al. (2009) and Ramırez-Macıas et al. (2009) and run in the multiplex manager (Holleley and Geerts, 2009) to select loci for the multiplex PCR (Fig. 260). In total four sets with 4-5 markers in each combination were generated and then ordered with respective florescent labelled dye accordingly.

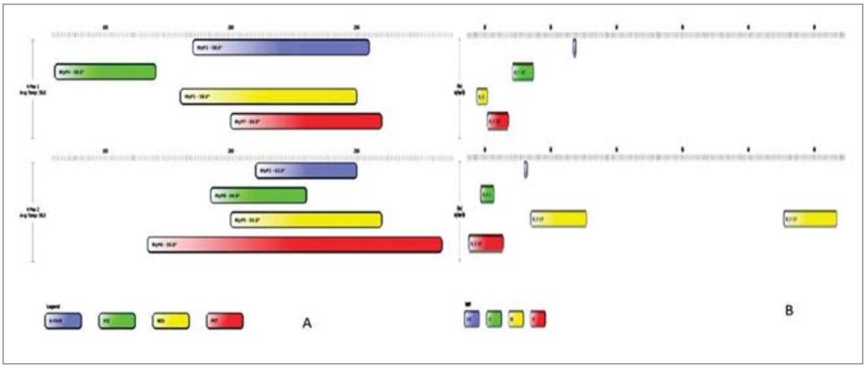


Fig. 260: In-silico PCR multiplexing to label the dye of microsatellite markers to be tested for the present study (A), multiplex 1a and 1b and the markers designed by Ramırez-Macıas et al. (2009) and (B), multiplex 2a and 2b for the markers designed by Schmidt et al. (2009).

Mitochondrial primers

In the degraded samples, higher amplicon sizes (>300bp) is hard to amplify (Goyal et al., Unpublished). Available sequences of a control region gene in the literature are of 1.3 Kb, which covers the global distribution of this species and the primers available for this species for use are greater than 800bp. These published primers have a low chance of amplifying in the degraded samples. Based on the gel quantification of the DNA, it is difficult to obtain the >800bp fragment in a single reaction. Therefore, we designed a total of five sets of primers of 250bp (Table 89) which covered all 44 haplotypes found in the total length of 1250 bp sequence (Castro et al., 2007). These primers will be used to generate the CR data for the samples obtained for the present study.

Table 89: Primers designed for the Control region gene of a shorter fragment

Primer Name	Primer sequences 5-3'
CR_RtyF1	GAAAGAGATAATAATAATGGAAC
CR_RtyR1	TTCGAGGTGTCCTTGTATATT
CR_RtyF2	TCGTATCAATCATGAATTTACTCT
CR_RtyR2	ACTGTTGTCATTTAATGGTTCC
CR_RtyF3	CCACATTTCTATAACATATTAGACT
CR_RtyR3	ACGATTAAGAACTGTATGTCAA
CR_RtyF4	CTATAACATATTAGACTTTCCTC
CR_RtyR4	CGAAAATAATATCTAGTTGAGG
CR_RtyF5	GCAAATTGCATGGTTTTATG
CR_RtyR5	AATATTTAGTTGAGGAAAGTC

Key findings and progress

DNA from all 18 samples was extracted successfully. Based on the gel image, DNA quality was categorized on a scale of 0-3 as good (3), moderate (2), low (1) and no (0) visible DNA (Table 90). Of the 18 samples, seven indicate good quality of DNA, three show moderate DNA, three samples were of low visibility, and five samples were not visible on a 0.8% agarose gel (Figure 261). In the visible DNA, the molecular weight of the extracted DNA ranged from 100bp to more than 1Kb.

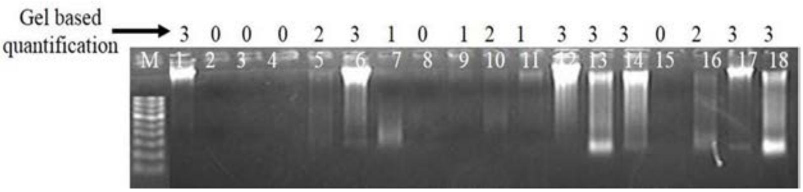


Fig. 261: Gel image of DNA extracted from 18 whale shark samples on 0.8% agarose gel and ranked 1 to 4 based on the quality of DNA 1, good quality of DNA; 2, moderate, 3 low visible and 4 no visible DNA.

Table 90. Gel based DNA quantification of whale shark samples (n=18).

SN	Gel based quantification	Scale	No of samples
1	No visible DNA	0	5
2	Low visible DNA	1	3
3	Moderate visible DNA	2	3
4	Good Visible DNA	3	7

The Control region gene was tested on two whale shark samples that exhibited good DNA quality, however, no amplification was obtained at different concentration of DNA template of 2µl, 1:20, 1:50 and 1:100 (Fig. 261). Whereas, Cyt b gene (401bp) amplified in samples having good to non-visible DNAs (Fig. 262). However, we need to optimize DNA quantity in samples which indicated poor PCR performance.

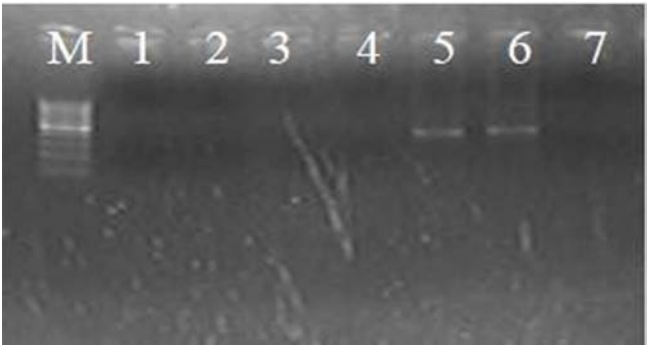


Fig.262: PCR amplification of Control region gene of 700bp tested in both no visible and good quality DNA. M=Leader; 1-4 whale shark, 4-6 positive fish samples.

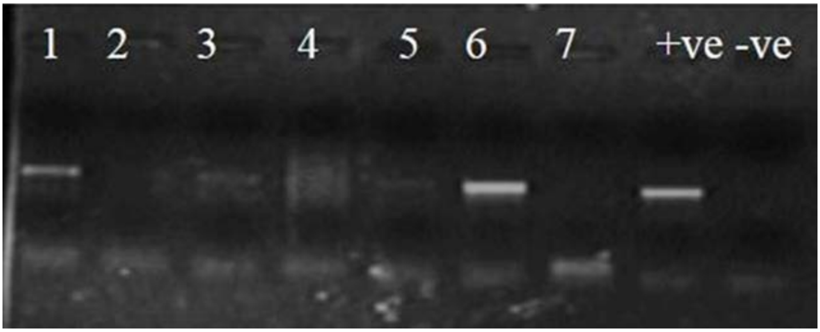


Fig. 263: PCR amplification of Cyt b gene of 400bp in both no visible (5-7) and good quality (1-4) DNA.

Based on the results obtained from DNA extraction and PCR amplification of the Control Region with a large amplicon size, we designed the primer of low amplicon size to can generate data from degraded samples, ensuring compatibility with global data sets. A total of five control region primers were designed of 250bp (Table 89). The list of published microsatellites loci was prepared and ordered based on the multiplex 1 and 2.

Conclusion

DNA was extracted from 18 samples, of which 7 yielded good-quality DNA, 3 had moderate-quality DNA, 3 showed low visibility, and 5 showed no visible bands on a 0.8% agarose gel. Seventeen microsatellite loci were selected and analyzed using multiplex manager, resulting in four sets of different marker combinations. Two sets of mitochondrial primers (Control Region and Cyt b) were tested. The Control Region primers did not amplify in the tested samples, whereas Cyt b successfully amplified in both high-quality and non-visible DNA samples. To enable amplification in degraded samples and ensure comparability with global populations, a total of five Control Region markers were designed.

CHAPTER 10

CONSERVATION RESEARCH

Whale Shark Conservation along Karnataka Coast

[1]Sandeep Ghosh, [2]Saymanti B and [3]Sajan John

[1]Sambodhi Research and Communications Pvt. Ltd.

[2]Wildlife Trust of India

A campaign to Save the Whale Shark was launched in 2004 by Wildlife Trust of India (WTI), aimed at encouraging local fishers to stop hunting the species along the coast of Gujarat. One of the most successful examples of Public-Private Partnership (PPP) in marine megafauna conservation, the project yielded significant results thanks to the active participation of local communities. Today, the Gujarat coast is considered one of the safest habitats for migratory whale sharks in India.

Since whale sharks travel vast distances along the coastline, their effective protection requires coordinated efforts among coastal states, local communities, and various government departments. Recognizing this need, the campaign was expanded to the coastal towns of Karnataka in 2022. To guide the campaign's implementation in the region, a pre-campaign study was conducted to identify knowledge gaps among stakeholders that the campaign would aim to address. This baseline survey was carried out by Sambodhi, and the findings are presented in this report.

1. Areas of inquiry

The detailed areas of inquiry are illustrated below-

Broad areas of investigation	Outputs and KPIS
Inputs	
Current KAP of the relevant stakeholders, both primary and secondary	Respondent profile
	Awareness about whale sharks, including sighting by self or others within the immediate circle
	Sources of awareness
	Knowledge about whale sharks, their characteristics and habits, and their endangered status

	Source of awareness
	Attitudinal predispositions regarding the whale shark, including its movement territory, the extent of danger it poses to human health, and finally, the act of hunting the species
	Awareness about the legal protection of the species
	Extent of empathy toward the need for protection
	Awareness and knowledge regarding conservation efforts, and the extent of willingness to be part of this effort
	Deterrents towards participation
Media habits	Listenership, viewership, and readership
	Sources of entertainment
Key influencers in the lives of the TGs	Key influencers (locally and globally) with strong equity among the fishing households and other non-fishing households residing in the coastal belt
Intermediate Outputs	Triggers shaping the campaign
	List of key influencers who can take the message to the masses
	Appropriate communication tools to reach out to the TGs
	SWOT analysis of different mediums available for communication
Final Outputs	Baseline values for KAP KPIs
	Recommendation of an appropriate communication strategy
	Impact measurement protocol in the form of a program log-frame.

2. Research Design

2.1. Respondent Segments vs Research Tools

We adopted a mixed-method approach for this study. This included a quantitative, structured questionnaire survey, supplemented by selective FGDs with fishing communities and IDIs with key secondary stakeholders, including government departments and CSOs. The qualitative research design also included in-depth interviews with relevant stakeholders, details of which have been provided below.

	Survey	IDIs	FGDs
Fisherfolk from designated fishing villages (engaged with trawler/boat workers)	✓		✓
Coastal residents from non-fishing villages	✓		
Fish traders and middlemen		✓	
Forest department staff (DFO, Rangers, Guards)		✓	
Fisheries department staff (Deputy Director of Fisheries and – District level) and Asst. Director of Fisheries (Taluk level)		✓	
Fish Farmer Producers Organisations		✓	
NGOs working on marine conservation issues		✓	

2.2. Sample size for quantitative survey in Karnataka

There were two different target groups that we covered in this study through the structured questionnaire survey, viz.

TG1: Adults and older adolescents of fishing families (aged above 25 years) who are actively engaged in fishing-related activities themselves[1]	TG2: Adults and older adolescents from non-fishing villages (18 years and above)

Here, we have used Cochran's formula to arrive at the minimum sample size required to represent the survey sample:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where:

- e is the desired level of precision (i.e., the margin of error), taken at 5%
- p is the (estimated) proportion of the population that has the attribute in question, taken at 50% of 0.5
- q is 1 – p.
- Z2 is the square of the Z value at 90% level of confidence, i.e., 1.6452.

This gives a minimum sample requirement for a state to be 267. However, given that we proposed a multistage sampling design, there is a Design Effect involved, which we assume to be 1.5, i.e., one-and-a-half times the sample size of a simple random sampling. This brings the sample estimate to 400, which is the prescribed minimum sample for each state.

We further proposed to distribute this sample across fishing households and non-fishing households to the tune of 7:3, i.e. 280 respondents from the former and 120 from the latter.

Therefore, for Karnataka, the quantitative sample was 280 respondents of TG1 + 120 respondents of TG2 = 400 respondents.

While the above was the estimated sample size, we covered 442 respondents in the field- 307 from TG1 and 135 from TG2.

Distribution of samples by Secondary Sampling Units

The research covered all three districts listed in the RFP, viz. Dakshin Kannada, Udupi, and Uttara Kannada. In the current study, SSUs were coastal villages (both fishing as well as non-fishing). We proposed to cover 20 households (one respondent per household) from each SSU. Since there were 280 samples of fishing villages and 120 samples from non-fishing coastal villages, the total villages covered works out to be 280 ÷ 20 = 14 fishing villages and [1] They could be fishermen or fisherwomen themselves, or those engaged in weaving/mending nets, engaged in dry-fish trade, trawler/boat drivers and helpers, etc.

120 ÷ 20 = 6 non-fishing villages. The distribution of the SSUs across the districts thus worked out to be as follows:

	Karnataka			
	Fishing villages	Respondent sample	Non-fishing villages	Respondent sample
Uttara Kannada	3	60 (69)	2	40 (46)
Udupi	4	80 (85)	2	40 (47)
Dakshin Kannada	7	140 (153)	2	40 (42)

The figure in parenthesis shows the actual number covered in the field.

It may be mentioned here that SSUs were selected using the PPS Circular Systematic Random Sampling Procedure.

Identification of sample TGs

The field team identified a random starting point in each village and followed the right-hand rule, visiting households based on a skip pattern, determined by dividing the total number of households in the village by 12. Using this method, 6 TG1 and 6 TG2 respondents were surveyed in each fishing village, while 12 TG3 respondents were selected from each non-fishing village. Only one respondent was interviewed per household. Further, if a household had more than one eligible respondent (within the same TG category as well as two TGs in the same household), a KISH grid was used to make the random selection.

Efforts were made to ensure a diverse representation of the fishing trade, with particular attention to capturing gender dynamics within the sector.

2.3. Distribution of Qualitative Sample

Focus Group Discussions	
Adult fishermen	3
Those who are not fishermen but are engaged in ancillary activities related to fishing	1
In-depth Interviews	
Fish traders and middlemen	4

DFO, covering 2 separate districts	2
Guards/Rangers, covering 2 separate districts	2
Deputy Director of Fisheries, District level)/ Asst. Director of Fisheries (Taluk level), covering 2 separate districts	2
Fish Farmer Producers Organisations	1
NGOs working on marine conservation issues	2

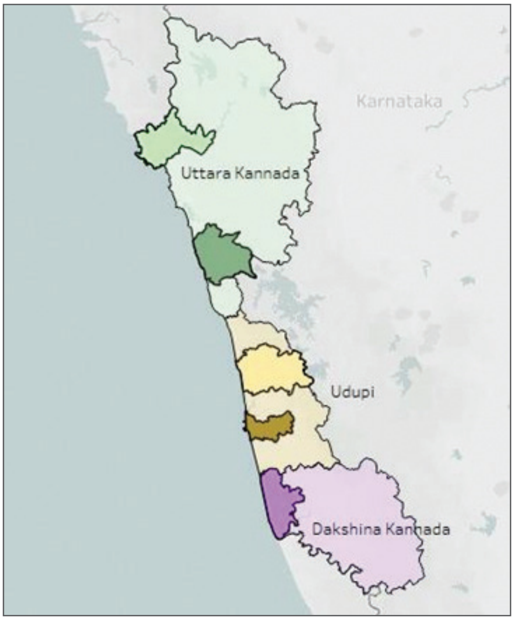
The actual stakeholder coverage using purely qualitative research techniques is as follows:

Name of the district	Research technique	Address	No. of Person Participated
Dakshina Kannada	FGD (fishers)	Thota Bengre, Mangalore, Dakshin Kannada	14
Dakshina Kannada	FGD (fishers)	Panambur, Mangalore, Dakshin Kannada	10
Dakshina Kannada	IDI (trader)	Hoiga Bazar, Mangalore, Dakshin Kannada	1
Dakshina Kannada	IDI (trader)	Mangalore Dockyard, Mangalore, Dakshin Kannada	1
Dakshina Kannada	IDI (DIG, Coast Guard of India)	Penambur, Mangalore, Dakshin Kannada	1
Dakshina Kannada	IDI (ACF, Forest Department)	Forest Department, Mangalore, Dakshin Kannada	1
Dakshina Kannada	IDI (AD, Forest Department)	Fisheries Department, Mangalore, Dakshin Kannada	1
Dakshina Kannada	IDI (troller owner and union president)	Mangalore, Dakshin Kannada	1
Udupi	IDI (trader and union president)	Malpe, Udupi	1
Udupi	IDI (union president)	Udupi	1
Uttara Kannada	FGD (non- fishers)	Karki, Uttar Kannada	8
Uttara Kannada	FGD (fishers)	Honnavara, Uttar Kannda	15
Uttara Kannada	IDI (boat owner and trader)	Karwar, Uttar Kannada	1
Uttara Kannada	IDI (DRFO, Forest Department)	Forest Department, Uttar Kannada	1
Uttara Kannada	IDI (DD, Fisheries Department)	Fisheries Department, Karwar, Uttar Kannada	1

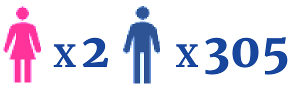
3. Baseline findings from Karnataka

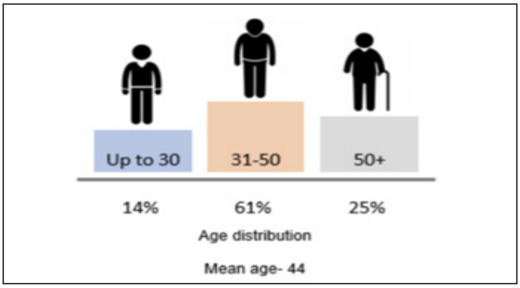
3.1.Fishers

Respondent profile Awareness and source



307
fishers sampled across 3 coastal districts- 86 percent of the total sample

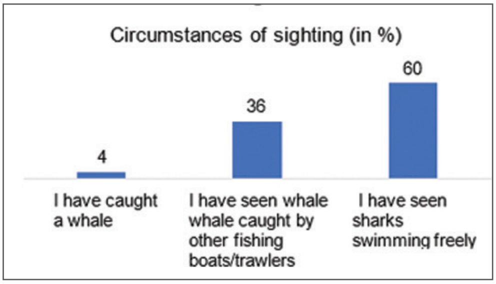




The recall rate of having heard of and/ or seen the whale shark was very high. Out of 307 fishers surveyed, 293 could spontaneously recall having heard of the whale shark. Of the 12 who could not recall, 2 identified positively when presented with a picture card. 295 out of the 306 who were aware of the whale shark confirmed that they had seen one, and about 69 percent reported having seen it up to 10 times in their lifetime.

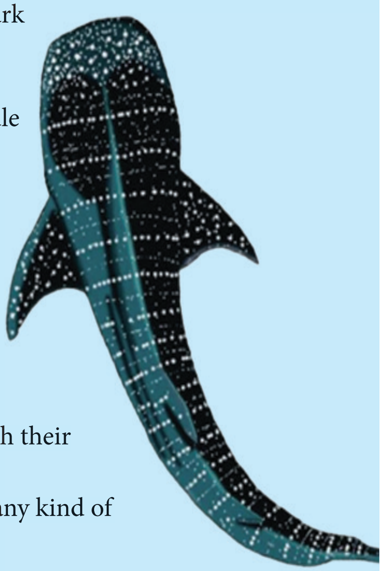
77

percent of fishers had sighted a whale shark in the deep sea, while 21 percent saw one along the coast



Miscellaneous information on sightings

- 49% of fishers think the whale shark is a shark, while 37% think it's a whale
- 92% wrongly believe that the whale shark is a mammal and gives birth to live babies
- 38% of the fishers who have seen a whale shark in the seas said the sightings take place throughout the year, while 47% said they take place in specific seasons
- 85% of the sightings were in the morning
- 78% recalled that they saw whale sharks swimming in groups
- 39% had ever seen a whale shark pup
- Only 7% had ever hit a whale shark with their boat/trawler
- Less than 4% had ever seen any tag or any kind of human-made



Accidental catching

Most whale shark catches occur accidentally, and live catch is usually released back into the sea.

12

out of 295 respondents who had ever seen a whale shark reported having ever caught one accidentally

3-4

is the median number of times this has happened. Most get caught in the fishing net

91

percent said they will release the whale shark if they accidentally catch one in the future

3

percent said they will bring it to shore if they catch one which is smaller in size

Commercialisation

While 39 percent of respondents were unaware of which body parts of the whale shark are commercially sold in the market, and 58 percent who were aware of the trade in body parts believed that the fin has the highest commercial demand, while 35% think it is the meat.

Despite a high level of agreement with various assumptions investigated during the survey, the reality painted adifferent picture. These assumptions appeared to be more accurate for sharks in general, particularly in states like Gujarat, Kerala and Tamil Nadu.

When comparing general perceptions with qualitative insights, it emerged that among those who did give an opinion on the commercial aspect of whale sharks, all agreed that they were no longer being caught. Moreover, 91 percent agreed that catching and selling a whale shark is economically unviable due to its high water content and low meat yield. Additionally, hauling such a large animal back to the landing sites was considered cumbersome.

No, we will not bring it because whenever it is taken out of the water, it dissolves. We cannot use it. A 500 kg fish becomes 100 kg by the time it comes to harbor" - Hannovara dockyard fishermen and traders.

But everyone agreed that in the past, the selling price of whale shark meat was around INR 120 to INR 125 per kilogram.

Additionally, 20 percent of respondents agreed to the hypothesis that its meat is dried and sold as chicken feed even today. However, this assumption is probably not true, as in Mangalore, only Bhootai Fish/small fish go to the fish factory for the manufacturing of poultry feed.

In my entire career, I have seen the whale shark several times, but have never purchased or sold one. However, about eight years ago, a whale shark was sold here for around INR 150/ per kg. Whale shark meat fetches a very low price due to the fact that the body is made up of about 70 percent water and only 30 per cent meat. Once it's left out in the sun, most of the volume is lost, and only the carcass remains. Even then, the meat must be dried before selling, as no one consumes the meat directly. So for us, catching a whale shark results in a loss. -Trader, Mangalore

While 23 percent of respondents agreed to knowing fishers who still use whale shark oil to waterproof their boats; however, we could not get any direct mentions or confirmations of the use of whale shark oil (dissolving the fat) for this purpose.

Additionally, 41 percent of respondents believed that its fins are in demand among traders and exporters. In reality, this demand applies to other shark species and not whale sharks. Fishers usually catch small sharks, and their fins are used for medicinal purposes, which contributes to their high demand.

According to Karnataka fishers, it is also common knowledge that whale shark fins have medicinal value. 44 percent of respondents believed that baby sharks are in high demand due to their perceived use in treating heart ailments. However, they noted that it is primarily fishers from Kerala and Tamil Nadu who hunt whale sharks, not those from coastal Karnataka. Most fishers recalled selling whale shark meat 10 to 25 years ago. Today, baby sharks are in more demand, costing over INR 600 per/kg.

Instead of its muscles, its fins (sharks and whale sharks) have more demand and cost more. Gujarat has the highest export of dry fish (shark family) with fins removed. A significant amount of such fish is caught in Tamil Nadu. In both Gujarat and Tamil Nadu, fishers use hooks to catch these species. Whereas, in

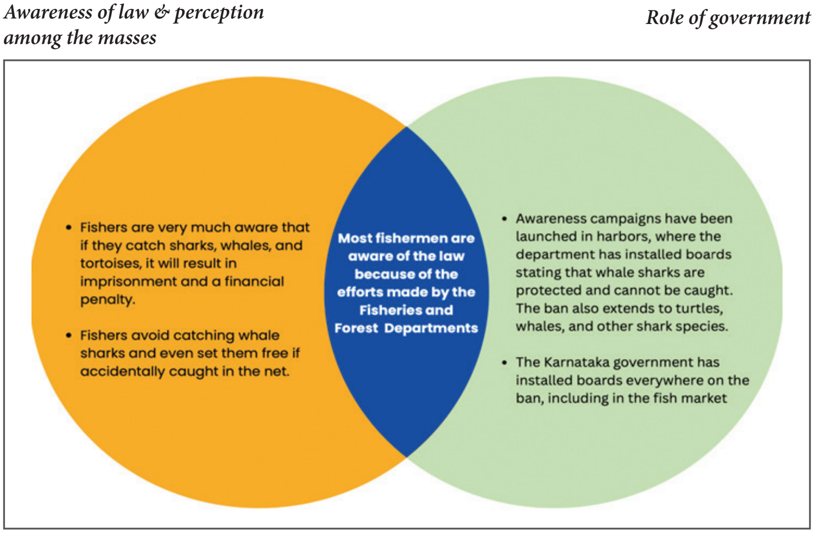
Karnataka, fishing is done using the net, which cannot be used to hunt whale sharks, unless one is caught accidentally – AD, Department of Fisheries

About 90 percent of respondents believed that the whale shark is a harmless creature, and in fact, it brings good luck to fishers who encounter it at sea. This could stem from the observation that whale sharks often attract smaller fish, which can result in a profitable catch for fishers.

Awareness of the law

The Indian Government's Ministry of Environment and Forest has granted full legal protection to whale sharks in Indian Territorial waters. When asked about the awareness of this legal status, 61 percent of respondents said they were aware of it, while 37 percent were unaware, and 2 percent simply didn't understand the law.

About 67 percent of respondents understood that the protection status of the species meant that it is forbidden by law to kill/destroy that species, 18 percent of respondents understood that it is forbidden by law to harm that species, and only 11 percent understood that it is forbidden by law to trade in the body parts of that species. Meanwhile, 23 percent admitted they did not know what the term 'protected species' means.



In our dockyard, we have a wall painting that highlights that such protected species should not be caught in the sea – Fishers, Mangalore

If you ban it, there is no loss for us. Whether it's banned or not, it's fine with us because this is not a regular fish that we come across frequently. In Karnataka, whale sharks are not seen in abundance. Around 99% of this fish is found in Gujarat and Kerala. If conservation practices start in Gujarat, then all other states will follow. What happens today is this fish goes from Gujarat to Kerala, where it is caught and then dried and salted. – Fishers, Hoiga Bazaar

Not just me, but almost all the fishermen are aware of this protected species, and understand that they shouldn't be caught while at sea. In this regard, the Fisheries Department conducts regular awareness camps, and our association also communicates this message in all the mahasabhas– Trader, Mangalore

The Fisheries Department usually conducts awareness programs in partnership with the Coast Guard base at Panamboor every four months– AD, Fisheries Dept, Mangalore

The study also found criticism for the government's work, which needs to be better targeted.

What they usually do is hold one meeting of the central management, offer TA/ DA and send invitations through the Fisheries College, cooperative societies and individuals from SC/ST backgrounds. Many genuine fishermen get left out in the process. We have objected to this- Fishers' FGD, Thokate Bengre

Here, they have classified middlemen and those who consume fish as fishers. Places like Kadapa and Puttur are being invited, where there is no fishing activity at all– Fishers' FGD, Thokate Bengre

Attitudinal predisposition behind conservation

It was found that people were all in favor of conserving the species and supportive of the ban. All respondents (100 percent) agreed that unless necessary steps are taken, the killing of the whale shark will continue, leading to their extinction.

About 98 percent of respondents were aware and agreed that catching and selling whale sharks or their parts, is punishable by law by up to 7 years in jail. An additional 1 percent were also aware of the fine, which ranges from INR .25,000 to INR 50,000 in such a scenario. Furthermore, 94 percent of respondents agreed that now that they are aware that the whale shark is protected by law, they will not consume any products made out of its body parts and will encourage others not to do so either. There was a large proportion–96 percent that were inclined to the ideology that protecting the whale shark has to be the government's responsibility, and the common people can do very little to curb its killing. Remarkably, half the respondents showed inclination towards protecting the whale shark, even though it could result in an economic loss for fisherfolk who depend on selling its meat, fin, oil, and fat. On the other hand, 46 percent of respondents believed that the killing of whale sharks is not a major issue along the Karnataka coastline, and is more prevalent in other regions. A small group of respondents agreed to know some fishers in the area who still hunt whale sharks. They shared that if they see a whale shark while at sea, they will certainly try to catch it with a net or a hook, citing continued local demand for whale shark meat, fin, liver, and oil. The remaining respondents showed no particular attitude towards the conservation of this species.

When asked how concerned they were about protecting whale sharks after having learnt so much about this, just over half of the respondents expressed strong concern. Another 36 percent were somewhat concerned, but not deeply, while the rest were either unconcerned or had no opinion at all.

86

percent of the survey participants felt that the ban on capturing whale sharks should not be lifted

86

percent of the survey participants were quite clear that even if they are presented with an opportunity in the future, they will not consume food made from whale shark meat/fins

55

percent feel that food made from whale shark meat/fins is not considered a delicacy in the local cuisine; 44% did not have an opinion on this

Participation history

Only 5 percent of respondents or someone in their family had ever participated in a conservation program. 37 percent of the respondents were quite likely to participate if, in the near future, a campaign is launched for the conservation of the whale shark, while 39 percent indicated they were somewhat likely to participate. Lack of opportunities, exposure to such opportunities and familiarity with how to join such events are major reasons that hold people back from participating.

Possible compliance and participation

While almost all fisherfolk and traders interviewed expressed eagerness to support and cooperate with a new campaign focussed on whale sharks, those with prior experience in similar initiatives urged caution.

> **I have been in this department for about 10 years. It is very difficult to make them understand. Well, they do understand, but don't listen**
> – AD Fisheries, Mangalore

Forest Department officials acknowledged the fact that most localities are aware of the Endangered Species Act. However, they also mentioned that most of the outreach efforts tend to focus on boat/trawler owners, who attend the meetings. These individuals are often educated, aware of the law, and motivated by both fear of legal consequences and genuine concern for conservation.

Moreover, it is not the owners who go out to sea; the boats are manned by out-of-state fishers, and the composition of the crew varies every time. Unfortunately, the messages shared during these awareness meetings are not always passed on to the crew, leaving a persistent communication gap.

This alludes that despite most of the population being pro-conservation, the campaign will have to have a wide coverage and be strategic in terms of its target audience and be mindful of what type of messaging resonates best with whom.

Media habits and Social Media presence

Udaya TV and Colors Kannada are the most-watched television channels, while Vijayavani and Udayavani are the most-read newspapers. Around 70 percent of the survey participants followed/used a social media account, and 98-100 percent of users of these platforms accessed their accounts daily or used them at least 3-4 times a week.

TV Channel	% Viewership	Newspaper	% Readership	Social Media	% Usership
Udaya TV	69	Vijayavani	63	WhatsApp	96
Colours Kannada	60	Udayavani	56	Facebook	65
Zee Kannada	37	Prajavani	41	Instagram	26
Star Suvarna	27	Vijay Karnataka	33	YouTube	28
Udaya Movies	15	Kannada Prabha	13		
TV9 Kannada	13	Samyukta Karnataka	5		

Communication leads and triggers

90 percent were of the opinion that there is no one in their fishing community whom they consider to be a spiritual leader and whose words they trust and follow explicitly

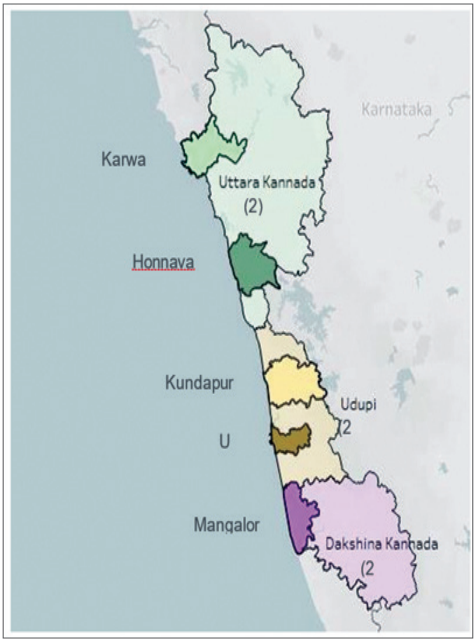
16 percent were part of a fishers' union, locally known as a sangha or co-operative society

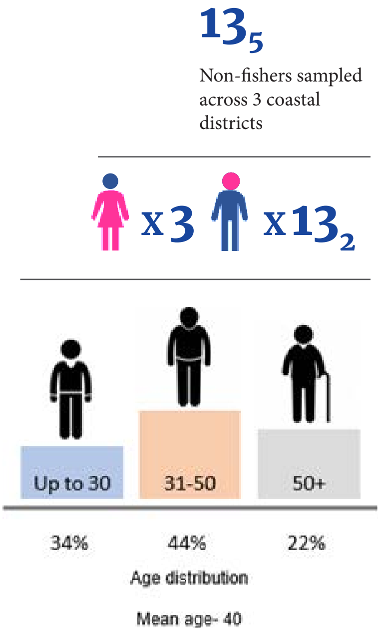
76 percent feel that if a whale shark is sighted during fishing, it will bring good luck

15 percent believed that whale sharks are worshipped as a divine being, most referred analogy being Koragajja

3.2. Non-fishers

Respondent profile

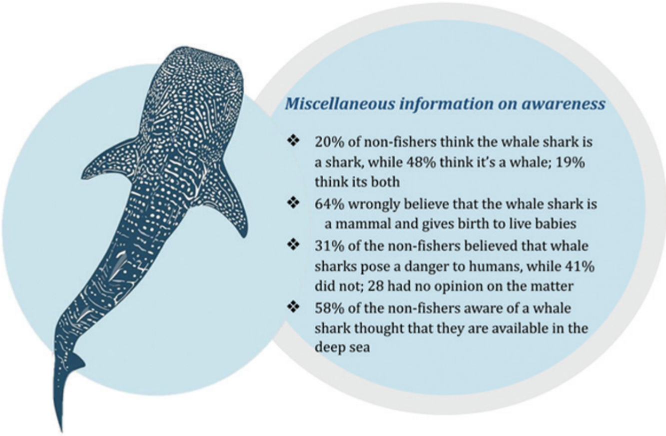




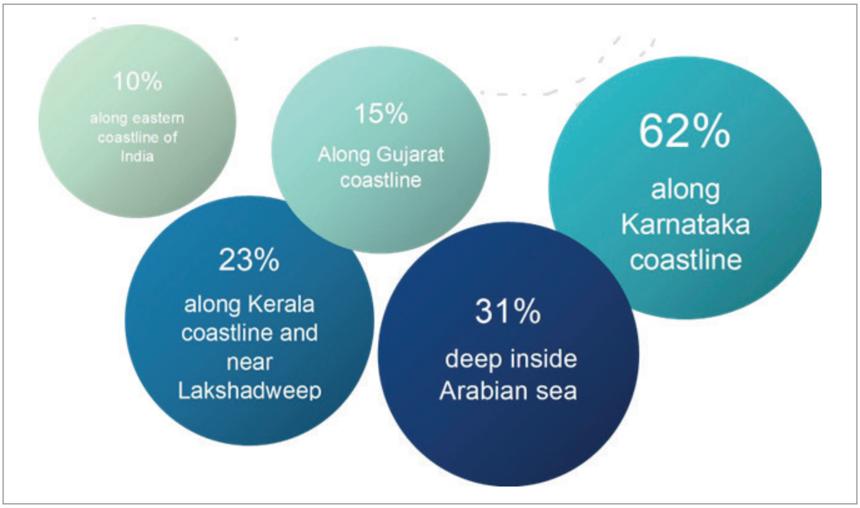
Awareness and source

Among the non-fisherfolk surveyed, 7 per cent were unaware of the whale shark. Out of 140 non-fisher citizens, 129 could spontaneously recall having heard of the whale shark. Of the 6 who could not recall, 2 identified positively through a pictorial prompt, bringing the effective sample size to 131. Among these 131 individuals who were aware of the whale shark, 111 claimed to have seen a whale shark in local markets.

Major sources of awareness (other than sightings) include TV news channels(54 percent of respondents), interaction with fishermen (47 percent) and documentary films (46 percent). Local newspapers, friends, colleagues, relatives and family elders were among lesser-reported sources.



When asked where in India one can find the Whale Shark, we got varied responses.



Empathy with the cause

Almost 72 percent of the respondents were unaware of whether whale sharks are being captured and killed along the Indian coastline. Only 7% believe that such activity is taking place, and only 1 respondent was of the opinion that this is happening along the Karnataka coastline.

When asked about their level of concerned for the protection of this species, after having learnt so much about its conservation status, just over half of the respondents expressed strong concern. Another 36 percent were somewhat concerned, while the remainder were either unconcerned or had no opinion.

Awareness of the law

When asked about their awareness of the law regarding the conservation status of the whale shark, 61 percent of respondents stated they were aware of it, while 33 percent were unaware, and 6 percent simply didn't understand the law.

76 percent of respondents understood that the protection status of the species means that it is forbidden by law to kill/destroy the species, 17 percent of respondents also understood that it is forbidden by law to harm that species, and only 11 percent understood that it is forbidden by law to trade in the body parts of that species. 25 percent of respondents said they did not know what the term 'protected species' meant.

Attitudinal predisposition behind conservation

The study found that people were all in favor of conserving the species and supportive of the ban. All respondents (100 percent) agreed that unless necessary steps are taken, the killing of the whale shark will continue, and they will eventually become extinct.

A large majority–93 percent, were aware and agreed that catching and selling whale sharks or their parts, is punishable by up to 7 years in jail. Furthermore, 91 percent of respondents agreed that now that they know that the whale shark is protected by law, they will not consume any products made out of its body parts and will encourage others not to do so either. A significant proportion– 94 percent, were inclined to the ideology that protecting the whale shark has to be the government's responsibility and that the common people can do very little to curb its killing. Interestingly, almost an equal proportion believed that the general public can still play a vital role in raising awareness about the protection of the whale shark. Remarkably, 64 percent of respondents showed inclination towards protecting the whale shark, even if it meant an economic loss for fisherfolk who earn their livelihood selling its meat, fin, oil, and fat. On the other hand, 40 percent of respondents believed that the killing of whale sharks is not a major issue along the Karnataka coastline, and is more prevalent in other regions. ; The remaining The remaining respondents showed no particular attitude towards the conservation of this species.

Attitudinal predisposition behind the consumption of whale shark products

0 percent of the survey participants had ever eaten food/soup made of whale shark meat/fins in the past

47 percent feel that food made from whale shark meat/fins is not considered a delicacy in the local cuisine; 53% did not have an opinion on this

89 percent of the survey participants were quite clear that even if they are presented with an opportunity in the future, they will not consume food made from whale shark meat/fins. 5% said they might consider it.

History of participation in conservation

Only 6 percent of the respondents or someone from their family had ever participated in any conservation program. 39 percent of the respondents were quite likely to participate if, in the near future, a campaign is launched for the conservation of the whale shark. 27 percent indicated they were somewhat likely to participate. Lack of opportunities, exposure to such opportunities and familiarity with how to join such events are major reasons that hold people back from participating.

Media habits and Social Media presence

Colors Kannada and Udaya TV are the most-watched television channels, while Udayavani, Vijayavan, and Prajavani are the most-read newspapers. Around 69 percent of the survey participants followed/used a social media account, and 98-100 percent of users of these platforms accessed their accounts daily or used them at least 3-4 times a week.

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Star Suvarna	33	Prajavani	41	YouTube	51
Zee Kannada	28	Vijay Karnataka	33	Instagram	41
TV9 Kannada	27	Kannada Prabha	13		

Insights from the FGD with Non- fishers

In the non-fishing households, there is little or no idea about the protected status of the whale shark. But they are aware that the prevalence is very low These non-fishers do recall a former campaign about 'Sea Elephant' several years ago They could also recall posters regarding 'something' to do with whale sharks near the fish harbour Lot of social media usage among adolescents as well as adults, including Facebook and WhatsApp; lot of traction of newspapers as well Local leader and panchayat members are key influencers, they need to be pivots based on which any communication needs to bestructured Village Karki, Taluk Honnavar, Uttar Kannada 8 members- 5 agricultural farmers, 1 lorry driver, 2 laborers

4. Inputs for campaign

4.1. The Koragajja backdrop

Among the non-fishing community, 37 percent believed that there is no religious significance attached to the whale shark, while the remaining 63% had no opinion regarding this, largely due to a lack of knowledge on the subject. Within the fishing community,however, whales and whale sharks are often referred to as the "King of the Sea" because of their sheer size. While not a majority, some members of the community consider the whale shark to be divine. It is customary among many fishers not to touch or harm the whale shark when they encounter it at sea.

> **In our community, there is a tradition that we should not catch whales. In one particular incident, a whale shark stayed near my boat for approximately two hours, but it did not harm us. We folded our hands in reverence, thinking of it as God** –Trader, Mangalore

Some fisherfolk consider the whale shark to be God, associating it with – Koragajja or Swami– a highly revered local spirit deity in Mangalore. He is considered powerful and is widely worshipped along the coast. His existence extends from Ullal in Mangalore to Kundapura in Udupi and is known by different names as we proceed from south towards north, but the reverence remains consistent. People pray to Koragajja in times of distress, loss, or when they seek success in important matters. Devotees often make vows or promises to offer something in return if their prayers are fulfilled.

4.2 BTL communications – Alavi Pooja

After the 61-day monsoon fishing ban (trawler fishing ban) ends on July 31st, the fisherfolk perform a Samudra pooja (Alavi Pooja). This ceremony is attended by people from all faiths and often includes local political representatives. Interestingly, the occasion frequently coincides with Raksha Bandhan, making it a culturally significant festival. As a festival, this is a good dissemination point for information on whale shark conservation.

4.3 Other BTL platforms

- Announcements in the landing sites/harbors and the local fish markets, where the wholesale trade takes place
- Many of the fishers are from other states (Bengal, Odisha, Tamil Nadu, Andhra Pradesh, Kerala, and even Bangladesh). While some have learnt to speak basic Kannada, they cannot read it or are illiterate. Therefore, audio announcements via loudspeakers are far more effective than posters or written materials. Suggested Message: "If you catch this protected species, you will face legal punishment, including imprisonment."

RJs can announce through local stations, as many people living in coastal areas have cars and they listen to FM while driving
- AD, Fisheries Department

To convince the younger generation, social media needs to be used widely to run the campaign. Put videos out on YouTube, it is very popular here - DIG, Indian Coast Guard

- The Fishery School (CMFRI) is a trusted source that can be used as a platform to reach out to fishers.

4.4. Importance of associations

- Regardless of the source, all communication intended for fishermen, traders, and others involved in fisheries inevitably passes through fisheries associations. In Mangalore, there are more than 24 such associations, and they can serve as essential channels for any dissemination/awareness-building efforts.
- For fishermen, the president of their union is the most trusted and influential figure; they are categorical in stating any communication pertaining to whale shark conservation. Even if it's common knowledge, it must come through the union president.

I don't think it is necessary for Udupi and Dakshin Kannada districts– maybe people in Uttar Kannada might still need it. Here, almost everyone knows, including small-scale fishers as well as those in big trawlers. I don't think they need a social influencer or someone else to tell them about this ban – AD, Fisheries

5. Barriers to communication

- The crew members, or the fishers, are inexpensive seasonal workers from other states like Bihar, West Bengal, Odisha, etc. and are not very well acquainted with the local language. Thus, merely distributing the pamphlets won't work; we need to talk to them directly and in the language they understand.
- At every community interaction with the fishers, there is a high possibility that a new cohort of migrant employees is witnessing the forum, which means loss of communication effort from the previous batch and each time we have to start from scratch to ensure that the rationale of the campaign is conveyed effectively.
- Many times, the meetings are attended by the local boat owners– who do not go out to sea, instead of the fishermen who actually go out to sea.
- Sometimes, fishers who are aware of the law will claim ignorance because if they are caught violating the law, they can claim they did not know - DIG, Indian Coast Guard

Way Forward

The baseline survey revealed a consistently high level of Knowledge, Attitude, and Practice (KAP) among both fishing and non-fishing communities in Karnataka. Among the 307 fishers interviewed, an overwhelming 95 percent were aware of the whale shark, with 91% stating that they would release the animal if it accidentally got caught in their nets. Awareness of the whale shark's legal protection was also notable—61% were aware that the species was protected under Schedule I of the Wild Life (Protection) Act, 1972,, and 98% understood that violations could result in imprisonment or fines. Similarly, in the non-fisher segment, 93% of respondents recognized the legal consequences of harming whale sharks, while 91% expressed clear commitment to avoid consuming whale shark products in the future. These findings highlight the strong conservation orientation already prevalent along the Karnataka coastline.

Given this high baseline awareness, coupled with the fact that whale shark strandings and accidental entanglements have been very few in recent years, the urgency for intensive interventions has diminished. The state government, through the Fisheries and Forest Departments, along with scientific institutions such as CMFRI and several civil society organizations, continues to play an active and supportive role in awareness generation and monitoring efforts.

In this context, and with conservation attitudes firmly embedded within communities, WTI has consciously chosen to step back from direct implementation in Karnataka, confident that the combined efforts of government and partner institutions will sustain whale shark protection in the region.

CHAPTER 11

CONSERVATION ACTION

Whale Shark Conservation along Kerala and Lakshadweep

[1]Saymanti B, [2]Sajan John, [3]Sandeep Ghosh, [4]Krishnakumar K K, [5]B C Choudhury

[1,2,5]Wildlife Trust of India [3] Sambodhi Research and Communications Pvt. Ltd.

[4] Centre for Socio-Economic and Environmental Studies

1. Need for Campaigns in other Coastal States

The preliminary survey (2012-13) revealed the existence of five whale shark aggregation sites (apart from Gujarat) along the Indian coastline (Fig 264). While a successful campaign in Gujarat has assured a safer abode for the species, efforts

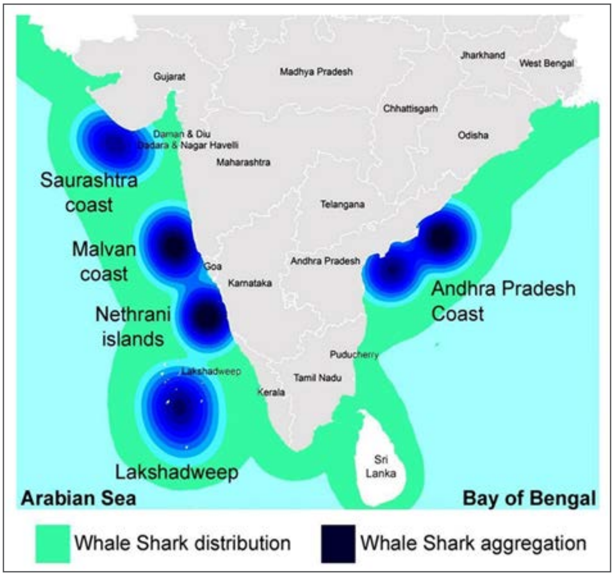


Fig. 264: Based on the TEK survey, six such whale shark aggregation areas have been identified

have to be consistent across the coast. The survey also highlighted that the biggest threat to this species is accidental entanglement during fishing operations, with incidentally caught whale sharks often ending up in the poultry feed and fertilizer industries.

The survey further revealed that while fishers in Karnataka and Kerala were generally aware of the ban, they were often hesitant to release the captured whale sharks. To address this issue, WTI expanded its whale shark campaign to other coastal states to enhance protection efforts. Prior to launching a full-scale campaign to assess the level of awareness and perception of the stakeholders, WTI conducted a pre-campaign assessment with the support of the Centre for Socio-economic and Environmental Studies (CSES), Kochi. Additionally, a mid-campaign survey was conducted in 2023 with the support of Sambodhi.

2. Formative Survey

A preliminary survey was undertaken along the coast of Kerala, with an aim to collect information regarding the extent of Knowledge, Awareness and Perception (KAP) of the local communities about whale sharks. This survey was executed by an independent organization, the Centre for Socio-Economic and Environmental Studies (CSES), to comprehend the predisposition to conserve the species. The data obtained from this survey served as the foundation for the campaign strategy in the designated regions, to elevate the existing KAP to transpire into a successful campaign. The study aims to delve into various aspects, including stakeholder attitudes, awareness levels, and potential obstacles to active participation in conservation efforts. The investigation will follow a holistic understanding of public perception, challenges, and opportunities pertaining to whale shark conservation.

2.1 Project Area

The offshore waters in and around Lakshadweep serve as an important whale shark aggregation site. However, frequent fishing activities by fishers from Kerala in these waters pose a significant threat to the gathering whale sharks. Hence, sensitising coastal communities is crucial to safeguard this vital aggregation site.

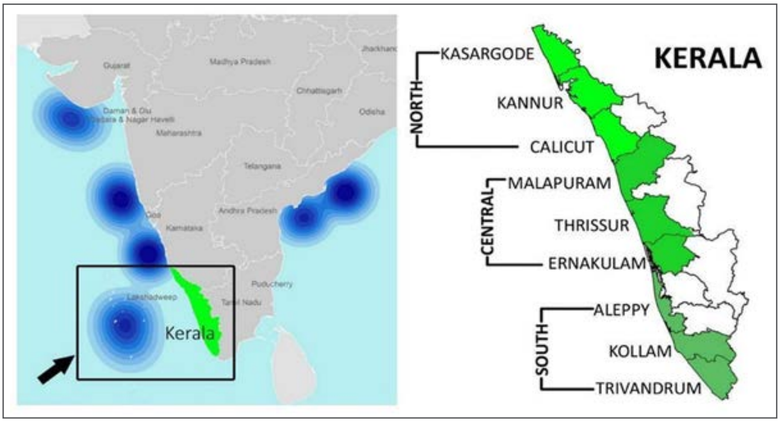


Fig. 265: Study area in reference to the whale shark aggregation. The non-shaded regions are non-coastal districts of Kerala.

The state of Kerala has a 590 km-long coastline spreading across 9 of its 14 districts. Among them, Kollam records the highest r marine fish landings, followed by Kozhikode and Ernakulam. Together, these three districts account for more than 50 per cent of the state's total marine fish catch (Fig 265).

According to the Economic Review 2016, the population engaged in marine fishing is 7.88 lakhs. There are 222 marine fishing villages, 15 fishing harbours and 10 fish landing centres (marine) in the state. Kerala is the second highest contributor to marine fish production, the highest being Gujarat. A survey conducted along the west coast of India, excluding the Gujarat coast by WTI revealed that the highest number of whale shark sightings were reported near the Lakshadweep waters.

2.2 Objective of the Study:

The broad objective of the pre-campaign study was to create a baseline database on the attitudes, perceptions, and awareness about whale shark fishing and the ban among the fishing and non-fishing communities in Kerala. Specific objectives include:

1. Measuring awareness levels about whale sharks among the people of Kerala.
2. Understanding attitudes and perceptions regarding the practice of capturing and trading whale shark meat, liver oil, and other body parts.
3. Gaining insights into possible motivators to elicit support from people towards

championing the cause of whale shark conservation.

2.3 Methodology

The study includes a quantitative survey and a qualitative study.

2.3.1 Quantitative Survey:

2.3.1.1 Citizen Survey:

450 respondents were interviewed from 30 wards near 15 fishing harbours/ landing centres. The sample composition included children, young adults, and adults from fishing and non-fishing communities.

No.	Fishing Harbour/landing centre	GP/Municipality/Corporation
1	Vizhinjam Harbour	Thiruvananthapuram Corporation
2	Muthalapozhi Harbour	Chirayinkeezhu GP
3	Thankassery Harbour	Kollam Corporation
4	Azheekal Harbour	Alapad GP
5	Neendakara Harbour	Neendakara GP
6	Thottappally Harbour	Purakkad GP
7	Cochin Harbour	Kochi Corporation
8	Kalamukku Fish Landing Centre	Elamkunnapuzha GP
9	Munambam Harbour	Pallippuram GP
10	Ponnani Harbour	Ponnani Municipality
11	Beypore Harbour	Kozhikode Corporation
12	Puthiyappa Harbour	Kozhikode Corporation
13	Chombala Harbour	Azhiyoor GP
14	Mappila Bay Harbour	Kannur Corporation
15	Kasaragod Harbour	Kasaragod Municipality

2.3.1.2 Fishermen Survey:

150 trawler/boat workers were interviewed in fishing harbours/landing centres. The list is provided in Table 91.

Table 91. List of Fishing Harbours/landing centres and their respective jurisdiction

2.3.2 Qualitative Survey:

- Depth interviews were conducted with trawlers/boat owners, Fisheries Department/CMFRI/Matsyafed staff, elected representatives, trawlers/boat workers, and other workers in the fishing sector.
- Survey Instruments: Questionnaires for citizen/workers surveys and checklists for depth interviews were used.
- Data Collection Procedures: Training was provided to investigators and supervisors. Common administration guidelines were used. Data collection was done during March and April 2018.

3. Survey Findings

Classification		No.	%
Region	South	150	33.3
	Central	120	26.7
	North	180	40.0
Age	Children	86	19.1
	Young adults	90	20.0
	Other adults	274	60.9
Gender	Male	184	40.9
	Female	266	59.1
Category	SC	9	2.0
	OBC	431	95.8
	GEN	10	2.2
Caste/ Category	Latin Catholic	124	27.5
	Ezhava/ Thiyya	124	27.5
	Dheevara/ Araya	97	21.6
	Muslim	66	14.7
	SC (Pulaya/Vannan/ Kanakka)	9	2.0
	Other	30	6.7
Total		**450**	**100.0**

3.1 Citizen Survey

A major component of this baseline study is a sample survey among 450 citizens in different geographical locations across Kerala (Table 92).

Table 92. Profile of the Respondents (Citizen Survey)

3.1.1 Awareness About Whale Sharks

One of the key objectives of the survey was to measure the awareness levels among the coastal communities (apart from Fishers) of Kerala about whale sharks. The respondents were first asked whether they had heard about this species. This initial question gauged their level of awareness about whale sharks.

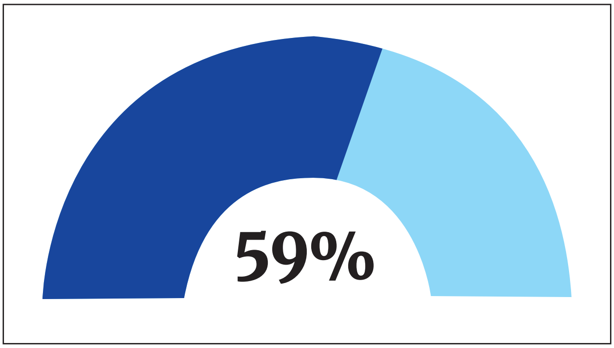


Fig. 266: 59% of respondents are aware of whale sharks

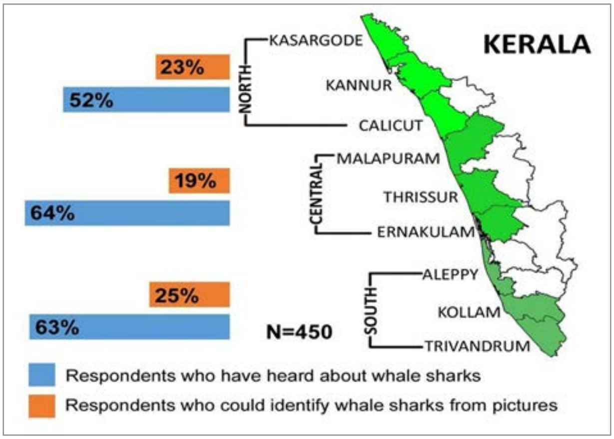


Fig.267. Geographic stratification of awareness level showed minimal difference

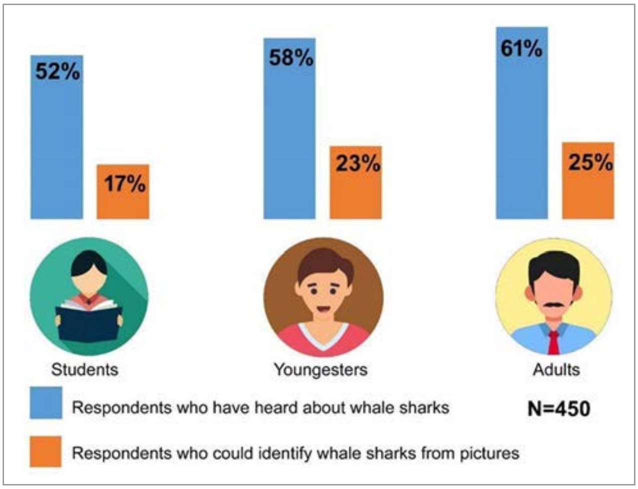


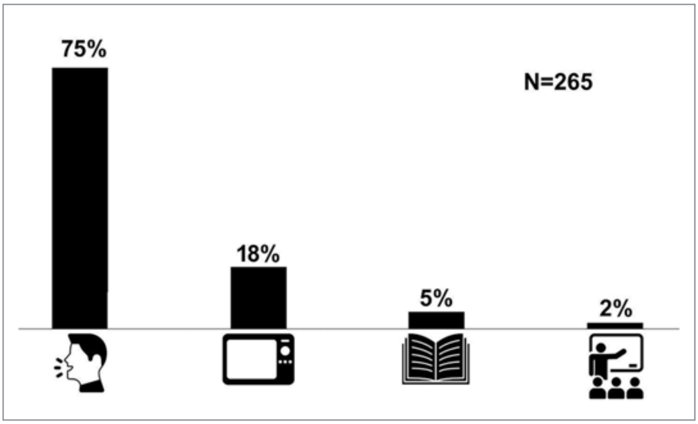
Fig. 268: Among the different age groups, awareness is lowest among children

Overall, about three in five respondents reported having heard of whale sharks, with more than half (59%) awareness recorded across all regions (Fig. 266). Awareness levels were similar in South and Central Kerala, with slightly lower awareness levels reported in North Kerala. Among the different age groups, awareness levels were recorded to be lowest among children (Figs. 267 & 268).

To assess respondents' ability to identify the species, they were shown a portfolio of photos of similar-looking fishes/whales such as blue whales, great white sharks and bull sharks. While a majority of the respondents had heard of whale sharks, fewer than one-fourth were able to correctly identify it from the photographs. Picture-aided awareness was notably lower in the central region and among children compared to other demographics.

3.1.2 Sources of Awareness

Respondents who were aware of the whale shark were asked about their source of



information. The majority, about three-fourths (75%), learned about the species through word-of-mouth from friends, relatives, and fishers. Approximately one-fifth (18%) gained knowledge from TV programs, with a significant portion citing the Discovery Channel. Print media, such as newspapers and books, contributed 5%, while awareness lectures at schools or colleges accounted for 2% (Fig. 269).

TV channels normally watch

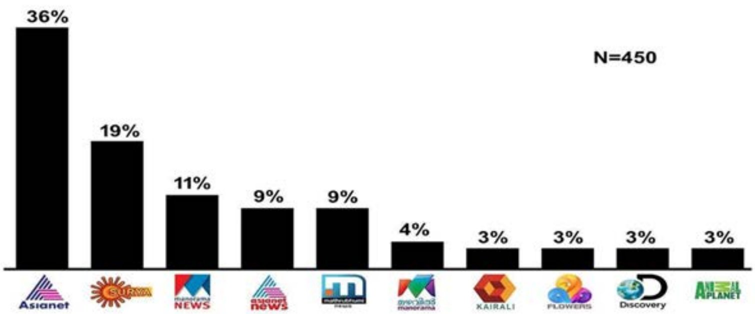


Fig. 270: Source of awareness among respondents who have heard about whale sharks through visual media

Newspapers read by the respondents

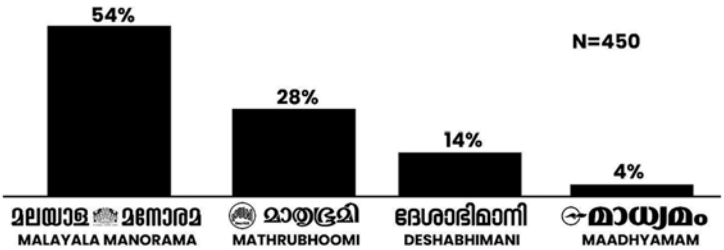


Fig. 271: Source of awareness among respondents who have heard about whale sharks through print media

Fig. 269: Source of awareness among respondents who have heard about whale sharks

The most popular TV channel among the target respondents was Asianet followed by Surya TV. The major non-Malayalam channels watched by the respondents were Discovery and Animal Planet (Fig. 270).

The major newspapers read by the respondents were Malayala Manorama, Mathrubhumi and Deshabhimani with Malayala Manorama leading significantly with a readership of 54%, while Mathrubhumi follows with approximately half that figure. Deshabhimani holds the third position with a readership of 15% (Fig. 271).

3.1.3 Perceptions about Whale Shark

Perceptions among the respondents who are aware of whale sharks were elicited through questions about their characteristics and habitats.

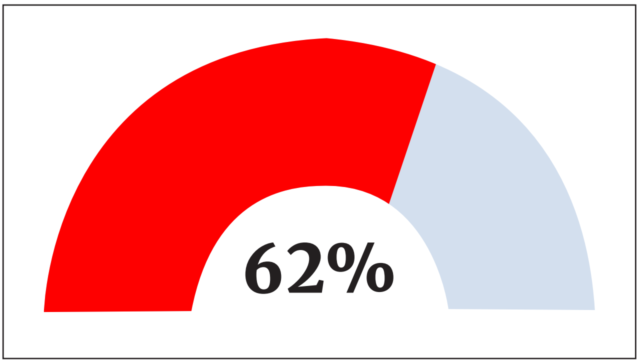


Fig.272: 62% of respondents were uncertain whether the species is a whale or a shark

Perception of whether it is a Whale or a Shark : Two-thirds of those aware of the whale shark were not certain if it was a whale or a shark (62%). Nearly one-third of the respondents (30%) correctly identified it as a type of shark, while the remaining (8%) mistakenly believed it was a whale (Fig.272).

Perceptions about whether whale sharks are dangerous : Respondents who were aware of whale sharks were asked a follow-up question–"Many people we spoke to say that whale sharks are dangerous because they are known to attack humans while others claim they are not dangerous. What is your opinion on this?" Approximately two-thirds of the respondents (63%) were uncertain about whether they were dangerous to humans (Fig. 273). Only 15% believed they were dangerous and attacked humans, while one-fifth knew that they were NOT dangerous to humans (22%).

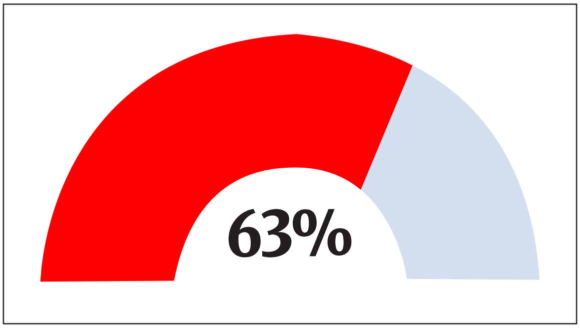


Fig. 273: 63% of respondents were uncertain whether whale sharks are dangerous or not

Perceptions on the whereabouts of whale shark : About two-thirds of those who have heard of whale sharks were unaware (60%) of where they can be found (Fig. 274). About one-fourth, were aware that they are found along the Kerala coast (26%).

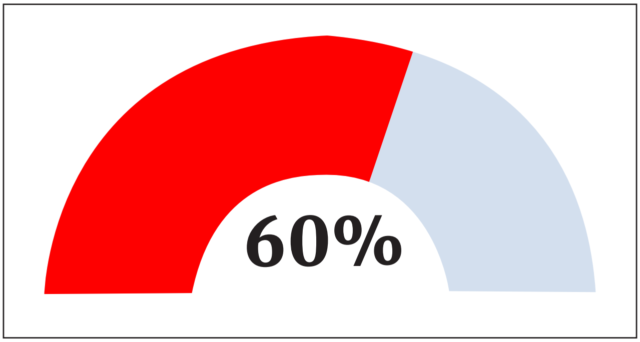


Fig. 274: 60% of respondents were unaware of where whale sharks can be found

3.1.4 Legal Awareness on the Protection of Whale Shark

Awareness regarding the legal protection of whale sharks was also measured. The majority of respondents (82%) were unaware that the species is legally protected. Among those who had heard of the whale shark, only about one-tenth were aware (11%) that it is a protected species and that killing or trading its body parts is illegal (Fig. 275).

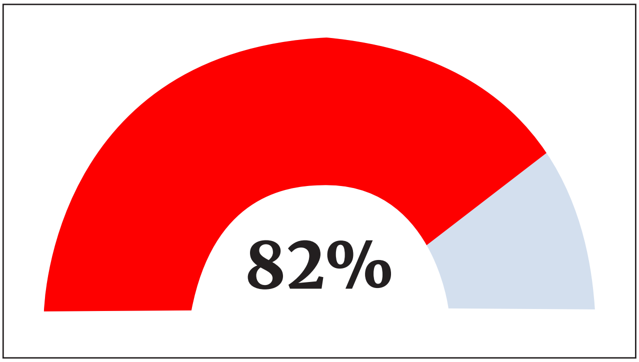


Fig.275: 82% of respondents were unaware that whale sharks are legally protected

3.1.5 Awareness about the Practice of Killing Whale Shark

Respondents who had heard about whale sharks were asked if they knew that they are killed along the Kerala coastline. Only 7 percent were aware of this fact (Fig. 276).

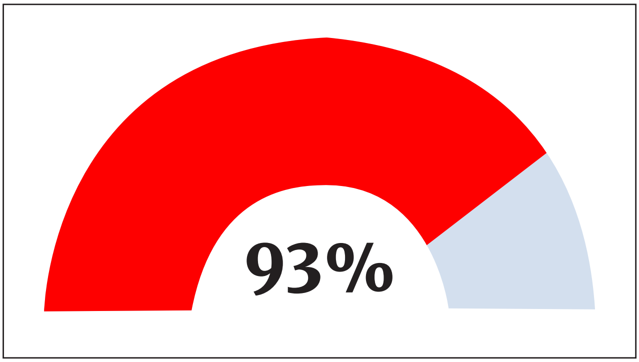


Fig. 276: 93% of respondents were unaware that whale sharks are killed along the Kerala Coast

3.1.6 Concern Regarding the Protection of Endangered Marine Species

When asked if respondents were concerned about protecting endangered marine species, About three-fourths (62%) stated that they were not concerned about protecting them (Fig. 277).

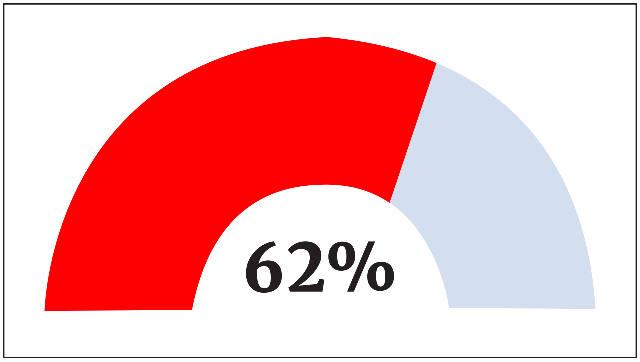


Fig. 277: 62% of respondents were not concerned about protecting endangered marine species

3.1.7 Involvement in Conservation Efforts

Only 6 percent of respondents reported having participated in activities aimed at protecting endangered species in the past. Interestingly, more than one-tenth of young adults participated in such activities, including events conducted by MPEDA, fisheries departments, CMFRI etc. such as seminars, classes and camps on marine and caostal conservation. Initiatives ranged from campaigns against hunting of small fishes to sea protection drives, particularly targeting plastic dumping and littering along shorelines. A few respondents from Purakkad GP also mentioned volunteering for the protection and management of sea turtle eggs.

Respondents who had not participated in such activities were asked to rank the reasons for non-participation. The reasons cited have been consolidated and provided below (Fig. 278).

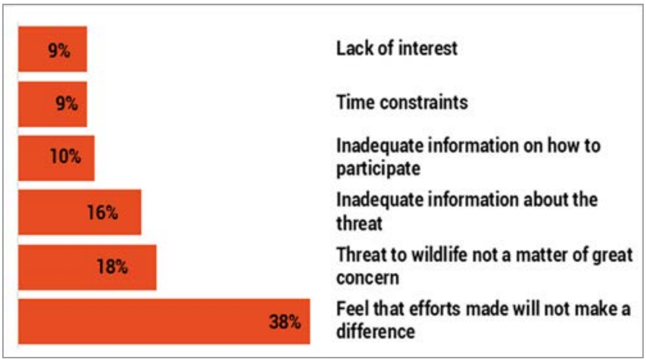


Fig. 278: Reasons for non-involvement of the general public in conservation efforts

The major deterrent for non-participation is the belief that such efforts will not make a difference. Other major reasons cited by the respondents were that threats to wildlife are not a personal concern and a lack of information on how to participate in these conservation efforts.

3.1.8 Consumption of Whale Shark Meat in the Future

Respondents were asked “If presented with an opportunity, would you eat food/ soup prepared from whale shark meat/ fins etc.?" and their responses were elicited (Fig. 279).

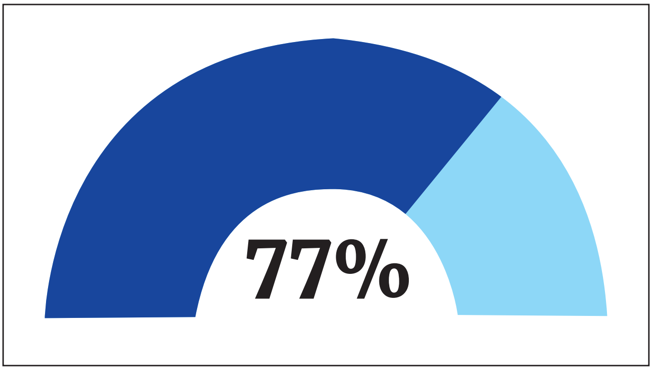


Fig. 279: 77% of respondents said that they would NOT consume any food prepared from whale sharks

3.1.9 Willingness to Participate in Whale Shark Conservation

An attempt was made to gauge the respondents' willingness to participate in future efforts for the conservation of whale sharks (Fig. 280).

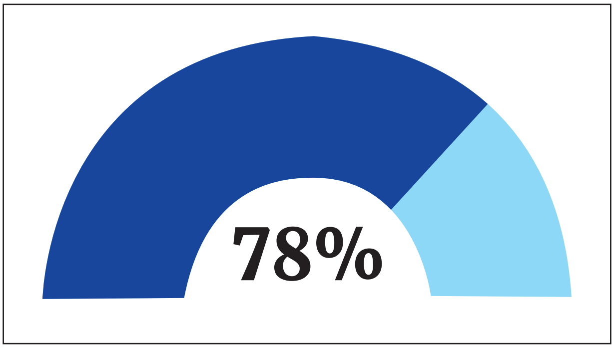


Fig. 280: 78% of respondents said that they are willing to participate in conservation efforts for endangered species

Respondents expressed strong support for participating in future conservation efforts, with about 59 per cent indicating willingness to get involved. Conversely, 13 percent were unwilling to participate in such efforts. There was little variation among different categories of respondents, highlighting the need for a widespread awareness campaign focused on whale shark conservation in Kerala.

3.2 Fishermen Survey

As the primary stakeholders, fishers are more likely to encounter whale sharks. A sample survey was specifically conducted to gain insights into aspects related to whale shark conservation. The survey spanned various localities along the Kerala coast and included interviews with 150 fishers. The aim was to understand their awareness of whale sharks, their experiences and perceptions of the species, and their attitudes towards the protection of this endangered species. A semi-structured questionnaire was utilised for data collection.

The profile of the sample fishermen is presented in Table 93.

Table 93. The demographic stratification of interviews conducted

Classification		Number of Respondents	%
Age	30 years or below	26	17.3
	31-40 Years	42	28.0
	41-50 Years	42	28.0
	Above 50 Years	40	26.7
Experience in Fishing in the Sea	10 years or below	26	17.3
	11-20 Years	50	33.4
	21-30 Years	39	26.0
	Above 30 Years	35	23.3
Distance at which the respondent goes fishing in the sea	25 NM or less	35	23.3
	26-50 NM	44	29.3
	51-100 NM	24	16.0
	More than 100 NM	47	31.4
Category	Other Backward Caste	147	98.0
	Others	3	2.0
Total		150	100.0

The majority of the fishers were below 50 years of age. However, about one-fourth were aged above 50 years. Nearly half of them travel more than 50 nautical miles for fishing and almost all belong to other backward communities.

3.2.1 Awareness about Whale Shark

As in the case of the citizen survey, the respondents were asked if they had heard about whale sharks. They were also asked to identify the fish from a portfolio of photos of similar fishes/whales. Responses to both these questions are given as Awareness and Picture- Aided Awareness (Fig 281 & 282)

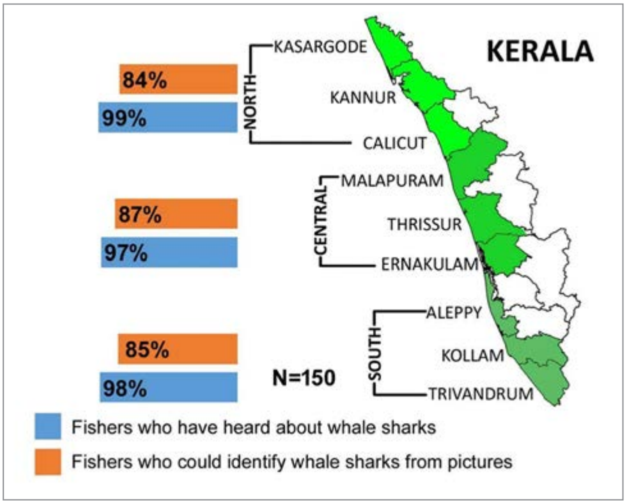


Fig. 281: Geographic stratification of awareness level by fishers showed not much difference

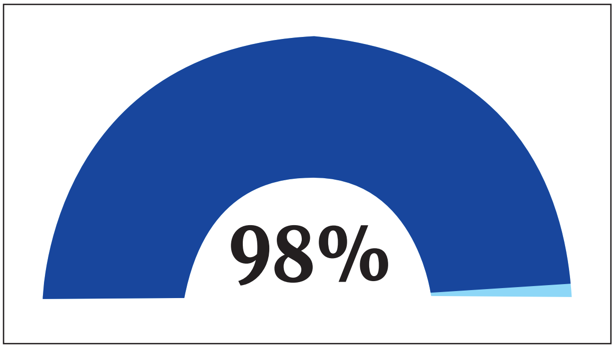


Fig. 282: Majority of fishers have heard about the whale sharks

As anticipated, the majority of fishers were aware of whale sharks. However, when presented with a portfolio of photographs of fishes /whales to identify a whale shark, 15 per cent were unable to identify it.

Spontaneous response to knowledge about Whale Shark

The fishers who were aware of the whale shark were asked about their knowledge of it. Their spontaneous responses are presented below (Fig. 283).

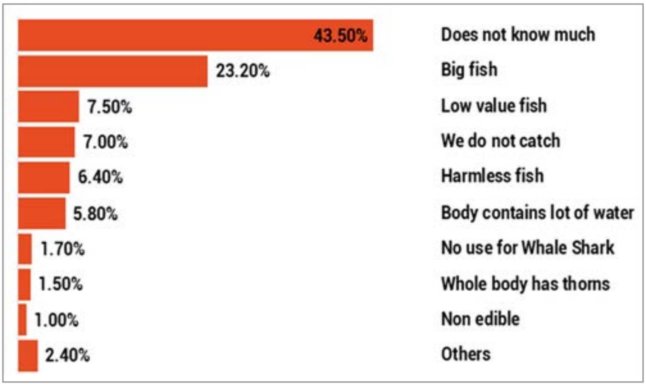


Fig.283: Majority of fishers were unaware of whale sharks (N=150)

Other responses included: Widely used in Gujarat; Has a large mouth; Has a large stomach; moves slowly; Its fins are costly; It is legally protected, and it often comes near the boat.

About half the fishers who were aware of whale sharks said that they did not know much about the species. Some of the comments are as below:

- "It is a useless fish (*Oru prayojanvumillatha meen*)"
- "It is a harmless one *(Oru pavam meen)*"
- "It is a fish with no value. For any other fish weighing 600- 700 kg, we will get INR 60,000-70,000. But a whale shark with the same weight will only sell for INR 10,000. The workload is the same for both. So normally, the trawlers avoid whale sharks."
- "Sighting whale sharks is a good sign. Chances for a good catch of small fish near it are higher ."
- "It will not attack us; we should not catch them. It is a harmless fish and is not dangerous to us. Normally, it does not get trapped in the net; in case it is trapped, we release it."
- "Its meat is not useful, but fins have a market. Some only take the fins."
- "Its fins have been used for manufacturing surgical stitching threads."
- "There is a demand for baby whale sharks. They are used to make some medicine for heart diseases" (fishers in Vizhinjam)

Fig: 284: Sensitising fishers along the Kerala coast by Field Officer

3.2.2 Local Names of Whale Shark

The whale shark is known by different names along the Kerala coast. It is widely known as *Pulli Sravu* (Shark with dots on the body) across the state, particularly in North Kerala. It is also known as *Thanni Sravu* (a Shark with high water content in its body) among the fishermen in North Kerala. In the South and Central parts, it is referred to as as *Puli Sravu or Puliyan Sravu* (Leopard Shark). Another name used in these areas is Udumbu (literal meaning is Monitor Lizard) or *Pulli Udumbu* due to its different shape from other sharks). Other names used in these areas include *Pulli Thimingalam* (Whale with dots in the body), *Vella Udumbu, Vellamkolli Sravu, ,Keeri Pallan Thimangala Sravu* among others.

3.2.3 Perceptions about Whale Shark

The perception among the fishers on whether it is a whale or a shark is illustrated below (Fig. 285). Among those aware of the species, only two-thirds correctly identified it as a shark, while about one-tenth identified it as a type of whale. Additionally, 11.7 percent believed it was a kind of fish, and 12 percent were unsure whether it was a whale or a shark.

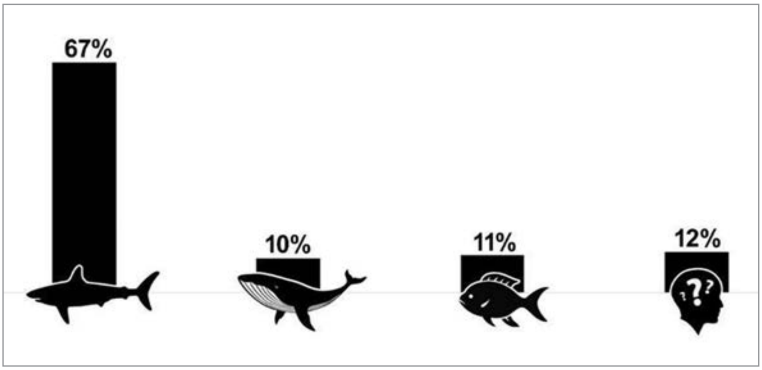


Fig. 285: Perception of fishers about whether whale shark is a whale or a shark (N=150)

3.2.4 Experience with Whale Sharks in the Sea

Out of the 150 fishermen involved in the baseline survey, 93 (62%) reported having seen a whale shark, either in the sea or at the harbour or landing centre. Additionally, 70 of the 150 fishers (47%) reported seeing live whale sharks in the sea (Fig. 286).

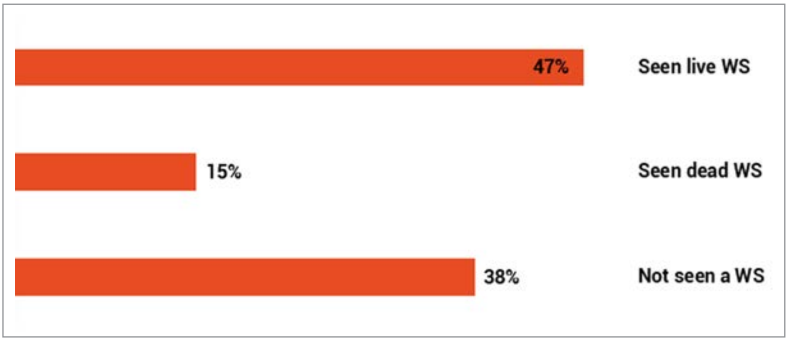


Fig. 286: Encounter with live/ dead whale sharks by fishers (N=150)

3.2.5 Percentage of Fishers WHO have Seen a Whale Shark

One-third of those who have seen a whale shark at least once in their lifetime (33 out of 93) reported seeing it in the last two years (2017 and 2018). More than half (50 out of 93) have reported having seen it after 2010. Additionally, more than four-fifths (76 out of 93) reported having seen it within Kerala territory (either in the sea or on shore). This indicates that whale shark sightings in fishing areas frequented by fishers are not uncommon.

The fishers who reported seeing whale sharks in the sea (70) were asked about their experiences. The questions asked and their responses are provided in Table 94.

Table 94. Experiences of fishers who saw a whale shark in the sea

Question	Response	No.	%
When do you see whale sharks?	Throughout the year	52	74.3
	Specific season	13	18.6
	Do not remember	5	7.1
Where have you seen whale sharks? Reef area, outer sea or near estuary?	Reef area	8	11.4
	Outer sea	62	88.6
Time of the day of sighting	Morning	45	64.3
	Noon	20	28.6
	Evening/night	5	7.1
How do you see the whale shark, i.e. with the fin out of the water or in other ways?	Fin out of water	70	100.0
	Other ways	0	0.0
How do you find them, single or in groups?	Single	70	100.0
	Group	0	0.0
Have you ever seen baby/pups (46 -100 cm) of Whale Sharks?	Yes	5	7.1
	No	65	92.9
Did you ever hit a whale shark with your boat?	Yes	0	0.0
	No	70	100.0
Did you ever see a whale shark with any "TAG" or markings in your area?	Yes	0	0.0
	No	70	100.0

Base: 70 respondents who saw whale sharks in the sea

More than three-fourths of the fishers who reported sightings of whale sharks, observed them throughout the year. Those who initially reported not seeing whale sharks year-round later mentioned sightings across multiple seasons.

This reiterates the fact that there is no specific season for whale shark sightings in these waters. The vast majority of sightings occurred in the deep sea area, with one-tenth of fishers also reporting sightings in the reef area. About two-thirds noted sightings in the morning, while one-fourth observed them at noon. In all cases, whale sharks were observed with their fin visible above the water. They were typically observed alone rather than in groups. Only a small proportion of fishers reported observing whale shark pups and none reported seeing any tags or markings on the individuals they encountered.

Whale shark pups or Bow-mouth guitarfish?

The bow-mouth guitarfish *(Rhina ancylostoma)* is often misidentified as a juvenile whale shark amongst amateur biologists/non-biologists. Its striking resemblance to the whale shark's body pattern is one of the major reasons for this misidentification (Fig. 287). The species is fairly common along both the West and East coasts of India, and bow-mouth guitarfishes land along the Kerala coast annually. An adult Bow-mouth guitarfish is relatively small compared to a whale shark, which may lead fishers to mistakenly identify them to be whale shark pups. We suspect that fishers might often confuse bow-mouth guitarfish with the pup/juvenile of whale sharks.

Fig 287: Adult bow-mouth guitarfish (Rhina ancylostomus) landed at Cochin harbour, Kerala

3.2.6 Catching/Hunting Experience

Among the interviewed fishers (N=150), 20% reported encountering whale sharks as accidental catches. The majority of them had caught whale sharks only once or twice in their lifetime. Of these, 25 fishermen had caught them in fishing nets, while 5 had caught them on hooks. Although they did not have any intentions of killing whale sharks, the ones that were accidentally entangled were already dead by the time they got to shore. Five fishermen (among these 20%) admitted to intentionally killing a whale shark at least once in their lives, using hooks. Reported prices for whale sharks varied considerably: one fisherman mentioned that the price was very low, while another claimed that dry fins could fetch about INR 4,500 per kg. One fisherman who continues to hunt whale sharks reported receiving a mere INR 55 for a kilogram of fins. He also mentioned that there is no market for it in Kerala, but there are agents who actively purchase them in the Kanyakumari region. The remaining 80% reported that they hadn't encountered a whale shark during their fishing operations (Fig. 288).

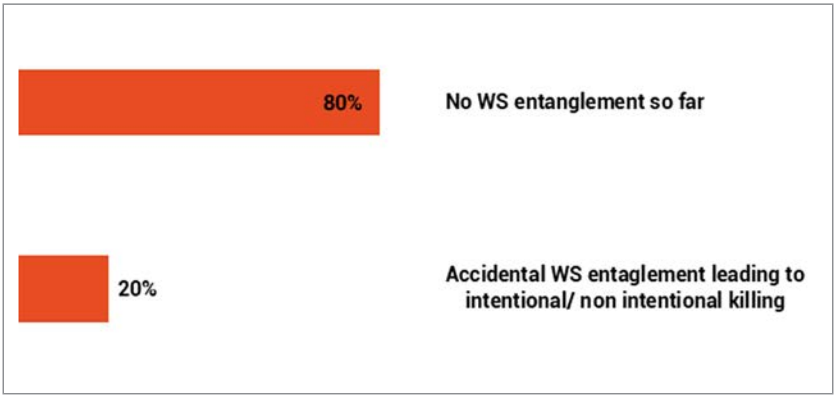


Fig. 288: Fishers interaction with whale sharks at sea during fishing (N=150)

3.2.7 Awareness about Whale Shark Conservation

Fishers were asked various questions about whale shark conservation. The responses are presented (Fig. 289 and Table 95)

Table 95. Responses to the questions regarding the Conservation of Whale Shark

Question	Response	Percentage of respondents
Do you feel whale sharks are important for the sea?	Yes	25
	No	45
	Don't know	30
Are you aware of the Wild Life (Protection) Act,1972 and that the whale shark is protected under this law?	Yes	10
	No	15
	Don't know	75
Should the ban on whale shark catch be removed?	Yes	10
	No	7
	Don't know	83
If you see a whale shark in the sea, what will you do?	Will not catch/Avoid	91
	Try to catch using a hook	5
	Not decided/no response	4
What will you do with an accidentally caught whale shark?	Will set free to the sea	6
	Bring it to the shore if dead	76
	Will bring it if it is small in size	18
Do you know anyone around your area who still hunts whale sharks?	Yes	11
	No	89
Is there any whale shark meat, oil or fin consumption in your area?	Yes	4
	No	96
Did you find any demand for whale shark meat, oil, fin or any other parts in the market in recent times?	Yes	5
	No	91
	No opinion	4

Base: 150 Fishermen respondents

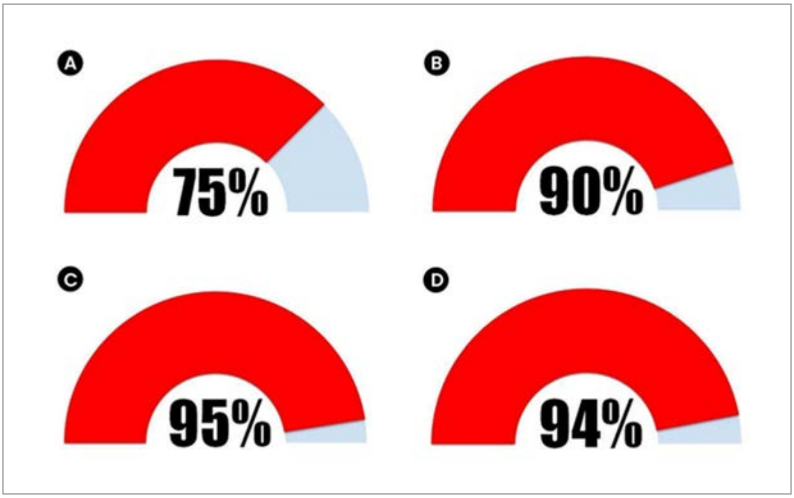


Fig. 289: Various opinions of fishers on whale sharks

A. A majority of the fishers interviewed believed that whale sharks were not important to the sea (75%).

B. Fishers reported that they were unaware of the Indian Wildlife (Protection) Act, 1972 (90%)

C. Fishers felt that whale sharks don't need any protection (95%) and

D. Fishers stated that they would bring a whale shark back to the shore if it were either dead/small in size (94%).

The majority (91%) of fishers stated that they would avoid catching a whale shark. However, when questioned about accidentally catching one, 18% admitted they would bring it ashore to sell if it was small in size. This is concerning, as it increases the risk of targetting whale shark pups, which in turn, could adversely affect the survival of the species. Over 75% indicated they will bring an accidentally killed whale shark ashore. Notably, only 10% of the fishers surveyed along the Kerala coast were aware that whale shark hunting still occurs and that there is a demand for their meat, oil and fins. Raising public awareness through campaigns about avoiding products derived from whale sharks could reduce future demand.

4. Follow up Survey-2022

In 2022, a random sampling survey was conducted across the districts of Kochi, Kozhikode and Trivandrum. The campaign focused on broad investigations into the current Knowledge, Attitudes, and Practices (KAP) of relevant stakeholders regarding whale sharks. This included assessing their awareness levels including any sightings, sources of awareness, and their knowledge about the legal protection status of the species. Additionally, the inquiry sought to gauge the extent of empathy towards the need for protection and to identify any deterrents towards active participation in conservation efforts.

The outputs and Key Performance Indicators (KPIs) of the campaign were closely tied to these areas of inquiry. They included identifying triggers that can shape the campaign and selecting appropriate communication tools to reach out to the target groups (Table 96).

Table 96. The geographical stratification of the interviews conducted

District	Location	Particulars	Fishing villages
Kozhikode	North Kerala	Mixed population with 56.2% Hindus and 39.2% Muslims	35
Malappuram	Central Kerala	Highest Muslim concentration (70.24%)	23
Ernakulum	Central Kerala	Highest Christian concentration (39.24%)	21
Allapuzha	South Kerala	Highest Hindu concentration (68.4%) and good Christian population (21%)	30

4.1 The Findings

4.1.1 Lack of Campaign Recall:

Reasons for low recall include the passage of time (over three years since the campaign), major events overshadowing it, and movement restrictions during the COVID-19 outbreak.

The dip-stick survey focused on Kochi, Kozhikode, and Trivandrum, with findings indicating a lack of awareness among stakeholders.

4.1.2 The Fishing Trade in Kerala

The fishing trade in Kerala is deeply embedded in its coastal geography, spanning over 590 kilometres of coastline and contributing significantly to the livelihoods of approximately 8 lakh people across 222 fishing villages. The state's marine fisheries sector operates within an Exclusive Economic Zone (EEZ) of 2,18,536 square kilometres. The major fishing districts include Thiruvananthapuram, Kollam, Alappuzha, Ernakulam, Thrissur, Malappuram, Kozhikode, Kannur, and Kasaragod.

Seafood export, primarily facilitated through Kochi and Trivandrum ports, is a key aspect of Kerala's fishing trade. Kochi handles the majority of exports, emphasising high volume-low value transactions compared to eastern coast ports. The trade involves various catches, including parrot fish, squids, mackerel, oil sardines, shrimps, Indian salmon, and ribbon fish.

A concerning issue in Kerela's fishing trade is the incidental capture of whale sharks, which are often drawn to smaller fish in nets. Although larger whale sharks are typically released due to their low market value, smaller ones are subjected to practices like fin extraction and oil collection before being discarded. Despite a ban on whale shark hunting, evidence indicates that targeted fishing and trade of smaller whale sharks persist, especially in regions like Munambam and Kochi.

The demand for certain catches, such as squid, cuttlefish, and prawns, is fueled by international markets, with exports reaching Europe, America, China, Japan, and Southeast Asian countries.

The whale shark trade, driven by the demand for fins and oil, reveals a clandestine market. Fishers find the effort of bringing a full-grown whale shark ashore impractical due to its watery body, media attention, and the risks involved. Instead, the lucrative market revolves around the extraction of oil and fins, which are in demand for medicinal purposes and international trade, especially in Dubai, Oman, China, Malaysia, and Hong Kong.

Although awareness initiatives have been undertaken by organizations like CMFRI and the Fisheries Department, significant gaps still exist in disseminating information about the ban on whale shark hunting, its associated penalties, and the Wild Life Protection Act. While many fishers are aware of the ban, they lack detailed knowledge about the penalties and legal consequences. Government departments are involved in spreading awareness through programs, coastal clean-ups, and collaborative efforts with NGOs, but challenges persist in effectively reaching all segments of the fishing community, particularly those from different linguistic backgrounds.

In summary, the fishing trade in Kerala is vital for the coastal population, but challenges such as the illegal trade of protected species like the whale shark persist, highlighting the need for enhanced awareness and enforcement efforts.

4.1.3 Demand, Trade, and the Ban

The ongoing capture of whale sharks in Kerala reveals a complex scenario, contrary to the official stance that such incidents are infrequent. Traders acknowledge that whale sharks caught by gillnet and hook fishers end up being sold in places like Munambam near Kochi. Smaller whale sharks are reportedly still hunted using hooks, with claims that they are sold in Kochi and Munambam.

While some fishers confirm having intentionally caught whale sharks through hook fishing, accidental catches are more common, especially among trawlers. An interesting revelation is that many fishers, despite being aware of the ban, do not consider selling whale shark meat due to low demand. Instead, some trawlers engage in the practice of cutting fins, eating the meat, and discarding the carcass at sea.

The demand for whale shark products, such as oil and fins, particularly in international markets like the USA, Dubai, Oman, China, Malaysia, and Hong Kong, drives a clandestine trade. The oil, known for its medicinal value, is collected and sold by fishers, while the fins are priced at INR 400/kg.

Despite the ban and ongoing efforts to protect whale sharks, the prevailing mindset among some fishers is that protecting these species is unnecessary, citing the significant expenses involved in their fishing expeditions. The demand for fins and oil continues to fuel the trade, with reports of smuggling despite export bans.

The lack of awareness about penalties and legal consequences, even among fishers who are aware of the ban, highlights the need for more effective information dissemination and enforcement strategies. The complex dynamics of the whale shark trade in Kerala underscore the challenges in conservation efforts and the importance of addressing economic incentives driving the practice.

4.1.4 Awareness of the Ban and the Extent of Dissemination

Awareness of the ban and penalties associated with hunting whale sharks in Kerala appears to be limited among the fishing community and related stakeholders. The first case involving a marine species, specifically a whale shark, brought attention to the issue, but many people remain unaware of the legal aspects.

Despite efforts by various entities, including the Fisheries College, Department of Fisheries, and Central Marine Fisheries Research Institute (CMFRI), there appears to be a lack of targeted campaigns focusing on the ban on whale sharks. Fishers and trawler owners reported a lack of awareness regarding penalty clauses, fines, and the severity of consequences, which can include fines ranging from INR 25,000 to INR 50,000 and imprisonment for up to seven years.

While there is general recognition of the protected status of whale sharks, knowledge about the Wild Life (Protection) Act, 1972 and its specific provisions remains limited within the fishing community.

The information dissemination efforts by organizations like the CMFRI, Fisheries Department, and local government involve awareness classes, coastal clean-ups, and joint activities with NGOs. The Fisheries Department conducts programs like "Arivu" to inform fishers about the ban and collaborates with CMFRI in awareness campaigns. However, the effectiveness of these initiatives is questioned, as many fishers, particularly those from out of state or with language barriers, remain uninformed.

Despite these efforts, scepticism persists among fishers about the need for the ban. Some hold the belief that the vastness of the sea ensures an endless supply of fish and question the necessity of conservation measures.

The government has undertaken several initiatives to disseminate information, including awareness programs, collaborations with research institutes, and the circulation of photos and posters through WhatsApp groups. However, the challenge lies in reaching diverse groups of fishers, including those from different regions and with varying levels of literacy.

In conlusion, while efforts have been made to spread awareness about the ban on hunting whale sharks, significant gaps remain in ensuring comprehensive understanding - especially regarding the penalties-among the fishing community in Kerala.

4.2 Inputs for Relaunching the Campaign in Kerala

4.2.1 Compensation Instead of just Recognition

- Emphasise the financial burden on fishers due to accidental catches of whale sharks.
- Propose a compensation plan to address the losses incurred by fishers when releasing accidental catches.

- Highlight the economic impact on boat owners and fishers, reinforcing the need for tangible support.

4.2.2 Learning from the Gujarat Model Success

- Recognize the success of the Gujarat model as a reference point for the campaign.
- Emphasise the idea of net loss, illustrating that conservation efforts in one region are compromised by the lack of similar efforts in Kerala.
- Leverage the success story from Gujarat to create a sense of urgency and responsibility among the local community.

4.2.3 Communication in the Local Language is Key

- Stress the importance of communicating in the local dialects and languages.
- Tailor campaign messages to resonate with the cultural nuances of different regions within Kerala.
- Use language that is easily understood and relatable to the diverse population, including both local and migrant communities.

4.2.4 Collaboration with Stakeholders

- Collaborate with the Harbour Development Committee to enhance the effectiveness of the campaign in key coastal areas.
- Engage with unions such as the Fishermen's Congress and Fishermen's Federation, for wider outreach.
- Foster partnerships with boat owners' associations and other relevant associations to strengthen the campaign's impact.
- Leverage these collaborations to disseminate information, conduct awareness programs, and ensure the active participation of the fishing community.
- Use effective illustrations in awareness programs, such as street plays, large prototype models, big picture illustrations, and videos/films of whale sharks.
- Display messages on conservation and the need to release accidentally trapped whale sharks in all major harbours and landing centres.
- Use the languages of migrant workers in boats/trawlers for campaigns.
- Conduct awareness programs in schools and colleges in coastal Kerala and publish articles in leading newspapers.
- Link the 'Save the Whale Shark' campaign to the issue of plastic pollution in the sea.
- Distribute stickers with pictures of whale sharks and information about their protection to trawlers and boats.

- Engage various organizations, unions, religious and caste organizations, family gatherings, and youth clubs in organizing awareness programs.

These findings and suggestions can guide the development of effective awareness programs for whale shark conservation in Kerala.

The State Fisheries Department's initiative, the Sagar Mitra Project, employs 'Sagar Mitras' (friends of the sea) as harbour volunteers to act as a bridge between fishers and the government. A significant concern among fishers is the lack of compensation for accidental catches, leading to financial burdens. While the media amplifies these incidents, recognition alone is considered insufficient. The lack of a compensation plan within the Fisheries Department has been acknowledged, and it is suggested that such initiatives should be implemented by the Forest Department in accordance with the Wild Life (Protection) Act, 1972. In the context of relaunching the campaign in Kerala, several considerations and insights emerged. While acknowledging the lack of a compelling punchline in Kerala, the historical success in Gujarat was highlighted, emphasising the need for a revamped strategy. Recognizing the changing dynamics, particularly among the younger generation of fishers who are engaged with social media and influenced by celebrity culture, the idea of leveraging popular actors as conduits for awareness was proposed, with the anticipation fo achieving up to a potential 50% conversion among the youth.

The reluctance of the Fisheries and Forest Departments to utilise local festivals and religious leaders for outreach was noted, highlighting the perceived rarity of issues related to the killing and landing of whale sharks in the state. Local traders and boat owners recognized the Fisheries Department's credibility and advocated for targeted campaigns, suggesting a focus on the coastal regions of Tamil Nadu, Andhra Pradesh, and Odisha.

Considering the multicultural milieu, the importance of localised campaigns and collaboration with stakeholders such as unions, the Harbour Development Committee, and the Forest Department was emphasised. Specific attention was drawn to the need for communication in appropriate dialects in areas like Beypore, which hosts a diverse population, including Bengalis and migrants. The involvement of migrant workers on boats highlighted the need for targeted awareness campaigns aimed at both them and boat owners, underscoring the importance of comprehensive outreach efforts.

The willingness of the Harbour Development Committee and Forest Department to assist in mass gatherings and disseminate information in local languages reflected a collaborative approach. The involvement of unions, despite potential clashes, was deemed crucial due to their strong influence within the fishing community. A proposal was made for collaboration among the Fisheries Department, WTI, and CMFRI to create a comprehensive campaign aimed at raising awareness about relevant acts and schemes, particularly related to protected species. Furthermore, the Assistant Director of Fisheries in Beypore recommended widespread campaigning across fishing villages, harbours, and landing centres to maximise impact.

5. Kerala Whale Shark Conservation Campaign

The Whale Shark Conservation Campaign along the Kerala coast aimed to unite various stakeholders, build community ownership, and raise awareness about whale shark conservation. Fishing communities were crucial to this initiative since they often interact with these species. By collaborating closely with fishing associations, religious institutions, coastal police, Social Forestry, and the Forest and Fisheries Departments, the campaign established trust and teamwork, ensuring that the conservation messages reached the right audiences. Over a span of seven years, the campaign covered all nine coastal districts of Kerala, gaining visibility and ensuring that the message resonated with people along the entire shoreline.

A key innovation was a custom-built mobile application that enabled fishers to record whale shark sightings and document successful releases when accidental catches occurred. This not only created a citizen science database but also empowered the community, transforming them from bystanders into active partners in conservation. Training sessions were organized to help fishers use the tool easily, directly linking technology to conservation efforts on the ground.

Over the years, this effort led to the successful rescue and release of 50 whale sharks, demonstrating the effectiveness of the campaign's approach. The campaign acknowledged the importance of long-term partnership and engaged schools and colleges through active Eco Clubs. By reaching out to younger generations, the initiative fostered stewardship and created young ambassadors who carried conservation messages into their families and communities. At the same time, cities like Trivandrum, Kochi, and Thrissur became key locations for urban campaigns through marathons, cycle rallies, and drawing competitions. These events not only encouraged enthusiastic participation but also attracted significant media coverage. In fact, over seven years, the campaign generated more than 200 media hits, spreading conservation messages across Kerala and beyond.

To create lasting reminders, signages were strategically placed in harbours and landing centres across the nine districts. This ensured that both communities and visitors come across these conservation messages daily. Additionally, seven striking wall paintings in Kasargode, Kollam, Trivandrum, and Kochi featured large artworks that depicted the whale shark and the threats it faces. These public murals served as cultural touchpoints, combining art with advocacy, and kept the spotlight on whale shark conservation long after campaign events concluded.

The campaign also included community recognition by honouring fishers who voluntarily released whale sharks caught in their nets. This decision, based on survey recommendations, proved effective by providing positive reinforcement for conservation-friendly actions. Recognizing these individuals not only motivated others to do the same but also fostered pride and ownership within the fishing community, demonstrating that conservation and livelihoods can successfully coexist.

Overall, the Kerala Whale Shark Conservation Campaign achieved significant successes. It reached nine districts, educated 1,70,093 fishing communities, engaged youth through schools and Eco Clubs, involved urban populations with large-scale events, and created lasting visibility through signage and wall art. Its impact is evident not just in numbers but also in the ownership developed among fishing communities and urban populations alike. By combining technology, community involvement, and cultural communication, the campaign transformed whale shark conservation into a visible and celebrated cause along Kerala's coast, ensuring its legacy as a shared responsibility for future generations.

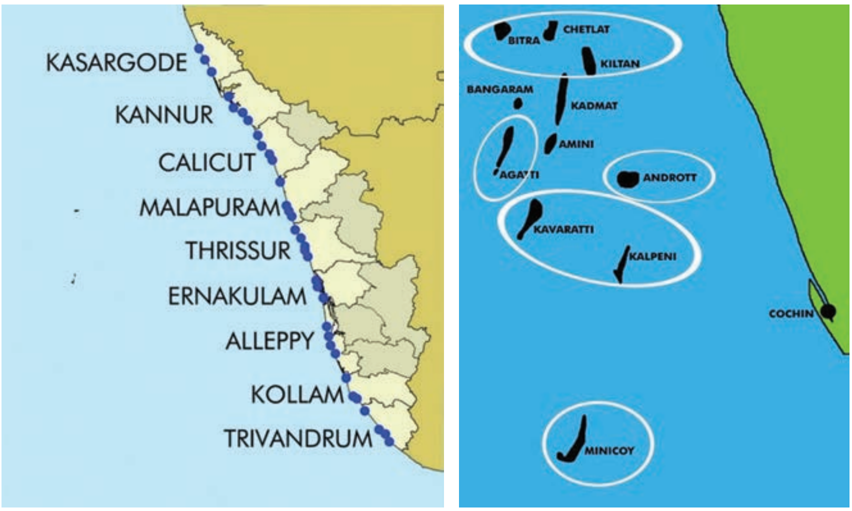


Fig. 290: Map showing campaign locations (a) in Kerala (b) in Lakshadweep

- **Wins of the Kerala Whale Shark Campaign**

Impact Area	Achievements
Whale Shark Rescues	**50 whale sharks** were safely rescued and released by fishers
Wall Paintings	**7 large-scale murals** created across Kasargode, Kollam, Trivandrum, Kochi
Media Outreach	Over **200 media hits** generated in **7 years**
Geographic Coverage	**9 districts** of Kerala coast covered through events and awareness drives
Community Recognition	Fishers felicitated for voluntary releases, fostering conservation pride
Youth Engagement	89,266 students reached through Eco Clubs, schools, and colleges, building long-term ambassadors
Community Sensitization	192,827 community members engaged through workshops, awareness drives, and direct interactions
Urban Campaigns	Marathons, cycle rallies, and drawing competitions in Trivandrum, Kochi, Thrissur

Project Launch and International Whale Shark Day Celebration

On August 30th, in celebration of International Whale Shark Day—an occasion established during the International Whale Shark Conference 2008 in Isla Holbox, Mexico—the "Conservation of Whale Shark along Kerala and Lakshadweep" project was formally launched at Sacred Heart College, Thevara.

Fig. 291: Whale shark campaign launch in Kerala in 2017

The launch event, held in conjunction with the Whale Shark Day celebrations, was inaugurated by Smt. Soumini Jain, Mayor of Cochin; Shri Hibi Eden, MLA; Mr. Vivek Menon, Executive Director & CEO, Wildlife Trust of India; Mr. Sunny Thomas, Director (Technical), Cochin Shipyard Ltd; Dr. Amit Mallick, APCCF, Kerala Forest Department; and Councillors Mr. C.K. Peter and Ms. Elizabeth Teacher, along with other distinguished dignitaries. The gathering highlighted the collaborative partnership between the Wildlife Trust of India (WTI), Cochin Shipyard Ltd, and the Kerala Forest Department, aimed at safeguarding this gentle giant of the seas.

Fig. 292: Whale shark rally held during launch of the project

The programme witnessed enthusiastic participation from over 700 students, ranging from Standard I to VII. The celebrations began with a rally by Sacred Heart Senior Secondary School students, followed by an exciting highlight– a 40-foot-long life-sized inflatable whale shark displayed on the college basketball court. The students were delighted by the sight, with many expressing awe at witnessing a representation of the "world's biggest fish."

The formal proceedings commenced with a welcome address by Mr. Sajan John, Manager and Head of Marine Projects, WTI. This was followed by Professor B.C.

Choudhury, Senior Advisor, WTI, who introduced the award-winning Whale Shark Conservation Project. Drawing parallels between science and action, he remarked, “Compared to the long journey that a whale shark tagged under our project once took from the Gujarat coast to the Somali coast, our conservation action journey from Gujarat to Kerala may appear small. Yet, the launch of this project in Kerala marks a significant collaborative step forward.”

The ceremonial lamp lighting was followed by addresses from several dignitaries. The Presidential Address was delivered by Shri Hibi Eden, MLA, while the inaugural address was given by Cochin Mayor Smt. Soumini Jain, who expressed pride in Kerala becoming the second state after Gujarat to embrace this pioneering initiative. “We are happy that WTI’s Gujarat project, which was the first of its kind in India, has now expanded its reach to Kerala’s coast,” she said. The Reverend Dr. Prashanth, Principal of Sacred Heart College, also extended his support through an inspiring address.

The keynote address was delivered by Mr. Vivek Menon, CEO of WTI, who highlighted the global importance of these magnificent fish: “Whale sharks, endangered in the tropical seas they inhabit across the world, are important indicators of ocean health. Protecting them is not just about saving one species, but about preserving the integrity of our oceans.”

The day-long programme offered students and attendees insightful sessions on the ecological significance of whale sharks, their relationship with sustainable coastal livelihoods, and the collective responsibility of communities in ensuring their survival. The event set a strong foundation for the conservation journey of whale sharks along the coasts of Kerala and Lakshadweep.

ECO Club/ School Events

Fig. 293: Children participating in the sand artwork as a part of the campaign

Engaging the younger generation through schools and colleges with active Eco Clubs was a strategic move to foster long-term commitment to conservation. These clubs serve as vibrant platforms where students can actively participate in environmental initiatives, making them natural partners in spreading the message about whale shark conservation. Their structured activities, enthusiasm, and collective spirit provided the campaign with a direct channel to engage young minds in meaningful ways. By sensitising students to the importance of protecting marine life, particularly the whale shark, the campaign sought to create a ripple effect that extended beyond the classroom, inspiring them to become ambassadors for conservation in their families, communities, and future endeavours.

This approach gained remarkable traction, reaching 89,266 students across all nine coastal districts of Kerala through partnerships with government schools. Conservation themes were brought to life through a variety of engaging activities– sensitisation sessions, art competitions, and quizzes, alongside larger events connected to Wildlife Week, International Ocean Day, and other interactive platforms. These diverse formats made the learning engaging, fun, and memorable, ensuring that the message of

whale shark conservation was not only understood but also internalised. By weaving conservation awareness into both everyday school activities and special occasions, the campaign laid a strong foundation for a generation of young leaders committed to sustaining the ecological balance of our oceans.

Fig. 294: School students participating beach clean up to reduce the plastic pollution

Community Sensitisation

Community sensitisation programmes were carefully designed to engage and educate diverse audiences, particularly local fishermen and other key stakeholders along the coast. These events typically featured expert presentations on the ecological importance of whale sharks, practical demonstrations on the use of the whale shark rescue application, and interactive discussions on sustainable fishing practices. The objective was to foster a sense of shared responsibility for conservation by equipping participants with the knowledge and tools needed

Fig. 295: fishers sensitisation event at major landing site in Kollam

to protect the species. Fishers learned techniques for safely releasing entangled whale sharks, while other community members gained a broader understanding of the crucial role these gentle giants play in maintaining marine ecosystems and the importance of responsible fishing practices.

The campaign targetting fishers emerged as one of the most impactful components of the whale shark conservation effort in the last seven years, reaching 192,827 fishers across all nine coastal districts of Kerala. Recognising the pivotal role fishing communities play in the survival of this species, the campaign strategically focussed on major landing sites for direct engagement. A life-sized inflatable whale shark became the centrepiece of these drives, attracting attention and sparking curiosity that naturally led to meaningful conversations about conservation.

During these sessions, fishers were sensitised about the urgency of protecting whale sharks, trained in standard methods for safely rescuing entangled individuals, and encouraged to take pride in their unique role as guardians of the species. By blending scientific knowledge, practical training, and strong messaging around pride and responsibility, the campaign not only raised awareness but also fostered a sense of ownership among fishing communities, transforming them into key partners in safeguarding the future of the world's largest fish.

Fig. 296: Campaign activities were conducted in nine district of Kerala

Urban Campaign

Urban Campaigns is a strategic initiative designed to engage the urban populations in support of whale shark conservation. These campaigns leverage the visibility and reach within urban populations to raise awareness about the ecological significance of whale sharks and the threats they face. By integrating conservation messages into community events, educational programs, and engaging events like marathons, help foster a sense of environmental responsibility among city dwellers. These often involve collaborations with local organizations, businesses, and government agencies to maximize impact and promote sustainable practices within urban communities, ultimately contributing to the broader goal of whale shark conservation.

Over the years, Urban Campaigns have steadily evolved, using city spaces and cultural platforms to spread awareness and connect people to the cause. In 2017, the campaign made its first breakthrough at the vibrant Cochin Carnival in Fort Kochi. Amidst the festive crowds, WTI and Cochin Shipyard Ltd. (CSL) introduced a 40-foot inflatable whale shark as part of the New Year's rally. Flagged off by Member of Parliament Prof. KV Tomas and Cochin Mayor Soumini Jain, the float became the highlight of the parade, captivating thousands of spectators. Balloons, sun visors, and collaterals carrying conservation messages were distributed, ensuring that, alongside the colour and joy of the carnival, a serious message about protecting the gentle giant of the seas resonated with the public.

Fig. 297: Whale shark inflatable also made its debute as a part of the Kochi carnival

Building on its growing visibility, the campaign took to the roads in 2022 with the first-of-its-kind cycle rally, initiated by local cycling groups from Thrissur. Covering 589 kilometres from Shankumugham Beach in Trivandrum to Paravur Beach in Kollam, the rally combined endurance sport with conservation outreach. Along the route, cyclists were welcomed by schools and community gatherings, directly engaging with 6,615 people from targeted coastal villages. This initiative bridged urban enthusiasm with rural realities, inspiring both cyclists and fishing communities to embrace whale shark conservation as part of their shared responsibility.

Fig. 298: More than 1300 runners participated to show their support for the Whale Shark conservation

By 2024–2025, the campaign had evolved into a powerful blend of conservation, heritage, and social responsibility through the Fort Kochi Heritage Run, organized by WTI in collaboration with VST Industries and the Cochin Collective. Designed around the themes of rediscovering the environment, heritage preservation, and anti-drug advocacy, the event brought together urban fitness enthusiasts and conservation supporters. Featuring both 10 km and 5 km run categories, the marathon was flagged off by dignitaries from the Indian Navy, Coast Guard, and Cochin International Airport. Highlights included a high-energy Zumba session and a well-attended valedictory ceremony at Vasco Square. Leaders from politics, civic bodies, and industry praised the collaboration, stressing the importance of linking marine conservation with cultural pride and youth empowerment. Through the collective energy of the runners and the symbolic unity of diverse stakeholders, the message of saving the whale shark gained new momentum within urban communities.

From the carnival's cultural celebration to the endurance of a cycling rally and finally to the unifying spirit of a heritage marathon, these urban campaigns illustrate a clear progression. What began as an eye-catching spectacle in 2017 has transformed into a holistic movement that integrates conservation into the lifestyle, heritage, and civic consciousness of Kerala's cities, ensuring that the call to protect whale sharks continues to echo across generations and communities.

Veterinary Training

WTI, in collaboration with the Kerala Forest Department and Animal Husbandry Department, has been consistently conducting these training sessions. Over the last few years, WTI has successfully trained approximately 332 Forest and Veterinary Officers. These initiatives are instrumental in strengthening conservation efforts and ensuring swift and efficient responses to marine wildlife emergencies. The impact of the training was assessed through pre- and post-training evaluations, demonstrating significant knowledge improvement among participants

Fig. 299: Veterinary training to capacity strengthen the Animal Husbandary Department

Conservation Signboards

Signboards serve as an effective medium for disseminating conservation messages to the community. They play a crucial role in spreading awareness and educating fishers about the significance of safeguarding this majestic species. Additionally, the signboard also displays contact details for reporting whale shark sightings or instances of entanglements. A total of 12 signboards are placed in different districts along the Kerala Coast.

Fig. 300: Whale shark sign board placed strategic location

Wall painting

The wall paintings have emerged as a pivotal medium in spreading awareness about whale shark conservation along the Kerala coast. These vibrant artworks do more than captivate attention—they serve as powerful tools of storytelling, translating complex ecological messages into accessible visuals that resonate with people of all ages. By showcasing the beauty and significance of whale sharks while simultaneously highlighting the threats of plastic waste and unsustainable practices, the murals inspire a collective sense of responsibility. They stand as visual reminders of the fragile balance between marine life and human activity, urging communities and visitors alike to adopt sustainable practices.

Each wall painting has been strategically placed at prominent locations, ensuring maximum visibility and engagement with local communities. In Trivandrum, a mural at Shanghumugham greets thousands who frequent the beach; in Kasargod, two murals at Charavathur and Nellikunnu strengthen community awareness at the northern tip of the state. Ernakulam's mural at Bilal's House and Thrissur's striking artwork at Azhikode Harbour connect urban and harbour communities to the conservation cause. Further south, Alappuzha's Thottapilly mural and the one at Kollam Harbour engage fisherfolk and travellers in key fishing hubs.

By blending art with conservation, these murals have created a shared sense of purpose, fostering a deeper emotional connection between people and marine life. They not only amplify the campaign's call for protecting whale sharks but also reinforce the fight against marine pollution, ensuring that conservation messages remain both visible and memorable in everyday community spaces.

Fig. 300: Wall paintings at various locations of the coastal districts for spreading the campaign messages

Whale Shark Wins

Just over a year into the campaign, a significant milestone was achieved when the first-ever whale shark was rescued and released by fishers from North Kerala. This incident took place in Malappuram, where crew members Mr. Hamsakkoya and Mr. Dirar of the fishing boat Almas-Tanur carried out the rescue. Their efforts were formally recognised during the Regional Whale Shark Conference held in Gujarat on 14–15 March 2019, where they received an award from Dr. Rajeev Gupta, IAS, Additional Chief Secretary – Forest and Wildlife, Government of Gujarat. This recognition underscored the significance of community participation in saving whale sharks and celebrated Kerala's entry into the conservation success story.

Fig. 302: The fishing boat crew members of Almas-Tanur were felicitated by Dr. Rajeev Gupta IAS (Additional Chief Secretary-Forest and Wildlife, Govt. of Gujarat), Mr. Hamsakkoya and Mr. Dirar, and Vivek Menon during the Regional Whale Shark conference

The momentum continued with a second whale shark rescue recorded in January 2020, when fishers from Calicut safely released another accidentally caught individual back into the sea. Since then, the campaign has grown stronger, empowering coastal communities with awareness, skills, and pride in their role as protectors of the species. Over the past seven years, fishers along Kerala's coastline have successfully released 50 whale sharks, demonstrating a sustained commitment to marine conservation and proving the effectiveness of grassroots sensitisation efforts.

The graph shows a clear upward trend in the number of rescues in Kerala over the years. Starting with just one rescue in 2018 and none in 2019, the figures began to rise gradually with 2 in 2020, 1 in 2021, and 3 in 2022. A significant increase was observed from 2023 onwards, with rescues reaching 11 that year and further climbing to 15 in 2024. The momentum continued into 2025, recording 17 rescues-the highest so far. This steady escalation highlights both the growing challenges that necessitate rescues and the strengthening response mechanisms over time. The updated rescue records are attached in the Appendix 7.

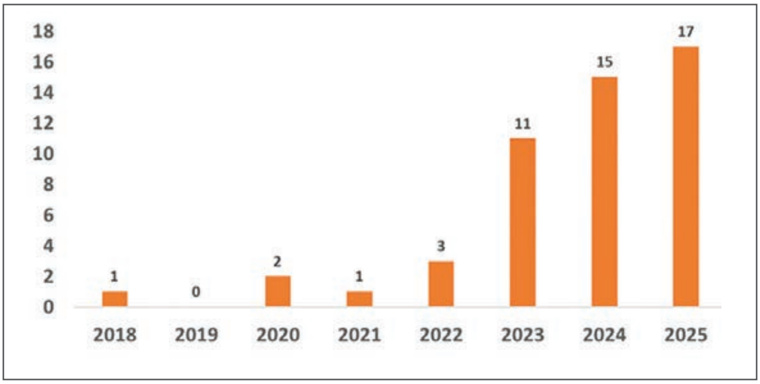


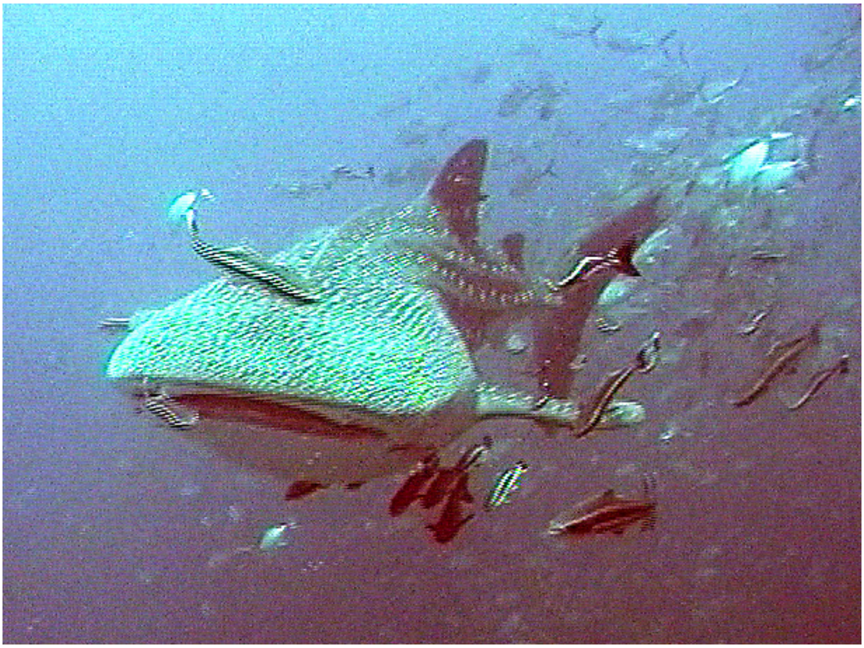
Fig: 303: Number of whale shark rescues in Kerala coast.

Fisher Felicitation

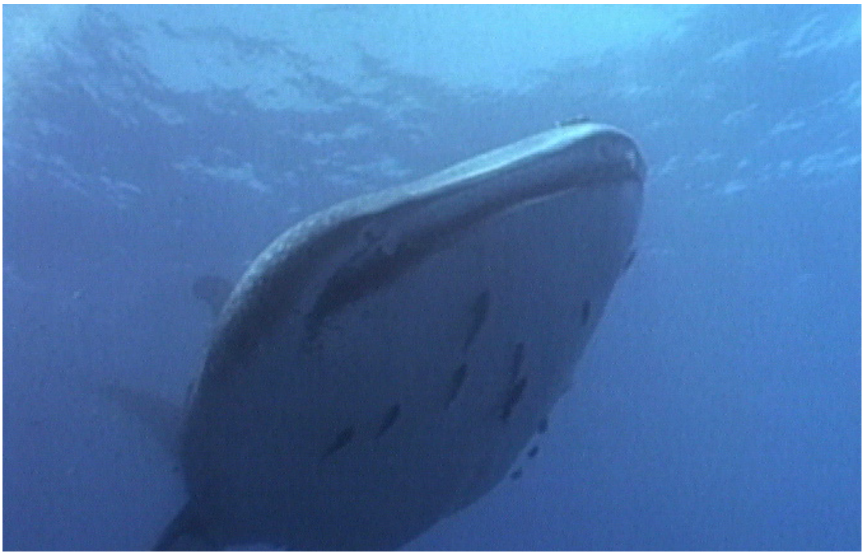
The decision to felicitate fishers who successfully released accidentally entangled whale sharks stemmed from survey recommendations, which highlighted that recognition and reward could serve as more effective conservation tools than mere compensation. By celebrating their actions, the campaign sought to honour the efforts of those who directly contributed to safeguarding this endangered species, while also encouraging others to follow suit.

Acknowledging and rewarding fishers in this manner not only incentivised positive behaviour but also created a ripple effect within the community, positioning these individuals as role models. This approach is closely aligned with the campaign's broader goal of promoting positive reinforcement and fostering community engagement. By building trust and pride among fishing communities, the initiative contributed significantly to shaping more sustainable and participatory conservation practices.

Fig. 304: Hon'ble Forest Minister of Kerala Shri Saseendran felicitating the fishermen for rescuing entangled Whale Sharks



Small fish frequently accompany the Whale Sharks for safety and feeding opportunities.



The presence of remoras on whale sharks is a natural partnership seen in oceans worldwide, aiding both feeding and cleaning.

6. Lakshadweep Campaign

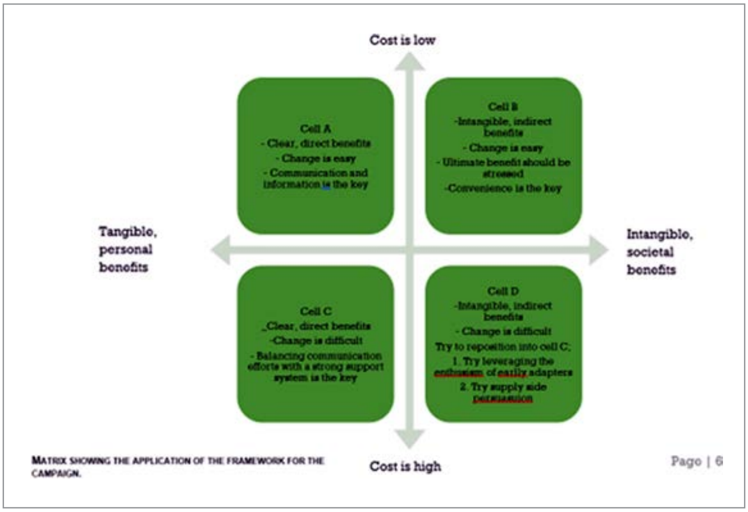
Keeping in mind the conservation-driven approach and mindset of WTI, a carefully tailored campaign was designed to help address and thus check the decline in whale sharks populations in the focus areas of Kerala and Lakshadweep. This strategically planned campaign was an intensive, structured programme, that directly engaged the target population, highlighting their role in this critical conservation effort and stressing on project outcomes that could lead to an increase in the awareness about the whale shark in these regions.

The two project sites revealed stark differences in the fundamental perception levels, highlighting the need for two separate approaches in each of the locations. In Kerala, the fishers follow unsustainable and unregulated fishing, resulting in accidental bycatch of whale sharks and thereby contributing to their decline. As per the survey, the fishers are familiar with the whale shark species and its legal status; However, they do not seem eager to cut the net and release the fish despite understanding the consequences. This reluctance likely stems from the significant monetary loss incurred in the process. This highlights the common obstacle to the conservation efforts through social change that the procedural adoption costs often exceed the tangible benefits for the target community.

Fig. 305: Whale shark sand scupture was created as part of the campaign in Kavaratti, Lakshadweep

In contrast, the perception of whale shark conservation in Lakshadweep is markedly different. Here, the fishing community largely practices sustainable fishing, and no deliberate killing of whale sharks have been reported. There is an ingrained sense of ownership among the people to protect the land and the sea. However, it is still important to raise awareness in these areas, as it could further motivate fishers to act as protectors of the species in the high seas, where the practice of external, unregulated and unsustainable fishing is prevalent. In the long run, the project in Lakshadweep aims to lead by example, inspiring fishers in other neighbouring areas to adopt similar sustainable practices. With Lakshadweep serving as a reference point, the following framework has been adopted.

**Do Better at Doing Good- by V. Kasturi Ragan, Sohel Karim and Sherryl K. Sandberg; Harvard Business Review Case Study*



Most social change campaigns with similar goals and characteristics, across the domains, fall under Cell C, requiring both strong and effective communication strategies as well as effective on-field implementation. While the individual benefits of behavioural change in these campaigns are clear, the costs of implementation might often be high.

To determine an appropriate strategy for our campaign, the above-mentioned framework* was used as a benchmark. The framework helped in determining a campaign plan appropriate for the various sites. Following the framework, the Minicoy campaign primarily aligned with both Cell C and Cell D. Anecdotal evidence indicates that awareness about the whale shark species amongst Kerala fishers was relatively high, yet there was little or no inclination to release accidental by-catch. This scenario falls under Cell D, where the cost-benefit ratio is disadvantageous to the concerned fishers. The benefits are intangible in the short run, and the cost of change is high. In this case, the way forward would be to educate the community about the direct benefits in order to reposition the traits from Cell D to Cell C. Another approach that could be adopted would be moral persuasion and leveraging the enthusiasm of early adapters. This campaign will seek to create an urgency in the minds of the target audience early on, in order to persuade a behavioural change.

Taking the above-mentioned aspects into consideration, the Lakshadweep campaign was designed to showcase and validate sustainable fishing practices. This helps protect and conserve fauna, keeping in mind that the entire economy of the archipelago depends on it. The campaign undertook a more conventional approach, with a strong emphasis on information dissemination amongst the younger generation to inculcate a sense of belonging and connect these emotions with whale sharks through an awareness campaign which can positively fuel conservation efforts in the future.

6.1 Approach

The broadly defined goal is to bring about behavioural and perceptive changes resulting in the desired conservation support. The focus for the campaign remained on increasing awareness among the local community actively involved in conservation efforts. It is therefore critical to identify the various stages of the process. *(*PSI India- Will Balbir Pasha Help Fight AIDS? (A)- A Harvard business school case study)

1. Awareness- getting the target population to know about the whale shark, its distribution, its conservation impact and the legal status
2. Perception- to understand the factors leading to the decline of the species and the ways it can be stopped
3. Attitude- motivating and triggering a shift in public perception and outlook towards recognizing the need for change in behaviour and practices
4. Behaviour- to take concrete actions on a continued basis- thus decreasing the risk of shifting away from sustainable fishing practices.

6.2 Target Groups

1. **Policymakers**

   Policymakers possess the legal authority and are constitutionally empowered to engage in the formulation of public policy. Individuals such as officials from the Forest Department and government employees play a key role in shaping objectives and generating interest in the conservation efforts. Involvement of policymakers in this campaign should be one of the initial steps to generate momentum and positive impact for the campaign.

2. **The Public**

   Lakshadweep comprises 20 fishing villages across 10 inhabited islands with a coastline of 132 km and approximately 40,328 fisherfolk. It is crucial to expose the local community to the realities of the situation and to involve them actively in conservation efforts through community participation. As primary stakeholders, fishers hold valuable knowledge that is vital to the campaign's success. Their active involvement not only strengthens conservation outcomes but also ensures that policymaking is informed by ground realities.

3. **Students**

   The campaign followed a captivating activity pattern, using vivid personalised materials to engage students through painting activities, quiz competitions and other interactive drives. Student involvement was a crucial step in reaching out to diverse age groups in the middle and senior schools. Engaging with children also provided an opportunity to influence young minds and nurture a new generation of responsible citizens. For this specific target group, a carefully tailored set of activities was implemented to ensure active participation aiding in knowledge percolation.

6.3 Why Lakshadweep

The survey "An assessment of the Past and Present Distribution Status of the Whale Shark (*Rhincodon typus*) along the west coast of India", conducted between 2011 and 2013, reported that Lakshadweep has 20 fishing villages spread across 10 inhabited islands, with a coastline of 132 km, an approximately 40328 fisher folks. The survey clearly stated that there were no records of incidental whale shark catches by Lakshadweep fishers, as not a single event had been documented.

However, in Kerala, out of 600 respondents, 350 had sighted whale sharks, and the majority of respondents had either sighted or incidentally caught whale sharks while fihsing near the Lakshadweep Islands. Interestingly, whale sharks are not hunted around the Lakshadweep group of Islands, where traditional fishing methods such as rowing boats and non-destructive fishing gears like hand lines, cast nets, wounding gears, and harpoons are practiced. These sustainable practices may have contributed to the higher number of whale shark sightings in the region. Furthermore, only a few mechanized boats operate in Lakshadweep, and these are primarily engaged in tuna fishing. Due to the unique nature of these fishing practices, the campaign in Lakshadweep will focus on protecting the habitat of the species and sensitising the local community to act as guardians of the area, with increased awareness of the potential risks of bycatch due to commercial fishing.

However, the Central Government and Niti Ayog have planned to develop these islands. As per the plans, ports and harbours will be developed and new improvised fishing methods (mechanized fishing) will be introduced. While at present, there is no threat to whale sharks, the move from traditional to mechanised fishing can change the status quo.

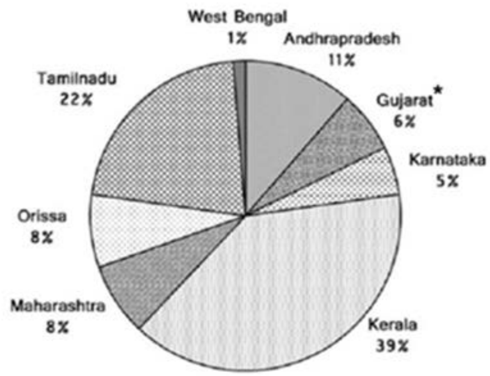


Fig. 4 Percentage contribution of landings/strandings recorded since May 2001

* From April 11 to May 11, 2001; 19 whale sharks (3–18.8 m Total Length) where landed along Gujarat coast.

Why Kerala?

Whale shark hunting in Gujarat has been completely stopped following the conservation efforts led by WTI and TCL. However, similar efforts are still required along the rest of India's coastline. Recognizing this need, WTI with the support of IUCN conducted a survey along the West coast (excluding Gujarat), during 2012-13 and found that the highest number of whale shark sightings were reported near the Lakshadweep waters (28% response from fishers). Literature survey further shows that whale shark landings and stranding are largely reported from Kerala. This can be explained by the fact that Kerala fishers often operate in Lakshadweep waters, where the high incidence of landings is observed.

Fig. 1. *Rhincodon typus* landed at CFH on 20th Nov. 2010

Fig. 2. *Rhincodon typus* landed at CFH on 3rd Feb. 2011

Whale shark (*Rhincodon typus*) landed at Neendakara Fisheries Harbour, Kollam

Fig. 1. *Rhincodon typus* landed at Kalamukku, Kochi

The conservation initiative sought to increase awareness levels of coastal communities and marine fishers along the coast of Kerala through a full-fledged campaign. It sensitized the coastal community on the importance of protecting the whaleA Additionally, the project worked with coastal district administrations to encourage the adoption of the whale shark as their mascot, following the successful model in Gujarat. By instilling a sense of pride in the community, the campaign aimed to ensure that by its conclusion, more fishers would voluntarily release accidentally trapped whale sharks from their nets.

6.4 Feedback survey for the school workshops

A feedback survey was organized for school students to assess their understanding of the subject. The survey was designed in two parts– a pre-survey and a post survey. Pre survey questionnaires were circulated to 10 students from different schools. The post survey was conducted with the same sample of respondents after the workshop. The respondents were chosen at random to avoid selection bias. The pre-questionnaire was designed to understand the students' awareness levels and their understanding of the session.

The results showed that students had an awareness level of 76.67 % as per the pre-workshop survey which increased to 88.34% in the post-workshop survey.

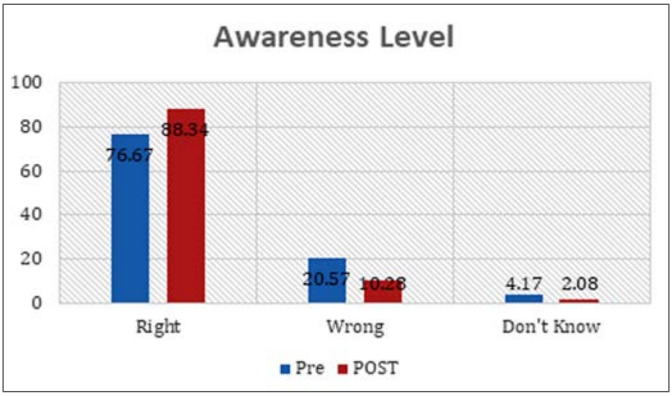
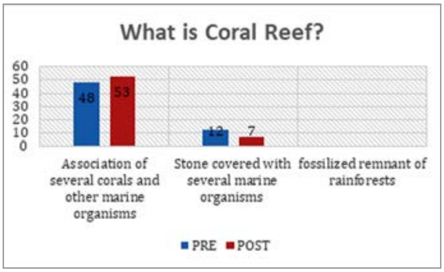


Fig. 306: Graph showing awareness level of the Lakshadweep students

The questionnaire contained a set of 6 basic questions for the pre-survey, whereas, the post-survey had 9. A few of the questions were repeated to assess knowledge retention, while new questions were added in the post-survey mostly based on the sessions conducted. The campaign was organized in six different schools across two island, reaching a sample size of 60 students.

The respondents were asked the definition of coral reefs and their protection status, approximately ~ 80% answered correctly in the pre-survey, which improved to ~88% in the post-survey.



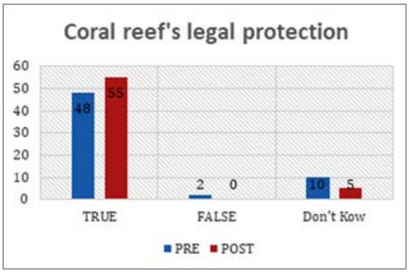
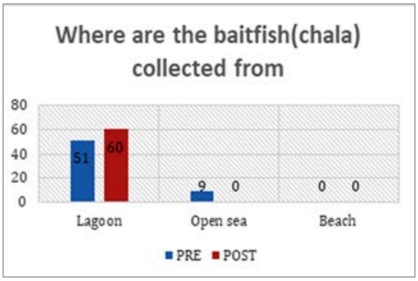


Fig. 302: Comparative Data From The Pre And Post Survey Showing Knowledge A bout Respective Subject

Students were asked where the baitfish are collected from and the essential factor for is survival. This question was designed to assess their basic knowledge of the surrounding environment. Considering that Lakshadweep's economy depends largely on tuna fishing, baitfishe such as Chala (sardines) form the foundation of sustainable fishing practices in the region.



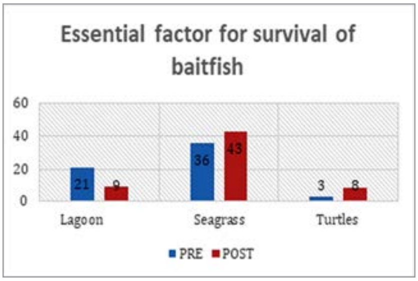
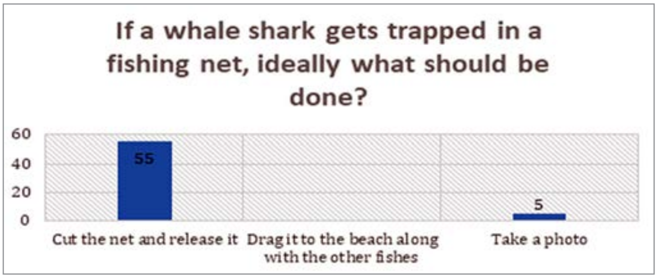


Fig. 307: Comparative Data From The Pre And Post Survey Showing Knowledge About Respective Subject

As a part of the post-analysis, students were asked what should be done if a whale shark gets caught in fishing gear, and what appropriate steps need to be taken. The survey revealed that 95 % of the students responded correctly.They were also asked to identify threats to coral reefs, to which 58.3% gave the correct answer.



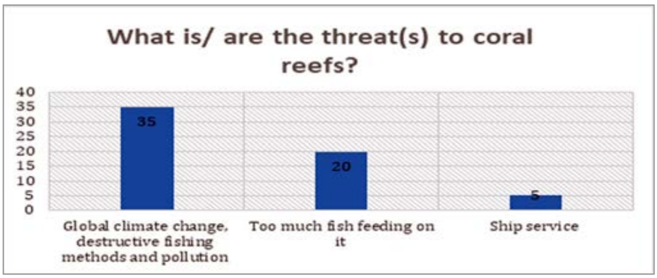


Fig. 308: Graphs Showing Perceptive Knowledge

6.5 Perception survey for the Fisher Community

A perception survey was conducted for the fishers of the two islands of Lakshadweep. The questionnaire was designed to understand their perceptions and knowledge regarding the whale shark and its conservation. A total of 35 fishers from Kavaratti and Minicoy were interviewed during the study period.

The questionnaire was translated into Malayalam (the native language spoken in Kavaratti) and Hindi (commonly spoken in Minicoy). Along with the translated questionnaire, the interviewer also carried resource materials, such as whale shark pictures, which were shown to the target audience. Public gathering locations such as fish landing centres and local fishing societies, were targeted, as these provided easier access to the fisherfolk.

Survey Being Conducted as a Part of Understanding the Perception of the Fishers

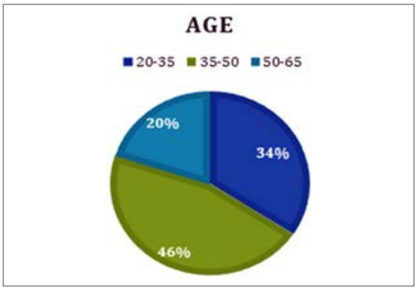
Etymology

During the initial stages of conducting interviews with fisher folk we were faced with a difficulty in explaining them about the whale shark. However, the presence of the life size mascot made it easier to communicate. During the interview sessions we understood various names are used for whale sharks in different islands.

In Kavaratti it is called Baifaid and in Minicoy it is called Fiberish, and Jaseri

6.6 Results based on the Questionnaire Survey

Out of the 35 respondents, 46 % were in the age group of 35- 50 years, 34 % were between 20-35 years, and 20 % were in the 50 -65 age group. of the 35 respondents, 20 % were below the literacy level, 26% had studied up to Standard VIII, 28 % up to Standard XII, and 26 % up to the postgraduate level.



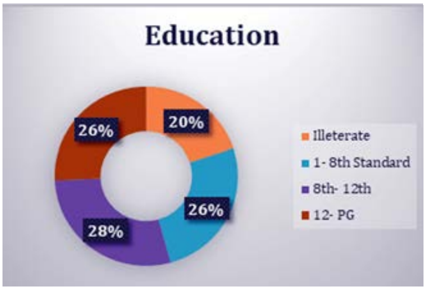
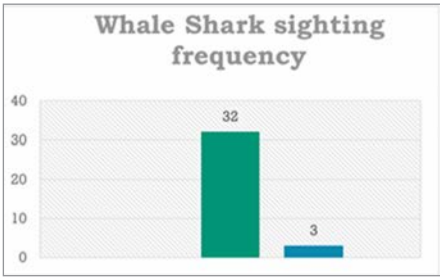


Fig. 309: Graph Showing Age Profile And Educational Background



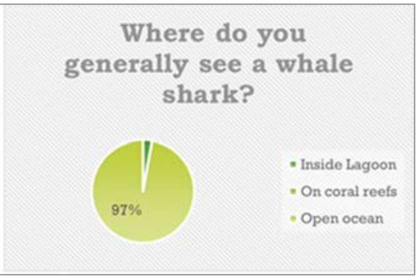


Fig. 310: Knowledge about Whale Shark sighting

Among (n= 35) the respondents interviewed, 91% (32) reported having sighted a whale shark. It can be inferred from the interviews that the probability of whale shark sighting is highest in the open ocean rather than the lagoon area. Whale sharks are primarily planktonic feeders and their seasonal feeding aggregation are largely associated with higher productive areas. *Taylor and Pearce, 1999

6.6.1 Frequency of whale shark sightings over a year

Over a calendar year, fishers reported whale shark sightings during different months. The variation in number of sightings in different months of the year were assessed and the peak seasons of the sightings were deduced. To present the results in a more realistic way, the cumulative number of respondents for each month of the year was calculated. Findings suggest that whale sharks are sighted with highest frequency during October to December, while April to June also records sightings, though at a lower frequency.

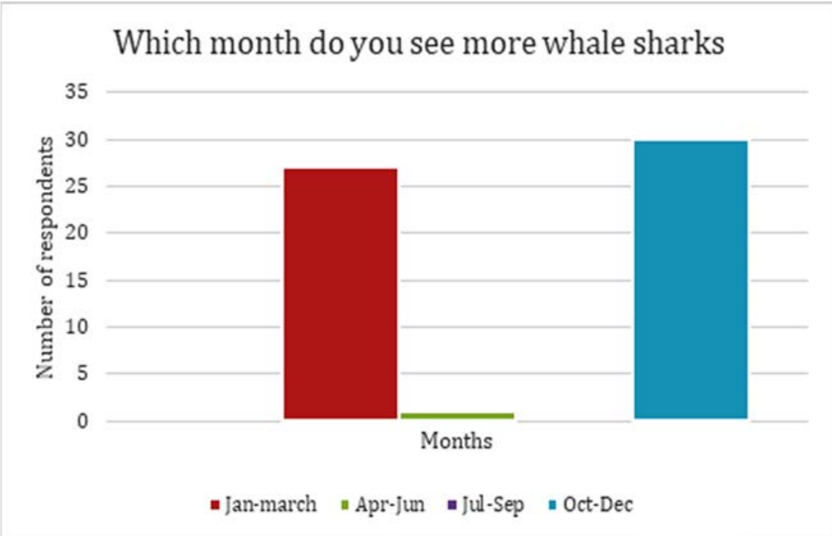


Fig. 311: Frequency of Whale Shark sightings

6.6.2 Fisher's Awareness on Whale Sharks

Majority of fishers were aware of the whale shark, though different names were used to refer to the species across various parts of the Union Territory. When picture aided questions were asked, most fishers identified it correctly. Overall, 80% of the fishers were aware of whale sharks.

6.6.3 Perception on threats and its population trend

Most of the interviewed fishers felt that the whale shark is facing increasing threats. When asked whether they believed the whale shark population is declining, 91 % of respondents agreed, linking the decline to reduced sightings over the years.

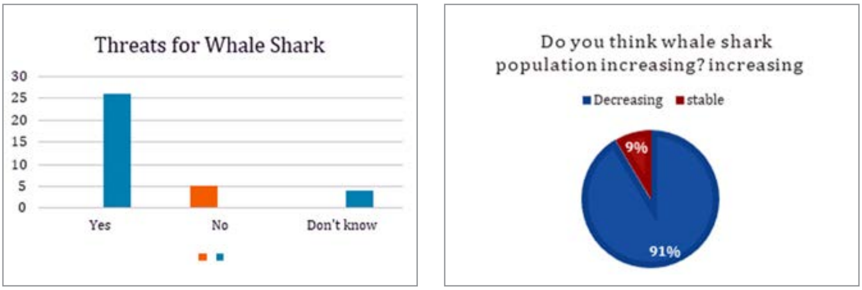


Fig. 312: Graph Showing Perception on Threat and Population Trend

6.6.4 Practice

All respondents were asked about the killing of whale sharks (both accidental and deliberate) in Lakshadweep and as well as in Kerala. 91 % stated that whale shark deaths caused by Lakshadweep fishers were unlikely. When asked about Kerala fishers hunting whale sharks, 66% responded 'no', while 20% said 'yes' and 14% were unsure. However, when questioned about whether they were hunted as a target fish, the answers yielded an inconclusive result.

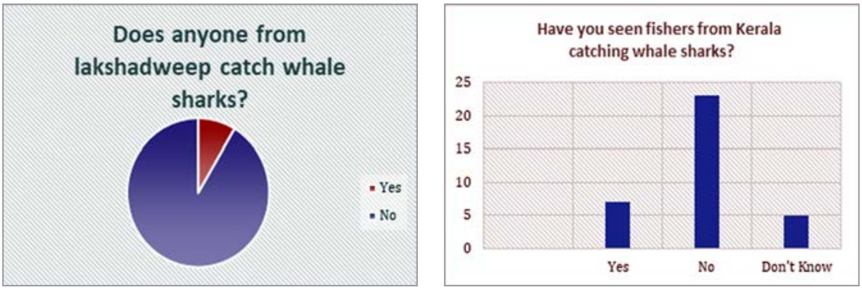


Fig. 313: Perception Graph Showing Hunting Trend of Fishers of Lakshadweep And Kerala

6.6.5 Attitude

Respondents were also asked whether they believed conservation efforts were needed at this point in time and, if so, how willing they would be to be a part of it. 94 % agreed that an attempt should be made to reduce the decline in whale shark populations. Given the reduction in sightings in recent years, many fishers are expressed concern. When asked about their willingness to participate in conservation efforts, 80% stated they were willing to contribute, while 20 % refused outright.

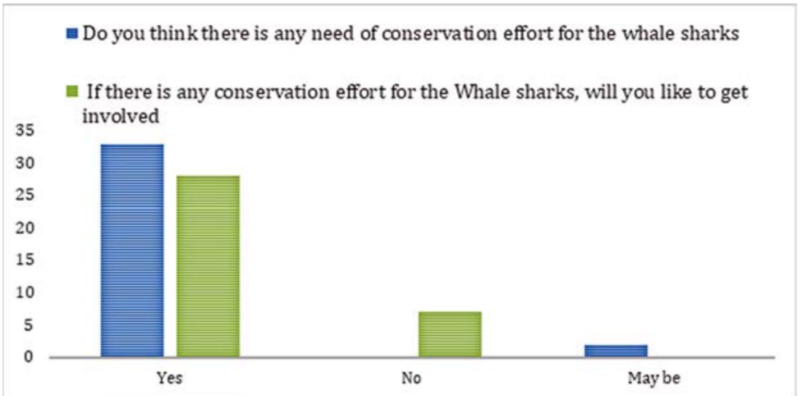


Fig. 314: Graph showing willingness to conserve

6.7 Suggestion and Recommendation

- For successful conservation measures, there is a need for a long term project. Based on the current knowledge of the whale shark aggregations, incidental captures, and illegal off –take, active conservation action practices should be emphasised across the western coast of India. The successful model of Gujarat could be customised based on the need. Since whale sharks are long ranging migratory species in the marine ecosystem, a collaborative conservation action plan involving the wildlife and fishery management authorities of all maritime states in India is essential.
- Since the incidental capture of whale sharks occur in different types of fishing gear without any provision of bycatch reduction mechanisms, it is imperative that a dialogue between the Ministry of Environment, Ministry of Agriculture and Ministry of Commerce be initiated on priority before any bycatch reduction policy is considered in the Marine Fishery sector. Such a policy will benefit not only whale sharks but also a range of other endangered marine fauna.
- Whale shark mortality is largely associated with entanglement in fishing

or trawl nets. Therefore, a recovery plan must be developed with inclusive management action involving the fishing communities.

- Targeted education and awareness programs about whale sharks encompassing other marine species and threats according to the region should be a major thrust area. The programs should be designed aiming to convert knowledge into active participation in conservation efforts. Coastal clean-up programs may be required to be conducted in project sites where pollution is a major threat to minimise the levels of toxic pollutants.
- Focussed research on determining the marine habitat, migration pattern of whale shark along the Indian coast, foraging and reproductive ecology and genetic profiling needs to be integral part of the project.
- A strong scientific foundation is integral to any successful project. In this regard, research on key themes on whale shark ecology needs to be immediately undertaken. Priority areas should included demography, habitat utiliz ation, migration patterns, breeding biology and population ecology. In depth scientific research, such as Satellite tagging can give clarity about their movements, growth, size, maturity and longevity.
- Capacity building of the Forest and Wildlife Department, Fisheries, Coast Guard, Navy and other enforcement agencies about the protection and conservation requirements should also be considered with urgency. It is recommended that the state establish a dedicated "Marine Cell" within the forest department, with clearly defined responsibilities. Equipping and training the staff of this cell will be essential to ensure its effective functioning. Training should be focused on monitoring and apprehending offenders, enhancing patrolling of the marine environment and fish landing centres, and systematically collecting data on incidental and target catches of marine protected species, including whale sharks.

It is to be noted that the Lakshadweep government has already initiated patrolling measures to curb unsustainable fishing practices.

6.8 2019–2020: Campaign Launch & Island Outreach

Launch (Oct 9, 2019, Kavaratti)

- WTI and the Lakshadweep Department of Environment & Forests inaugurated the Minicoy Whale Shark Conservation Project during Wildlife Week.
- The event was presided over by senior officials including the UT Administrator, Chief Wildlife Warden, and Panchayat leaders.
- A **life-size whale shark mascot** was introduced to engage communities who had never seen the fish in their waters.

School & Community Engagement

- Reached over **3,500 islanders** and students across schools.

- Activities: painting workshops, marine quizzes, video screenings (e.g., Mike Pandey's Shore of Silence), interactive mascot sessions.
- Emphasis on children as future ambassadors of conservation.

Minicoy Outreach

- Awareness sessions in schools (82 students engaged).
- Discussion on local whale shark sightings ("Fiberish" in local language).
- **Multi-stakeholder consultation (Oct 21, 2019)** with Coast Guard, Fisheries, Police, Moopans (village heads). Stakeholders pledged support, highting the importance of traditional **sustainable fishing** practices.

Other Islands Covered

- **Bitra, Chetlat, Kiltan, Androth, Kalpeni, Agatti**
- Activities included island shows, badge/brochure distribution, beachside awareness, and school programs.
- Combined outreach to **thousands of islanders and children,** with highlights such as the release of 43 Hawksbill turtles in Chetlat.

6.9 2023–2024: Fishermen Training & Student Sensitisation

Skill Development Training (Feb 19, 2024, Kavaratti)

- Conducted by CIFNET, MPEDA NETFISH, Fisheries Dept., and WTI.
- Fishermen trained on modern sustainable fishing practices.
- WTI delivered sessions on whale sharks as flagship species.

Community Sensitisation and App Training

Androth & Kiltan:

- 160 fishermen in Androth; 180 in Kiltan participated.
- Focus: identifying whale sharks, preventing entanglement, and use of monitoring tools.
- Forest Department, Fisheries, and CIFNET collaborated.

Student Engagement

- **Androth (1,300 students), Kadmat (1,040), Amini (1,880), Kavaratti, and Pandath schools** engaged through talks, drawing competitions, and inflatable whale shark displays.
- Children learned about whale sharks and marine megafauna while showcasing artistic talent.

Community Events

- Inflatable whale shark displayed at **Moola Beach, Androth** (1,760 visitors) and **Kiltan multipurpose hall** (240 participants).

Amini Island event (March 6, 2024):

- 1,000 fishers and over 3,000 students participated.

- Keynote by WTI and local officials reinforced conservation urgency.
- Drawing competition winners were felicitated.

6.10 2024–2025: Strengthening Community Ownership

Agatti Island (Jan & Feb 2025)

- Sensitization programs with **120 fishers** and **360 students.**
- Focus on sustainable fishing practices and preventing accidental captures.

Kavaratti Island (Jan 25, 2025)

- Over 1,000 stakeholders (Fisheries, Port, Forest, fishers) engaged.
- Football tournament (Kerala U-18 vs. Lakshadweep U-18) organized as part of outreach.
- Sand sculpture of a whale shark was created to inspire conservation pride.

Androth Island (Feb 1, 2025)

- Awareness event with 520 students of Govt. Junior Basic School, Moola.
- Collective pledge for marine conservation taken.

Chetlat Island (Feb 4, 2025)

- Multi-faceted sensitization with **community members, fishers, and government officials** (Forest, Fisheries, Police).
- Drawing competition for students held at Dr. APJ Abdul Kalam Memorial School.

Minicoy Island (Feb 8–12, 2025)

- Three student programs at Govt. Senior Basic School, Minicoy.
- Community sensitization in Boduathri fishing village.
- Focus: threats to whale sharks, sustainable marine practices.

Kalpeni Island (Jan 29–30, 2025)

- School program held at Senior Basic Govt. School.
- Community sensitization targeting fishers on sustainable practices and marine heritage protection.

6.11 Key Achievements (2019–2025)

- Reached tens of thousands of islanders, students, and fishers across all major inhabited islands.
- Life-size whale shark mascot & inflatable became campaign icons.
- Integration of art, sports, and cultural programs (painting, sand sculpture, football matches) into conservation.
- Strong multi-stakeholder collaboration with Forest Department, Fisheries, CIFNET, Coast Guard, police, and panchayats.

- Empowered fishers to act as protectors of whale sharks by leveraging traditional sustainable fishing knowledge.
- Built long-term student ambassadors for conservation through competitions, storytelling, and experiential learning.

The Lakshadweep Whale Shark Campaign was launched in 2019 during Wildlife Week in Kavaratti. The event was led by the UT Administrator along with senior officials from the Forest Department and Panchayat. It marked a historic moment as the community saw a life-size whale shark mascot for the first time. Many islanders had never before seen a representation of the world's largest fish that swims in their waters. The campaign reached over 3,500 islanders through outreach activities. School children participated in art workshops, marine quizzes, film screenings, and human chain demonstrations. In Kavaratti alone, more than 340 students took home the message that they should become ambassadors for the species' future.

The campaign then spread to Minicoy, the southernmost island, where children learned about the locally known "Fiberish" through interactive talks, video screenings, and drawing activities in schools. On October 21, 2019, a multi-stakeholder consultation brought together Coast Guard officers, Police, Fisheries officials, and traditional village heads (Moopans). They pledged their support and affirmed that sustainable fishing practices already contribute to protecting whale sharks. The campaign mascot later travelled to other islands—Bitra, Chetlat, Kiltan, Androth, Kalpeni, and Agatti—where island shows, beach awareness programs, school sessions, and the distribution of badges and brochures spread the conservation message to thousands more. Highlights included the release of 43 Hawksbill turtles in Chetlat and over 500 students participating in activities. . By the end of 2020, the campaign had established whale sharks as a source of pride for the community across the archipelago.

After a pause during the pandemic, the campaign regained momentum in 2023-24 with a strong focus on training and awareness. On February 19, 2024, CIFNET, MPEDA NETFISH, and the Lakshadweep Fisheries Department conducted a three-day skill development workshop in Kavaratti. Fishermen received updated information on sustainable fishing practices. WTI representatives included whale shark conservation in the training and emphasized Lakshadweep as an important aggregation site. In Androth and Kiltan, community programs gathered more than 300 fishers, focusing on whale shark identification, preventing accidental entanglement, and responsible fishing. At the same time, inflatable whale shark displays at public venues like Moola Beach in Androth attracted nearly 1,800 people, sparking conversation about conservation.

The campaign also strengthened its outreach to schools. In Androth, 1,300 students took part in interactive sessions, while 1,040 students in Kadmat engaged in whale shark awareness programs and drawing competitions. Amini Island hosted one of the largest gatherings, with nearly 3,000 students and 1,000 fishers attending the campaign event in March 2024. Overall, thousands of children across Amini, Kavaratti, Kadmat, and Pandath participated in classroom sessions, film screenings, and creative contests, instilling conservation values in the next generation.

By 2024-25, the campaign had entered a phase of deeper community involvement and creative outreach. In Agatti, sensitization sessions for 120 fishers and 360 students focused on sustainable fishing and marine stewardship. In Kavaratti, over 1,000 stakeholders, including Fisheries, Port, and Forest officials, gathered in January 2025 for a major sensitization event. This included a football match between Kerala and Lakshadweep under-18 teams and a sand sculpture of a whale shark, which became a powerful visual symbol. In Androth, 520 students from Government Junior Basic School pledged their committed to advocating for marine conservation. In Chetlat, a program targeting both government officials and schoolchildren underscored the enforcement of conservation laws and community engagement.

In February 2025, Minicoy hosted three awareness programs, involving students at the Government Senior Basic School and fishers from Boduathri village. These activities blended cultural identity with conservation messaging. Similarly, in Kalpeni, sessions for schoolchildren and fishing communities highlighted the ecological importance of whale sharks and connected sustainable practices to a healthy marine environment. These initiatives ensured that conservation was no longer just an external campaign but a shared responsibility rooted in local life.

Over six years, the Lakshadweep Whale Shark Campaign has evolved from an awareness drive into a community-driven conservation movement. From the symbolic arrival of the mascot in 2019 to workshops, fisher training, public beach displays, school competitions, and creative activities like sports and sand art, the campaign has engaged tens of thousands of islanders. It has built strong partnerships across Fisheries, Forest Departments, the Coast Guard, and local governance while promoting pride and stewardship among children and fishers. Today, whale sharks in Lakshadweep are not just gentle giants of the sea but symbols of community-driven conservation and sustainable living.

APPENDIX – 1

I. Location visited along the west coast of India to conduct the TEK and ITK based questionnaire survey on Whale Shark.

MAHARASHTRA	GOA	KARNATAKA	KERALA	LAKSHADWEEP
THANE	NORTH GOA	UTTAR KANNADA	KASARGOD	AGATTI ISLAND
ARNALA	CHAPORA	BELAMBER	AJANOOR	ANDROTH ISLAND
DAHANU	DONAPAULA	BELEKERI	ARIKKADI	KADMATH ISLAND
NAIGAON	MALIM-	DANDEBAG	BEKAL	KAVARATHI ISLAND
TEMBHI	PANJIM	GABITHWADA	CHERUVATHUR	MINICOY ISLAND
UTTAN	MORIJIM	GANGAVALI	HOSDURGA	
MUMBAI	SIRIDAO	GOKARN	THALANGARA	
CUFFEE PARADE	SOUTH GOA	GOTNEBAG	KANNUR	
FERRY WHARF	BAINA	HOLANGADDE	AYIKKARA F.H	
MANORI	BENAULIM	KAGAL	AZHEEKAL	Kerala Continues…….
SASOON	BETUL	KAJUBAG	NEW MAHE	ALLEPEY
VERSOVA	CANACONA	KARWAR F.H	PUTHIYANGADI	ARTHUNKAL
RAIGAD	CUTBONA	MANJUGUNI	TELLYCHERRY	MANAKODAM
ALIBAUG	KHARIWADA	MUDGEAMDALLI	CALICUT	PALLITHODU
BHARADKHOL	MAJORDA	NOVBAG	BADAGARA	THOTTAPALLY
KARANJ		PAVINKURVE	BEYPORE F.H	THUMPOLLY
MORA		TADRI	CHALIYAM	THYKAL
MURUD		UDUPI	CHOMBALA	QUILON
VERSOLI		HEJMADI	KOLAVI	CHILLICKAL
RATNAGIRI		PADUBIDRI	PUTHIYAPPA	NEENDAKARA
AMBOLGAD		BADAYERMAL	QUILANDY	QUILON PORT
HARNAI		BIJADI	VELLAYIL	SAKTHIKULANGRA
KELSHI		GANGOLLI	MALAPPURAM	THANKASSERY
MIRKARWADA		GOPADI	KOOTAYI	WADI
SAKHAR		GUJJARBETTU	PARPANANGADI	TRIVANDRUM
SINDHUDURG		KAIPUJAL	PONNANI	MAMPALLY
DHABHOLI		KODARI	THANUR	CHILAKKOOR
MALVAN		KODIKANYANA	VADAKKE	VETTOOR
TARKARKLI		KUDAPURKODI	THRISSUR	ADIMALATHURA
WADETAR		MALPE F.H	MUNAKKAKADVU	CHERIATHURA
		MANOOR	CHETTUVA	POONTHURA
		MARAVANTHE	NATTIKA	PUTHENTHOPPU
		MATTUKOPPAL	AZEECODE	PUTHUKURICHI
		NAVUNDA	PALAPETTY	SANTHIPURAM
		PADUKARE	THALIKULAM	VALIAVELI
		SHIROOR	ERNAKULAM	VETTUTHURA
		THOTTAM	COCHIN F.H	VIZHINJAM
		TRASI	FORT KOCHI	
		DAKSHIN KANNADA	KALAMUKKU	
		MANGALORE	MUNAMBARAM	
		PADUKARE	NARAKKAL	
		ULIYARAGOLI	PUTHUVAIPU	
		ULLAL		

II. Whale Shark Survey Questionnaire in English (This was translated into Malayalam, Kannada, Konkani and Marathi)

Wildlife Trust of India

Mangroves for the Future
INVESTING IN COASTAL ECOSYSTEMS

IUCN

An assessment of the past and present distribution status of the *Whale Shark Rhincodon typus* along the west coast of India
Wildlife Trust of India (WTI)
B-13, Second Floor, Sector-6, Noida, Uttar Pradesh, 201301

Name of village:	Date:
Name of fisherman:	Occupation:
Religion:	Contact no. :
Age:	Educational Qualification:
Owner/employee:	Type of boat & gear:

1. How far out into the sea do you go to fish?
2. How many days/time in a month/day do you fish? When is the fishing holidays / season when you don't fish in your area?
3. What Type of boat & gear?
4. Do you use GPS/Wireless for navigation or searching fishing grounds?
5. Are you aware of the Whale shark?
   AIDED
   PICTURE AIDED
6. Whale Shark is a "Whale" or "Shark"? What you call it locally (Local name) ?
7. Where do you most often see whale sharks?
   - Throughout the year / Specific season (Peek sighting season):
   - Reef area / Bay / Near estuary:
   - Water conditions:
   - How far offshore (km) –
   - Water depth (estimate) –
   - Time of the day – Morning / Noon / Afternoon/ Evening:
8. How do you see the whale shark i.e. with the fin out of the water? How do you find them single or in group? If you see them when sailing do they portent anything either good or bad for you?
9. Any change in the frequency of Whale shark sighting in last 10 years? Any change in their seasonal sighting or locations?
10. Do you know what a whale shark feed on? If "yes" what is that?
11. What fishes and animals (Turtles, sea birds, crabs etc) do you find most around Whale sharks?
12. Is it dangerous to humans?

    O Yes O No
13. Do you feel Whale shark is important for sea? Any specific religious association of whale sharks or sharks with your community?
14. Do you know from where whale shark comes and goes back?
15. Have you ever seen whale shark mating or giving birth to pups?

16. Had you ever seen baby/pups (46 -100 cm) of whale sharks? If yes how small, when and where?
17. If you see a whale shark in sea what you do?
18 . Do you often get whale shark as accidental catch: If so how often and how many?
19 In what types of gear do whale sharks get caught?
20 What you do with accidentally caught whale shark?
21 Did you ever hit to a Whale shark with your boat? If yes what happened to the whale shark?
22 Did you ever see any "TAG" or any kind of marking on whale shark around your area? If yes what kind of mark or tag?
23 . Have you ever hunted a whale shark? If Yes how many?
24. If yes what type of gears do you used to catch a Whale Shark?
25. Where did you sell it? What price did you get for it?
26. What are whale sharks used for (past and in the present) in your village?
27. Are you still in the practice of Whale shark hunting? Do you know anyone around your area who still hunts whale sharks?
28. Is there is any whale shark meat, oil or fin consumption in your area?
29. Recently did you find any demand of Whale shark meat, oil, fin or any other parts in the market?
30. What are levels of pollution, oil spills in your area? Had you ever seen any dead whale shark during oil spills or due to any pollution outbreak?
31. What is the visibility of water in your area ? In which season it increases ? Do Whale sharks also seen during high visibility season ?
32. How often you encounter beached whale shark ? What you do with them ?
33. Are you aware of Wildlife Protection Act and the fact the Whale Shark is protected under this law?

O Yes O No

34. Do you any other species of "shark" or marine animal protected under this law ?
35. Should the ban on whale shark catch be removed?

O Yes O No

36. Do you know anything about "Whale shark tourism" ?
37. Are you aware of the Whales/Dolphin/Dugong/Porpoise/Seaturtle?
38. How many times you have seen the Whales/Dolphin/Dugong/Porpoise/Sea turtle? How often?
39. If you see /Dolphin/Dugong/Porpoise/Sea turtle in sea, what you do?
40. Do you often get Whales/Dolphin/Dugong/Porpoise/Sea turtle as accidental catch: If so How often?
41. If you get catch what you do? In what types of gear do they get caught?

Other remarks:

III. Pictures taken during the questionnaire survey conducted along the west coast of India

Conducting questionnaire-based fishermen surveys to document their TEK and ITK on Whale Shark all along the Maharashtra Coast

Conducting questionnaire-based fishermen surveys to document their TEK and ITK on Whale Shark all along the Goa Coast

Conducting questionnaire-based fishermen surveys to document their TEK and ITK on Whale Shark all along the Karnataka coast

Conducting questionnaire-based fishermen surveys to document their TEK and ITK on Whale Shark all along the Kerala coast

4. Whale Shark pictures provided by various sources along the west coast of India and Lakshadweep during the survey.

Video of free swimming Whale Shark (2011) in Minicoy Island, Lakshadweep, provided by fishermen during the survey

Pictures of free swimming Whale Shark (2005) in Netrani Island, Karnataka, provided by SCUBA diving instructor during the survey

Picture of free swimming Whale Shark (2009) in Saurashtra Coast, Gujarat, provided by Mumbai fishermen during the survey

Picture of Whale Shark landed (2007) in Karwar , Karnataka, provided by CMFRI staff during the survey

APPENDIX - 2

HINDU. JULY 2, 2012

Stranded blue whale let off into ocean at last

Staff Reporter

NAGAPATTINAM: In renewed rescue efforts by the community, the blue whale that was stranded in the Mannavaram swamp off Siruthalaikadu in Vedaranyam was set free into the deep sea, here on Sunday.

This was after the day-long efforts to drift the whale away from the swamp and into the open waters stood foiled, as the whale retreated deeper into the swamp on Saturday night.

The four-tonne, 25-feet long blue whale was initially found stranded at about dawn on Saturday in the Mannavaram swamp a few kilometres south west off Kodiakarai coast.

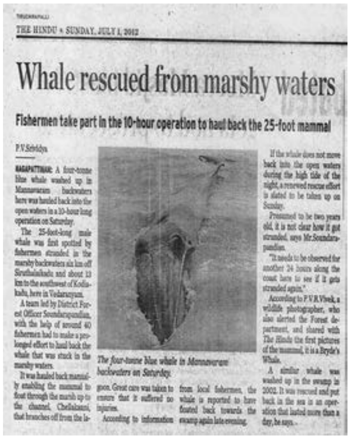
GREAT SAVE: The blue Whale rescued off Mannavaram swamp and being let off into the deep sea off Kodiakkarai in Vedaranyam on Sunday.

The stranded whale was rescued manually from the swamp only to be let off into the open waters in the channel that branched off the lagoon. However, the mammal, bereft of any injuries, had later drifted deeper into the swamp in the night, rendering futile the day-long rescue operation staged by the forest department.

However, just after dawn on Sunday, rescue operations were renewed – this time on the initiative of the community. In order to ensure that the whale did not retreat to the swamp, the mammal was hauled out slowly with ropes, drifted off the lagoon and led up to a depth of seven feet into the sea.

"The whale had moved about 800 meters further into the swamp and we had to ensure that the mammal was hauled out slowly with the use of ropes, in order to pull it farther into the sea," said P.V.R. Vivek, a wild life photographer, who initiated the renewed efforts mobilising fishermen to the swamp.

The efforts paid off after the mammal swam back farther away from the brackish lagoon and into the deep sea. "We stood assured until we waited and watched the whale swim back into the sea for over a few hundred meters," says Mr. Vivek.



TIRUCHIRAPALLI

THE HINDU • SUNDAY, JULY 1, 2012

Whale rescued from marshy waters

Fishermen take part in the 10-hour operation to haul back the 25-foot mammal

P.V.Srividya

NAGAPATTINAM: A four-tonne blue whale washed up in Mannavaram backwaters here was hauled back into the open waters in a 10-hour long operation on Saturday.

The 25-foot-long male whale was first spotted by fishermen stranded in the marshy backwaters six km off Siruthalaikadu and about 13 km to the southwest of Kodiakadu, here in Vedaranyam.

A team led by District Forest Officer Soundarapandian, with the help of around 40 fishermen had to make a prolonged effort to haul back the whale that was stuck in the marshy waters.

The four-tonne blue whale in Mannavaram backwaters on Saturday.

It was hauled back manually by enabling the mammal to float through the marsh up to the channel, Chellakanni, that branches off from the lagoon. Great care was taken to ensure that it suffered no injuries.

According to information from local fishermen, the whale is reported to have floated back towards the swamp again late evening.

If the whale does not move back into the open waters during the high tide of the night, a renewed rescue effort is slated to be taken up on Sunday.

Presumed to be two years old, it is not clear how it got stranded, says Mr.Soundarapandian.

"It needs to be observed for another 24 hours along the coast here to see if it gets stranded again."

According to P.V.R.Vivek, a wildlife photographer, who also alerted the Forest department, and shared with The Hindu the first pictures of the mammal, it is a Bryde's Whale.

A similar whale was washed up in the swamp in 2002. It was rescued and put back in the sea in an operation that lasted more than a day, he says.

days. "On that day, after he chased the drunken man ed, picked up the club he had been forced to drop, and re- san had been attached. Kathiresan collapsed, same evening he was shifted to the MIOT hospital in Ma- nally from Sathankulam in Tuticorin district.

Caught and dragged to death: a whale shark tale

CALLOUS KILL *The whale shark was caught in a banned net. Initially alive, it was dragged ashore by fishermen who were then ordered to push it back to sea (right). But thanks to the injuries inflicted upon it, its carcass washed ashore a short while later (above)* — PHOTOS: M. KARUNAKARAN

P. Oppili

CHENNAI: An adult whale shark was caught in a net when it came to shallow waters to breed, and was then dragged to death by a group of fishermen in Injambakkam on Monday.

According to marine welfare activists, a group of fishermen came ashore on Sunday around 7 p.m., with the whale shark caught in a banned purse-seine net. The whale shark, measuring 21 ft and weighing more than 1.5 tonnes, was alive then, near the shore. On Monday morning, the fishermen, instead of pushing it back into the waters, dragged it ashore.

Activists complained that though information was passed on to the Fisheries and Wildlife authorities, they came to the spot on Sunday evening and said that as it had turned dark it would be difficult to push the whale shark back into the sea.

In the meanwhile, a rumour spread among the fishermen that the whale shark's teeth could fetch them a fortune. They used a huge pole to drag the whale shark on to the sands, inflicting severe injuries.

When the officials returned on Monday morning, the whale shark was struggling to survive. They ordered the fishermen to push it back to sea. A couple of hours later, its carcass washed ashore.

Activists blamed the Fisheries and Wildlife authorities for their callous attitude which, they claimed, led to the death of the creature.

K. Venkataraman, director, Zoological Survey of India, said that the marine animal was an endangered species and categorised under Schedule I of the Wildlife Protection Act of 1972. He said killing or inflicting injury on a whale shark would attract severe punishment similar to that of slaying a tiger.

Dr. Venkataraman said that during this period of the year, whale sharks come close to the shore to breed. Whenever they were caught in a net and killed, the fishermen extracted oil and used it for painting their boats.

"They are harmless marine creatures. To date, no status survey had been done on them. In Gujarat, the government rewards fishermen who release whale sharks," he added.

APPENDIX - 3

APPENDIX I: Details of Whale Shark landings in EGREE Region between 2013-15

S.No	Date	Landing Centre	Direct	Indirect	Total
1	06.11.2013	Kumbhabishekam	✓		1
2	20.6.2013	Uppada	✓		1
3	July		✓		1
4			✓		1
5	08.05.2013	Kumbhabishekam	✓		1
6	Sep			✓	1
7	10.04.2013	Kumbhabishekam	✓		1
8				✓	1
9	Nov			✓	1
10	12.03.2013	Bhairavpalem	✓		1
11	18.12.2013	Kumbhabishekam	✓		1
12				✓	1
13	01.10.2014	Kumbhabishekam	✓		1
14				✓	1
15	Feb			✓	1
16	13.3.2014	Kumbhabishekam	✓		1
17	04.10.2014	Kumbhabishekam	✓		1
18	04.12.2014	Kumbhabishekam	✓		1
19	Jun			✓	1

S.No	Date	Landing Centre	Direct	Indirect	Total
20	07.08.2014	Kumbhabishekam	✓		1
21		Kumbhabishekam	✓		1
22		Kumbhabishekam	✓		1
23	07.09.2014	Kumbhabishekam	✓		1
24		Kumbhabishekam	✓		1
25	07.10.2014	Kumbhabishekam	✓		1
26	20.7.2014	Kumbhabishekam	✓		1
27	24.7.2014	Kumbhabishekam	✓		1
28	13.09.2014	Konapakapeta		✓	1
29	14.09.2014	Konapakapeta		✓	2
30		Mulapeta		✓	1
31		Kumbhabishekam	✓		1
32	15.09.2014	Konapakapeta		✓	1
33		Mulapeta		✓	1
34	16.09.2014	Konapakapeta	✓		1
35		Konapakapeta	✓		1
36		Konapakapeta		✓	1
37	16.09.2014	Uppada	✓		1
38		Uppada	✓		1
39		Uppada	✓		1
40		Uppada	✓		1
41		Uppada	✓		1
42		Uppada	✓		1
43	16.09.2014	Kumbhabishekam	✓		1
44	17.09.2014	Kumbhabishekam	✓		1
45	20.09.2014	Kumbhabishekam	✓		1
46			✓		1

S.No	Date	Landing Centre	Direct	Indirect	Total
47			✓		1
48			✓		1
49	14.11.2014	Kumbhabishekam	✓		1
50		Kumbhabishekam	✓		1
51	18.11.2014	Kumbhabishekam		✓	1
52	20.11.2014	Kumbhabishekam	✓		1
53	21.11.2014	Kumbhabishekam	✓		1
54	23.11.2014	Kumbhabishekam		✓	1
55	26.11.2014	Bhairavpalem	✓		1
56	29.11.2014	Kumbhabishekam	✓		1
57	19.12.2014	Kumbhabishekam	✓		1
58	Jan	Kumbhabishekam		✓	7
59	20.02.2015	Kumbhabishekam	✓		1
60	March			✓	2
61	07.05.2015	Uppada		✓	1
62	13.7.2015	Uppada		✓	1
63	July	Mulapeta		✓	2
64	14.7.2015	Kumbhabishekam	✓		1
65	08.06.2015	Kumbhabishekam	✓	✓	2
66	08.07.2015	Kumbhabishekam		✓	1
67	16.8.2015	Kumbhabishekam		✓	1
68	23.8.2015	Kumbhabishekam		✓	1
69	01.07.2016	Kumbhabishekam	✓		1

Source: Sathiyaselvam *et al* 2016

APPENDIX II: Name of the sampled coastal villages

SRIKAKULAM
Chinapukkellapalem
Isakalapalem
Gollagandi
Hukumpeta
VISHAKAPATNAM
Lawsons Bay
Visakhapatnam Harbour
Rishikonda
Jalariyendada
Moolapalem
Appikondaa
Thikkavanipalem
Poodimadaka
Bheemilipatnam
Peddarishikonda
Dibbalapalem
VIJAYANAGARAM
Baripeta
Bodduvenkatesupeta
Kotturu
Neelageddapeda
Tippalavalasa
Chepalkancheru
Peddakondrajpalem
EAST GODAVARI
Danavipeta
Kakinada Harbour
Konapapapeta
Kumbabishekam
Uppada
Uppada Baramakam
Uppada Baramakam
Uppada Subbampeta
Vakalapudi
Uppada Urban
Yellayapeta
KRISHNA
Chinnakari Agraharam Pallipalem
Campbellpet
Gilakaladindi
Etimoga
Gollagandi
Giripuram
Gullalamoda
Nakshatranagar
Manginapudi
Nachugunta
Podu
Sathravapalem
Ysr Fishermen Colony
Palakayatippa
GUNTUR
Nizampatnam Harbour
Adarsanagar
Kothapalem

Lankavanidibba
Gokarnamatham
Suryalenka
PRAKASHAM
Kothasatram Pallipalem
Gundamala
Vottur
Chakicherla
Chennaiah Palem
Kotha Satram
Thatichetla Palem
Patha Palem
Chinaramudu Palem
Thummalapenta Palli Palem
Kataripalem
Kothapatnam
Krantinagar
Devalapallipalem

NELLORE
Isakapalli Pathapalem
Ponnapudi Palli Palem
Kothuru
Krishnapatnam
Lakshmipuram
Pathapalem
Krishnapuram
Vottukuru Palli Palem
Venkata Narayana Puram
Venkanna Palem
Muthukuru Pattapalem
Nelaturupadu
Manjakuppam
Govindapally Pattapalem
Chinnathota
Mypadu
Kondurpalem

APPENDIX III: Postcard distributed for understanding the occurrence of Whale Shark pups on the Andhra Pradesh coast.

A. Front side of the postcard

పేరు : ....

చిరునామా : ....

....

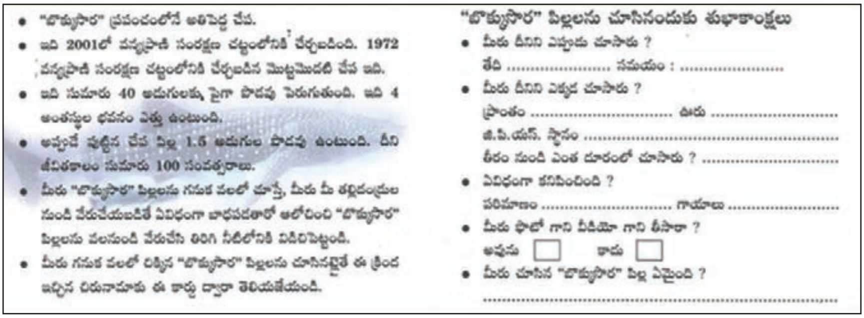
....

....

To
WILDLIFE TRUST OF INDIA
D.No. 19-7-18,
Flat No. F3,1st Floor,
Manthripragadavari St.,
Cinema Road, KAKINADA.

ఈ చిత్రం కేవలం బొమ్ముసొర ఆకారాన్ని చూడటం కోసం మాత్రమే. మీరు దీనితో ఎప్పుడూ ఆడవద్దు

B. Reverse side of the post card



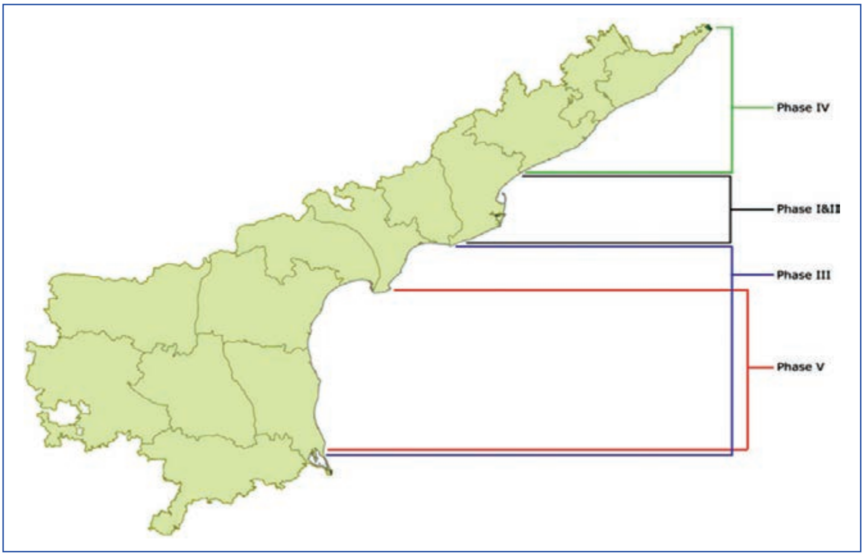
- "బొమ్ముసొర" ప్రపంచంలోనే అతిపెద్ద చేప.
- ఇది 2001లో వన్యప్రాణి సంరక్షణ చట్టంలోనికి చేర్చబడింది. 1972 వన్యప్రాణి సంరక్షణ చట్టంలోనికి చేర్చబడిన మొట్టమొదటి చేప ఇది.
- ఇది సుమారు 40 అడుగులకు పైగా పొడవు పెరుగుతుంది. ఇది 4 అంతస్థుల భవనం ఎత్తు ఉంటుంది.
- అప్పుడే పుట్టిన చేప పిల్ల 1.5 అడుగుల పొడవు ఉంటుంది. దీని జీవితకాలం సుమారు 100 సంవత్సరాలు.
- మీరు "బొమ్ముసొర" పిల్లలను గనుక వలలో చూస్తే, మీరు మీ తల్లిదండ్రుల నుండి వేరుచేయబడితే ఏవిధంగా బాధపడతారో ఆలోచించి "బొమ్ముసొర" పిల్లలను వలనుండి వేరుచేసి తిరిగి నీటిలోనికి విడిచిపెట్టండి.
- మీరు గనుక వలలో చిక్కిన "బొమ్ముసొర" పిల్లలను చూసినట్లైతే ఈ క్రింద ఇచ్చిన చిరునామాకు ఈ కార్డు ద్వారా తెలియచేయండి.

"బొమ్ముసొర" పిల్లలను చూసినందుకు శుభాకాంక్షలు

- మీరు దీనిని ఎప్పుడు చూసారు ?
  తేది .... సమయం : ....
- మీరు దీనిని ఎక్కడ చూసారు ?
  ప్రాంతం .... ఊరు ....
  జి.పి.యస్. స్థానం ....
  తీరం నుండి ఎంత దూరంలో చూసారు ? ....
- ఏవిధంగా కనిపించింది ?
  పరిమాణం .... గాయాలు ....
- మీరు ఫొటో గాని వీడియో గాని తీసారా ?
  అవును ☐ కాదు ☐
- మీరు చూసిన "బొమ్ముసొర" పిల్ల ఏమైంది ?
  ....

Appendix IV: Whale Shark TEK questionnaire survey along the AP coast from October 2015- April 2016

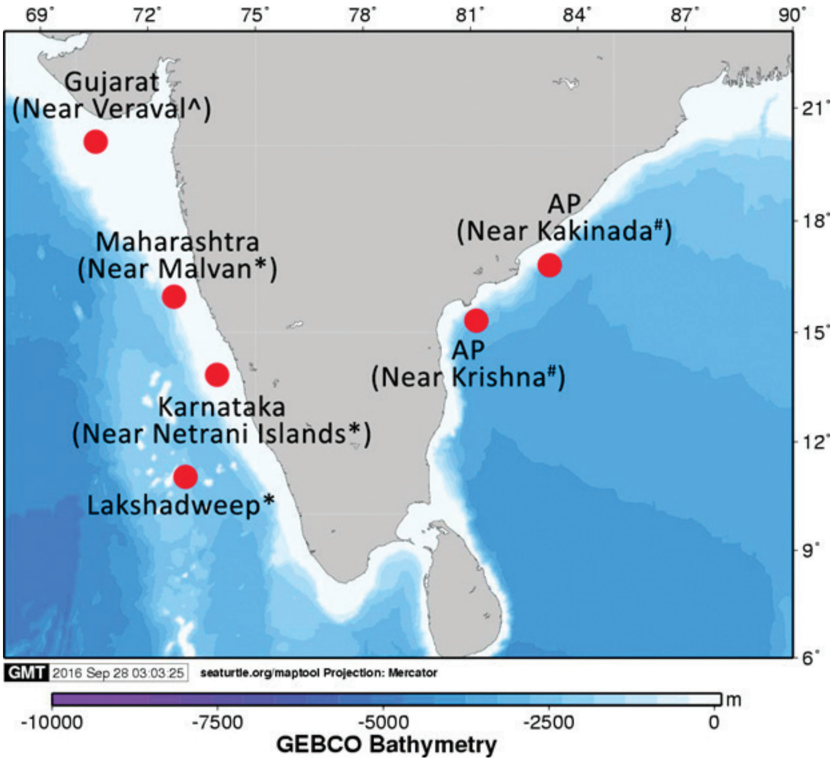
Appendix V: Phases of TEK Sampling along Andhra Pradesh Coast



Appendix VI: Proposed Whale Shark Conservation Action Plan along the Andhra Pradesh Coast

Coastal Districts & Other Agencies	Detailed survey of Whale Shark aggregations	Initiation of Active Awareness program, Poster, Bill board	Research, Tagging & Ecological Studies	Community Involvement	Rescue & Release	Co-ordination between fisheries & Wildlife Department	Feasibility of Eco-tourism prospects	National Whale Shark recovery plan	State Whale Shark recovery plan
Srikakulam		✓		✓		✓			✓
Vijayanagaram		✓		✓		✓			✓
Vishakapatnam	✓	✓	✓	✓	✓	✓			✓
E.Godavari	✓	✓	✓	✓	✓	✓	✓		✓
W.Godavari		✓		✓		✓			✓
Krishna	✓	✓	✓	✓	✓	✓	✓		✓
Guntur	✓	✓	✓	✓	✓	✓	✓		✓
Prakasham		✓	✓	✓		✓			✓
Nellore		✓		✓		✓			✓
MoEF&CC , GOI								✓	✓
Agriculture Ministry, Forest And State fisheries department						✓			✓

Appendix VII: Geographic locations where Whale Sharks have been sighted, or where they are believed to aggregate (red dots) in Indian waters.



^Study conducted with the support of TCL and GFD

*Study conducted with the support of IUCN-MFF

Study conducted with the support of EGREE Foundation

Appendix VIII: Questionniare

A Traditional Ecological Knowledge (TEK) based investigation of historical occurrence, distribution and population trend of Whale Shark (Rhincodon typus Smith, 1829) along the Andhra Pradesh coast

Wildlife Trust of India (WTI)

F-13, Sector 18, Noida, UP

Name of village :	Date:
Name of fisherman:	Occupation :
Religion:	Contact no. :
Age:	Owner/employee:

1. How far out into the sea do you go to fish?
2. How many days/times in a month/day do you fish? When is the fishing holiday/season when you don't fish in your area?
3. What type of boat and gear are used for fishing?
4. Do you use GPS/Wireless for navigation or searching fishing grounds?
5. Are you aware of the Whale shark?

Aided
Picture Aided

6. Whale Shark is a "Whale" or "Shark"? What do you call it locally (Local name)?
7. Where do you most often see Whale Sharks?
8. Throughout the year / Specific season (Peek sighting season):
9. Reef area / Bay / Near estuary :
10. Water conditions :
11. How far offshore (km) –
12. Water depth (estimate) –
13. Time of the day – Morning / Noon / Afternoon/ Evening:

14. How do you see the Whale Shark i.e. with the fin out of the water? How do you find them single or in group? If you see them when sailing do they portent anything either good or bad for you?
15. Any change in the frequency of Whale Shark sightings in the last 10 years? Any change in their seasonal sighting or locations?

16. Do you know what a Whale Shark feeds on? If "yes" what is that?

17. What fishes and animals (Turtles, sea birds, crabs etc) do you find most around Whale Sharks?
18. Is it dangerous to humans?

    Yes

    No
19. Do you feel Whale Sharks are important for the sea? Any specific religious association of Whale Sharks or sharks with your community?
20. Do you know from where the Whale Shark comes and goes back?
21. Have you ever seen Whale Sharks mating or giving birth to pups?
22. Have you ever seen baby/pups (46 -100 cm) of Whale Sharks? If yes how small, when and where?
23. If you see a Whale Shark in the sea what do you do?
24. Do you often get Whale Sharks as accidental catch: If so how often and how many?
25. In what types of gear do Whale Sharks get caught?
26. What do you do with accidentally caught Whale Sharks?
27. Did you ever hit a Whale Shark with your boat? If yes what happened to the whale shark?
28. Did you ever see any "TAG" or any kind of marking on Whale Sharks around your area? If yes what kind of mark or tag?
29. Have you ever hunted a whale shark? If Yes how many?
30. If yes what type of gear do you use to catch a Whale Shark?
31. Where did you sell it? What price did you get for it?
32. What are Whale Sharks used for (past and in the present) in your village?
33. Are you still in the practice of Whale Shark hunting? Do you know anyone around your area who still hunts Whale Sharks?

34. Is there any Whale Shark meat, oil or fin consumption in your area?
35. Recently did you find any demand for Whale Shark meat, oil, fin or any other parts in the market?
36. What are the levels of pollution, and oil spills in your area? Have you ever seen any dead Whale Sharks during oil spills or due to any pollution outbreak?
37. What is the visibility of water in your area? In which season does it increase? Are Whale Sharks also seen during high visibility season?
38. How often do you encounter beached Whale Sharks? What do you do with them?
39. Are you aware of the Wildlife (Protection) Act, 1972 and the fact the Whale Shark is protected under this law?

    Yes

    No
40. Do you have any other species of "shark" or marine animal protected under this law?
41. Should the ban on Whale Shark catch be removed?

Yes

No

42. Do you know anything about "Whale Shark tourism"?
43. Are you aware of the Whales/Dolphins/Dugong/Porpoise/Sea turtle?
44. How many times you have seen the Whales/Dolphin/Dugong/Porpoise/Sea turtle? How often?
45. If you see /Dolphin/Dugong/Porpoise/Sea turtle in sea, what do you do?
46. Do you often get Whales/Dolphin/Dugong/Porpoise/Sea turtles as accidental catches: If so

How often?

47. If you get an accidental catch what do you do? In what types of gear do they get caught?
48. Other remarks:

APPENDIX - 4

I: Questionnaire

Study of Whale Shark and marine megafaunal distribution along Odisha, and potential for marine and coastal species-based tourism

Wildlife Trust of India (WTI)
F-13, Sector 18, Noida, UP

Name of village :	Date:
Name of the fisher :	
Religion:	Contact no. :
Age:	Owner/employee:

Number of fishers in the village:

Number of boats in the village:

1. How far out into the sea do you go to fish?
2. How many days/times in a month/day do you fish?
3. When is the fishing holiday/season when you don't fish in your area?
4. What type of boat & gear are used for fishing?
5. What types of nets are used for fishing?
6. Do you use GPS/Wireless for navigation or searching fishing grounds?
7. Are you aware of
   - Whale shark
   - Whales
   - Dolphins
   - Porpoises
   - Turtles

8. Whale Shark is a "Whale" or "Shark"?
9. Where do you most often see Marine megafauna?

Near estuary	5 km offshore	10 km offshore	20 km offshore	>20 km offshore

10. How do you see the megafauna in water?

11. How do you find them single or in group?

12. If you see them when sailing do they portent anything either good or bad for you?

13. Any change in the frequency of megafauna sightings in the last 10 years?

14. Any change in their seasonal sighting or locations?

15. Do you know what a megafauna feeds on? If "yes" what is that?

16. Are megafauna dangerous to humans?

17. Do you feel megafauna is important for the sea?

18. Any specific religious association of megafauna with your community?

19. Do you know from where megafauna comes and goes back?

20. Have you ever seen megafauna mating or giving birth to pups/laying eggs?

21. Have you ever seen baby/pups (46 -100 cm) of megafauna? If yes how small, when and where?

22. If you see a megafauna in the sea during a fishing operation what do you do?

23. Do you often get megafauna as an accidental catch:

24. In what types of fishing nets do megafauna get caught usually?

25. What you do with accidentally caught megafauna

26. Did you ever hit a megafauna shark with your boat?

27. Have you traded megafauna in the market?

28. What are the uses of megafauna (past and present) in your village?

29. Is there any megafauna meat, oil or fin consumption in your area?

30. Recently did you find any demand for megafauna meat, oil, fin or any other parts in the market?

31. How often do you encounter beached megafauna? What do you do with them?

32. Are you aware of the Wildlife (Protection) Act,1972

33. Are you aware that the below-listed species are protected under the Wildlife (Protection) Act,1972

34. Do you know anything about “marine megafauna tourism”?

35. If there is a possibility of marine megafauna tourism in your area, are you ready to take it up?

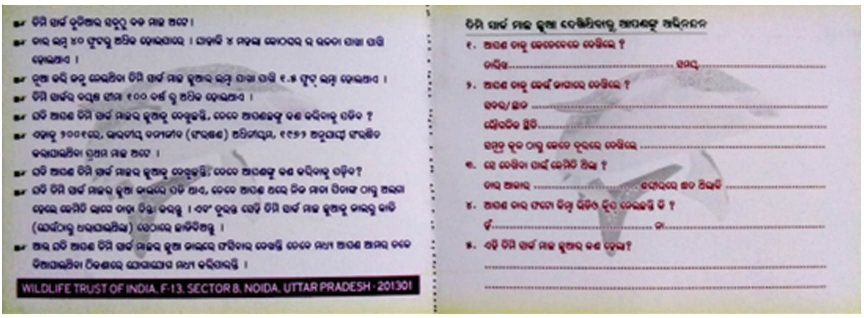
36. If yes, what sort of assistance you expect from govt.?

37. If marine megafauna tourism is initiated, which departments will be coordinated?

II: Postcard distributed for understanding the occurrence of Whale Shark pups in the Odisha coast.

Front side of the postcard

The reverse side of the postcard



III: Sighting records of Whale Sharks along Odisha and West Bengal coast

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Whale	Baidhara Pentha beach, Puri, Odisha	4-12-2016	1	Dead	Khaleej Times India
Whale	Panth Niwas, Puri, Odisha	3-4-2017	1	Dead	Kolkata 24x7
Whale	Balukhanda beach, Puri, Odisha	16-2-2017	1	Dead	Ani (Hindustan times)
Whale	Mangala river mouth, Puri, Odisha	5-2-2016	1	Dead	Debabrata Mohanty (The Indian Express)
Sperm Whale	Rushikulya beach, Berhampur, Ganjam, Odisha	3-2-2016	1	Dead	Deccan Chronicle
Whale	Chinchira beach, Kendrapara, Odisha	5-2-2017	1	Dead	Debabrata Mohanty (The Indian Express)
Bryde's Whale	Rushikulya River Mouth, Odisha	22-5-2009	1	Alive	John, et al., 2012
Whale	Rushikulya River Mouth, Odisha	10-4-2009	3	Alive	John s
Bryde's Whale	Rushikulya River, Odisha	23-5-2009	1		M. Khan, April 2009
Bryde's Whale	Rushikulya River, Odisha	29-7-2010	1		Dr. Siba Prasad Parida 2010
Fin whale	West Bengal	22-1-1983	1	Dead	De Silva,1987
Fin whale	Jhelampur beach, , West Bengal	May, 2006	1		Yennawar, 2009
Short-finned pilot whale	Salt lake, Culcutta, West Bengal	1950	1		Jones,1953
Short-finned pilot whale	Salt lake, Culcutta, West Bengal	1950	1		De Silva, 1987

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Blue whale	Jambudwip,West Bengal	Feb, 1934	1		Jones,1953
Blue Whale	Sordip Bay, West Bengal	-	1	Dead	De Silva, 1987
Bryde's Whale	West Bengal	17-12-2012	1		Dipani sutaria, http://portal.thebengalpost.com
Short – Finned pilot Whale	Salt lakes, near Culcutta, West Bengal	1-7-1852	A shoal	Alive	Jerdon, 1867: Moses, 1947
Short – Finned pilot Whale	Hoogly river, near Serampore, West Bengal	1852	1	Dead	Jerdon, 1867

IV: Sighting records of porpoises along Odisha and West Bengal coast

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Indo-Pacific finless porpoise	Gahirmatha beach, Odisha	4-2-1986	2	Dead	James et al., 1989
Indo-Pacific finless porpoise	Gahirmatha beach, Odisha	Mar, 1987	2	Dead	James et al., 1989
Indo-Pacific finless porpoise	Odisha coast	Dec, 2004-Mar 2005	1 group	Alive	Pattnaik et al., 2007
Indo-Pacific finless porpoise	Budhabalanga river, Odisha coast	04-03-2017	1	Alive	Alissa Barnes, http://marinemammals.in
Indo-Pacific finless porpoise	Odisha coast	25-02-2012	1	Alive	Sajan John, http://marinemammals.in
Indo-Pacific Finless porpoise	Rajnagar, Odisha	15-2-2015	1	Alive	Dolphin estimation, Odisha 2015, CDA & Chilka WL
Indo-Pacific Finless porpoise			1	Dead	Sajan John, 2011 (Personal observation)

V: Sighting records of dolphins along Odisha and West Bengal coast

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Pan tropical spotted dolphin	Near Sundarban, West Bengal	1889	1	Alive	Blanford, 1891
Pantropical spotted dolphin	Dingha, West Bengal	18-5-2006			Yennawar, 2009
Long-beaked common dolphin	Paradeep, Odisha	5-9-1987	12	Alive	Jayaprakash et al., 1995
Indo-Pacific bottlenose dolphin	Dingha fish landing centre, Midnapore West Bengal	11-11-1995	1	Dead	Kar,1996
Indo-Pacific humpback dolphin	Gahirmatha beach, Odisha	Jan-Mar, 1983	4	Dead	James et al., 1989
Indo-Pacific humpback dolphin	Gahirmatha beach, Odisha	Jan-Mar, 1984	3	Dead	James et al., 1989
Indo-Pacific humpback dolphin	Gahirmatha beach, Odisha	Jan-Mar, 1985	2	Dead	James et al., 1989
Indo-Pacific humpback dolphin	Gahirmatha beach, Odisha	Jan-Mar, 1987	4	Dead	James et al., 1989
Ganges river dolphin	Dudya River, West Bengal	1986			Gosh and Choudhary, 1986

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Indo-Pacific hupbackrd dolphin	Gahirmatha beach, Odisha	Nov,1998-Feb,1999			Sutaria and Jefferson, 2004
Irrawady dolphin	Gahirmatha beach, Odisha	Mar, 1987	1	Dead	James et al., 1989
Irrawady dolphin	Lampur beach, West Bengal	16-5-2006			Yennawar,2009
Beaked dolphins	Gahirmatha beach, West Bengal	March 1983	6	Dead	Silas Et al., 1983
Snubfin dolphins	Gahirmatha beach, Odisha	March 1987	1	Dead	James et al., 1989
Irrawaddy dolphin	Gahirmatha beach, Odisha		1	Dead	James et al., 1989
Irrawaddy dolphin	Gahirmatha beach, Odisha	2001	2	Dead	Khan; Pattnaik et al., 2007
Irrawaddy dolphin	Devi river mouth, Odisha	2001	2	Dead	Khan; Pattnaik et al., 2007
Spinner dolphin	Odisha coast	Dec, 2004-Mar 2005	1 group	Alive	Pattnaik et al., 2007
Indo-Pacific humpback dolphin	Odisha coast	Dec, 2004-Mar 2005	3 group	Alive	Pattnaik et al., 2007
Bottle-nose dolphin	Odisha coast	Dec, 2004-Mar 2005	1 group	Alive	Pattnaik et al., 2007
Indo-Pacific humpback dolphin	Gahirmatha, Odissa coast	Nov 1998 to Feb 1999	Several	Alive	Sutaria et al., 2004
Indo-Pacific humpback dolphin	Gahirmatha, Odissa coast	Nov 1998 to Feb 1999	2	Dead	Sutaria et al., 2004

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Indo-Pacific bottlenose dolphin	Mouth of the Jatadhari River, Odisha	2-8-2010	2	Dead	Natarajan KS, http://marinemammals.in
Indo-Pacific bottlenose dolphin	Odisha coast	04-02-2012	1	Dead	Ashish Senapati, http://marinemammals.in
Indo-Pacific humpback dolphin	Odisha coast	25-2-2012	1	Alive	Sajan John, http://marinemammals.in
Spinner dolphin	Rushikulya beach, Odisha	10-3-2016	1	Dead	Alissa Barnes, http://marinemammals.in
Dwarf Spinner dolphin	Mousuni Island Bengal.	29-9-2012	1	Dead	Avisek Chatterjee
Bottle-nosed Dolphin	Museum of the Asiatic Society, Kolkata	1848	1	Dead (stuffed skin)	Jerdon 1867; De Silva, 1987; Corbet & Hill, 1992
Gangetic dolphin	Kakdwip to Howrah Bridge	2005-2007	31	Alive	Sharma, 2010
Irrawaddy dolphin	Chilika lagoon(WL), Odisha	15-2-2015	144	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Irrawaddy dolphin	Rajnagar, Bhitarakanika, Odisha	15-2-2015	58	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Irrawaddy dolphin	Bhadrak, Odisha	15-2-2015	4	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Bottle-nosed dolphin	Rajnagar, Bhitarakanika, Odisha	15-2-2015	23	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Bottle-nosed dolphin	Berhampur, Odisha	15-2-2015	22	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Bottle-nosed dolphin	Bhadrak, Odisha	15-2-2015	2	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Bottle-nosed dolphin	Balasore, Odisha	15-2-2015	5	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Chinese Humpback dolphin	Rajnagar, Odisha	15-2-2015	123	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Chinese Humpback dolphin	Berhampur, Odisha	F15-2-2015	2	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Humpback dolphin	Rajnagar, Bhitarakanika, Odisha	15-2-2015	50	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Pantropical Spotted dolphin	Rajnagar, Bhitarakanika, Odisha	15-2-2015	15	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Ganges River dolphin	Baripada, Odisha	15-2-2015	1	Alive	Dolphin estimation in Odisha during 2015, CDA & Chilka WL Division
Irrawaddy dolphin	Rajnagar, Bhitarakanika, Odisha	20-1-2017	55	Alive	Dolphin estimation in Odisha during 2017, Odisha State Forest and Environment department
Irrawaddy dolphin	Bhadrak, Odisha	20-1-2017	5	Alive	Dolphin estimation in Odisha during 2017, Odisha State Forest and Environment department
Humpback dolphin	Odisha	20-1-2017	34	Alive	Dolphin estimation in Odisha during 2017, Odisha State Forest and Environment department

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Bottle-nose dolphin	Odisha	20-1-2017	31	Alive	Dolphin estimation in Odisha during 2017, Odisha State Forest and Environment department
Pantropical spotted dolphin	Rajnagar, Bhitarakanika, Odisha	20-1-2017	5	Alive	Dolphin estimation in Odisha during 2017, Odisha State Forest and Environment department
Gangetic dolphin	Budhabalanga River, Sahupada in Balasore, Odisha	17-12-2015	1	Dead	indiatoday in Education (18-12-2015)

VI: Sighting records of turtles along Odisha and West Bengal coast

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Turtles	Bhanshalghat, West Bengal	Dec 1982 – Feb 1983	10,000	Alive	Silas Et al., 1983
Turtles	Digha fish landing centre, West Bngal	15-12-1982	59	Alive	Silas Et al., 1983
Turtles	Digha fish landing centre, West Bngal	15-12-1982	59	Alive	Silas Et al., 1983
Turtles	Digha fish landing centre, West Bngal	15-12-1982	12	Dead	Silas Et al., 1983
Turtles	Digha beach, West Bngal	1-2-1983	11	Alive	Silas Et al., 1983
Olive ridley	Digha fish landing centre, West Bngal	Feb, 1983	9	Dead	Silas Et al., 1983
Olive ridley	Digha Muhana landing centre, West Bngal	20-2-1983	15	Dead	Silas Et al., 1983
Olive ridley	Bhankshalghat, West Bengal	19-12-1983	15	Dead	Silas Et al., 1983
Olive ridley	Howrah, West Bengal	1982-83	165	Dead	Silas Et al., 1983
Olive ridley	Shealdah, West Bengal	1982-83	58	Dead	Silas Et al., 1983
Olive ridley	Howrah, West Bengal	1982-83	134	Dead	Silas Et al., 1983
Olive ridley	Howrah, West Bengal	1982-83	35	Dead	Silas Et al., 1983
Olive ridley	Howrah, West Bengal	1982-83	27	Dead	Silas Et al., 1983
Olive ridley	Howrah, West Bengal	1982-83	50	Dead	Silas Et al., 1983

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Turtles	Narghat, West Bengal	21-12-1982	90	Alive	Dainik Chetana, 22-12-1982, Silas Et al., 1983
Turtles	Pentakotah, Orissa	1981-82	2000	Dead	Silas Et al., 1983
Olive ridley	Gahirmatha, Orissa	1980-81	500	Alive	Silas Et al., 1983
Olive ridley	Gahirmatha, Orissa	1982-83	200,000	Alive	Silas Et al., 1983
Turtles	Gahirmatha, Orissa	March, 1983	7000 to 7500	Dead	Silas Et al., 1983
Olive ridley	Gahirmatha, Orissa	Dec 1993-May 1994	2153	Dead	Pandav et al, 1997
Olive ridley	Paradeep, Orissa	Dec 1993-May 1994	1032	Dead	Pandav et al, 1997
Olive ridley	Kujang, Orissa	Dec 1993-May 1994	1671	Dead	Pandav et al, 1997
Olive ridley	Kujang, Orissa	Sep 1993-Apr 1994	1500	Dead	Pandav et al, 1997
Olive ridley	Gahirmatha, Orissa	1993	7500	Dead	James et al., 1989
Olive ridley	Balasore, Orissa	Dec 1993-May 1994	28	Dead	Pandav et al, 1997
Olive ridley	Devi River Mouth to Rushikulya River, Orissa	Dec 1993-May 1994	348	Dead	Pandav et al, 1997
Olive ridley	Gopalpur to Patasonapur, Orissa	Dec 1993-May 1994	50	Dead	Pandav et al, 1997
Olive ridley	Ekkula, Gahirmatha, Orissa	25 Jan to 6 Feb, 1984	300,000	Alive	James et al., 1989

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Olive ridley	Gahirmatha, Orissa	6th Apr to 13th Apr, 1984	200,000	Alive	James et al., 1989
Olive ridley	Gahirmatha, Orissa	1984	392	Dead	James et al., 1989
Olive ridley	Gahirmatha, Orissa	13 Jan to 28 Jan, 1985	287,000	Alive	James et al., 1989
Olive ridley	Gahirmatha, Orissa	1985	694	Dead	James et al., 1989
Olive ridley	Gahirmatha, Orissa	1 Mar to 10 Mar, 1986	48,000	Alive	James et al., 1989
Olive ridley	Gahirmatha, Orissa	Feb, 1986	531	Dead	James et al., 1989
Olive ridley	Gahirmatha, Orissa	5 Jan to 14 Jan, 1987	200,000	Alive	James et al., 1989
Olive ridley	Gahirmatha, Orissa	6 Mar to 14 Mar, 1987	402,000	Alive	James et al., 1989
Olive ridley	Gahirmatha, Orissa	5 Jan to 14 Jan, 1987	360	Dead	James et al., 1989
Olive ridley	Gahirmatha, Orissa	1975-1976	150,000	Alive	Bustard 1974; 1976
Olive ridley	Gahirmatha, Orissa	1976	150,000	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	1977	150,00	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	1978	200,00	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	1979	130000	Alive	Silas et al., 1985

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Olive ridley	Gahirmatha, Orissa	1983	200,00	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	1984	500,00	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	1985	287,000	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	13 Jan to 28 Jan 1985	694	dead	Silas et al., 1985
Olive ridley	Gahirmatha, Orissa	13 Mar to 23 Mar 1985	8,083	Alive	Silas et al., 1985
Olive ridley	Digha, West Bengal	8 Nov to 10 Nov 1984	12	Alive	Silas et al., 1985
Olive ridley	Digha Muhana, West Bengal	10-11-1984	10	Alive	Silas et al., 1985
	Diamond Harbor, West Bengal	10-11-1984	70	Dead	Silas et al., 1985
Olive ridley	Diamond harbour fish market, West Bengal	21 Oct to 22 Nov 1984	190	Dead	Silas et al., 1985
Olive ridley	Diamond harbour fish landing centre, West Bengal	21 Oct to 8 Dec 1984	11	Alive	Silas et al., 1985
Olive ridley	Caltex More, West Bengal	13-1-1985	21	Dead	Dainik Chetna (14-1-1985), Contai
Olive ridley	Contai, West Bengal	14-1-1985	55	Dead	Dainik Teerbhumi (14-1-1985i
Olive ridley	Caltex More, West Bengal	13-1-1985	29	Alive	Dainik Chetna (14-1-1985), Contai

Species Name	Location of sighting information	Date of sighting	No. of animals	Status (Dead/ alive)	Sources of Information
Olive ridley	West Bengal	17-12-1982	39	-	Dainik Chetna (14-1-1985), Contai
Olive ridley	West Bengal	21-12-1982	90	-	Dainik Chetna (14-1-1985), Contai
Olive ridley	West Bengal	31-1-1984	71	-	Dainik Chetna (14-1-1985), Contai
Turtles	Bhanshalghat, West Bengal	Dec 1982 to Feb 1983	10,000	Alive	Kar & Dash, 1978
Turtles	Howrah Market, West Bengal	5 Dec to 16 Dec 1983	410+		Kar & Dash, 1978; Silas et al. 1984
Olive ridley	Rajkul checkpost, West Bengal	30 Jan 1984	74		Kar & Dash, 1978; Silas et al. 1984
Olive ridley	Gahirmatha beach, Orissa	12-2-1984	392	Dead	Silas et al. 1984
Olive ridley	Sagar Island, Odisha	22-11-1984	3	Dead	Silas et al., 1985
Olive ridley	Frazergunj, Odisha	7-12-1984	1	Alive	Silas et al., 1985
Olive ridley	Gahirmatha, Odisha	1999	180,000	Alive	Tripathy , 2002
Olive ridley	Gahirmatha, Odisha	1998	14,000	Dead	Pandav et al., 1998
Olive ridley	Gahirmatha, Odisha	1995	60,000	Alive	Pandav et al., 1998
Olive ridley	Gahirmatha, Odisha	1998	8,000	Alive	Pandav et al., 1998
Olive ridley	Rushikulya, Odisha	10-12-2011	2	alive	Sajan John, 2011 (Personal observation)

VII: Name of sampled villages in Odisha

1. BALASORE

1. Aldia
2. Badadeulabad
3. Baharda
4. Balaramgadi
5. Bardhanpur
6. Chandipur
7. Dasi
8. Dumuria
9. Gobindapur
10. Gokalpur
11. Gopinathpur
12. Hanagoth
13. Haripur
14. Hasanpur
15. Inchudiha
16. Jayadev kasaba
17. Kusumuli
18. Mirzapur
19. Mundideula
20. Nidhipada
21. Nilida
22. Nischinta
23. Pala balasore
24. Patrapada
25. Purana balasore
26. Raghunathpur
27. Ranasahi
28. Sahajanagar
29. Tapasi
30. Tiakhia
31. Aladiha
32. Anadeula
33. Aruadam
34. Badakasaba
35. Badasimulia
36. Chandamani
37. Choumukh
38. Dagara
39. Jai
40. Jamunasul
41. Kalasimuli
42. Kankadapal
43. Kumbhari
44. Madhapura
45. Nanguri
46. Nayabali
47. Nuagan
48. Palabegunia
49. Sadhuchaka
50. Tahalia
51. Telini
52. Alumeda
53. Bagada
54. Chhanua
55. Endrai
56. Juari
57. Kasafal
58. Nabara
59. Solpata
60. Balikira
61. Barbatia
62. Bartana
63. Harinkuli
64. Iswarpur
65. Kantabani
66. Khadibil
67. Maheshpur
68. Malaruan
69. Nafrai
70. Nilipura
71. Palusia
72. Ranasinghpur
73. Sahapur
74. Sanausa
75. Tengramari
76. Ghantiadi
77. Gobardhanpur
78. Gopimhanpur
79. Kalikapur
80. Kalyanpur
81. Kasida
82. Namkana
83. Sarsida
84. Badabasuli
85. Narayanpur

2. BHADRAK

96. Bahdha sahi
97. Bhagabanpur
98. Jagannathpur
99. Kuali
100. Purushotampur
101. Radhakrishna-pur
102. Suan

103. Begunia
104. Dosinga
105. Jaideb durga
106. Dhamara
107. Nuagan
108. Gobindpur
109. Rampur
110. Saraswati
111. Kumarchatak
112. Sakarpur
113. Taladapa

3. KENDRAPARA

114. Badalpal
115. Badhi
116. Barakandha
117. Bathighar
118. Bijoyanagar
119. Chandiapalli
120. Hariabanka
121. Jamboo
122. Kajal patia
123. Kantilo
124. Kendarapatia
125. Kentia
126. Khadianta
127. Kharinasi
128. Kholanai
129. Kochila
130. Panchagochhia
131. Rajendranagar
132. Ram nagar
133. Ratpanga
134. Sahabajipur
135. Saharakani
136. Sugal
137. Suniti
138. Narayanpur
139. Amarabati
140. Ananta keshori
141. Baghua
142. Balungapatia
143. Banipal
144. Baradia
145. Barhapur
146. Bhanja prasad
147. Bhatpara
148. Garta
149. Koilipur
150. Prabhati
151. Rajendranagar
152. Rajeshwari-nagar
153. Sundripal
154. Talchua

4. JAGATSINGHPUR

155. Balip tana
156. Bandar
157. Dandabedi
158. Dekani
159. Dhanuhar belari
160. Fulabelari
161. Ichhapur
162. Marichpur
163. Naharana
164. Rahana
165. Ambiki
166. Badabelari
167. Garia
168. Siali
169. Fatepur
170. Taladanda

5. PURI

171. Alasahi
172. Anakana
173. Balabhadrapur
174. Balidia
175. Dalukani
176. Haripur
177. Kaliakana
178. Kanamana
179. Madhupur
180. Nagar
181. Natara
182. Patasundarpur
183. Shan
184. Sudikeswar
185. Arakhakuda
186. Balipantal
187. Nuagarh
188. Banbarada
189. Chandrabhaga
190. Kirisahi
191. Ramalanka noliapatna
192. Sana patna
193. Balinoliasahi
194. Nuasahi
195. Sribantpur

6. GANJAM
196. Baxipalli
197. Deegipur
198. Golabandha
199. Gopalpur
200. Venkatraipur
201. Bada arjipalli
202. Bandar
203. Sana arjipalli
204. Gokurkuda
205. Kalarabadi
206. Kontiogada
207. Prayagi
208. Anantraipur
209. Dayanidhipentho
210. Garampeta
211. Markondi
212. Pati sunapur
213. Ramayapatna
214. Sunapur

VIII: Name of sampled villages in West Bengal

SOUTH 24 PARGANAS

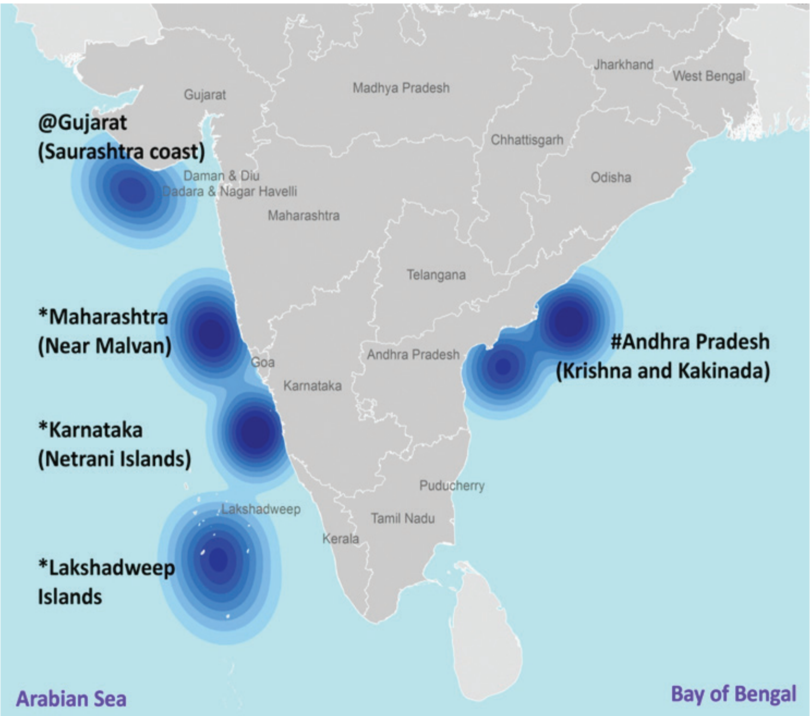
1. Laxmi Janardanpur
2. Burul
3. Diamond Harbour Municipality
4. Falta
5. Mallikpur
6. Fraser Ganj
7. Mousuni
8. Chuprijhara
9. Malgora
10. Kakdwip
11. Sri sri Ramakrishna
12. Swami Vivekananda
13. Kulpi
14. Belpukur
15. Karanjali
16. Kakan Dighi
17. Nagendrapur
18. Nandakumarpur
19. Banashyam Nagar
20. Digambarpur
21. G.Plot
22. Heramba Gopalpur
23. Patharpratima
24. Sagar
25. Dhablat
26. Ghoramara
27. Muriganga
28. Ramkar Char
29. Raidighi
30. Sridhar Nagar
31. Dakshinganga
32. Lothian Island
33. Purna Chandrapur
34. Achintyanagar
35. Ramganga

2. PURBA MEDINIPUR

1. Gurugram
2. Majilapur
3. Basantia
4. Dariapur
5. Lauda
6. Chhatri
7. Egra
8. Dubda
9. Paniparul
10. Haldia
11. Baruttar Hingli
12. Debhog
13. Khejuri
14. Birbandar
15. Kamrada
16. Lakashi
17. Tikashi
18. Khajuri
19. Betkundu
20. Lakshya
21. Natsal

22. Haripur
23. Kalicharanpur
24. Kendamari
25. Samsabad
26. Sonachura
27. Amdabad
28. Brajalalchak
29. Dibakar Pur
30. Junput
31. Digha
32. Nandigram
33. Shankarpur
34. Mandarmani
35. Mug beria

IX: Geographic locations where Whale Sharks are believed to aggregate (blue gradient) in Indian waters based on interactions with fishers.



@Study conducted with the support of TCL and GFD

*Study conducted with the support of IUCN-MFF

Study conducted with the support of EGREE Foundation

X : common names of crafts and gears used along Odisha and West Bengal Coast

CRAFTS	
Kattumaram (Teppa/ Theppa)	Chotta teppa, Medium Teppa, Beda Teppa, Padava
Fibre	Chotta fibre, Bada fibre
Plankbuilt Boats	Dingy/ Oula donga/ Choat/ Danga/ Dhinghy/ Nava/ Pandhva/ Patia/ Sabado/ Salti
Bhut- Bhuti/ 1-Cylindrer Gill Netter	2-Cylindrer Gill Netter, 6-Cylindrer Gill Netter
Trawler	Bachari/ Chot/ Dingy/ Patin/ Poukhia/ Salti

GEARS	
Shore Seines	Bada jaal, Gado jaal, Sarini jaal/ Sarini jaal/ Ber jaal/ Ghanal jaal
Boat Seines	Irragali jaal/ Iraga Jalo
Gill Nets	Kabala jaal, Jaga jaal, Ghagra jaal, Ilish jaal, Chandi jaal, Bettis/ Menjiram jaal, Bahal jaal, Bhetki jaal, Bhasani jaal, Bharang jaal
Trammel Nets	Disco jaal, Polasana jalo, Pandu jaal
Ring Nets	Ring jaal
Lift Nets	Marala jaal
Bag Nets/ Stake Nets/ Drift Nets	Behundi jaal/ Behandi jalo, Bhasa behundi/ Bhasni jalo, Kachal/ Kiel jal/Mal jal, Panchkati khui jaal, Panchkatti ber jaal, Lohi jaal, Ilidhi Jalo, Juga wala, Kattala, Phasi jalo, Nagkunda jalo
Tidal Wall Nets	Bheet jaal/ Bedha jalo/ Malo jalo
Encircling Net	Jungal jaal, Gheri jalo, Khia badio jalo, Sabado jalo
	Don/ Kanta, Burdu, Jamu thadu, Sorrah thadu
Hooks & Lines	
Misllaneous Gears	Koni jaal, Bada jaal, Sana jaal, Katu jaal, Kanbudda jaal, Chingudi jaal, Guduli jaal, Seraag jaal, Fand jaal, Gado jaal, Chanara jaal, Pamphlet jaal, Vekti jaal, Sabla jaal, Binjra jaal, Dahal jaal, Kangurda jaal, Moti jaal, Atala jaal, Laden jaal, Sarian jaal, Binti jaal, Phinga jaal, High pin jaal, Patia jaal, Hurahuri jaal, Kantia jaal, Sarian jaal, Kathatiari jaal, Palia jaal,Bhaunri jaal, Irrigal jaal, Suti jaal.

Appendix XI: Glimpses of marine megafauna survey along the Odisha and West Bengal coast during 2016-17

APPENDIX - 5

I. Region-wise list of landing centres surveyed during the Whale Shark historical occurrence survey along the Gujarat coast

REGION	LANDING CENTERS SURVEYED	
Region – I	1.	Salaya
	2.	Sikka
	3.	Bedi
	4.	Tuna
	5.	Badreswar
	6.	Mundra
	7.	Mandvi
	8.	Jakau

REGION	LANDING CENTERS SURVEYED	
Region – I	9.	Rupen
	10.	Okha
	11.	Muldwaraka
	12.	Damlej
	13.	Veraval
	14.	Jaleswar
	15.	Sutrapada
	16.	Hirakot
	17.	Phera
	18.	Mahuva
	19.	Vanakbara
	20.	Goghla
	21.	Jafrabad
	22.	Mangrol
	23.	Madhavpur
	24.	Porbander
	25.	Dahej
	26.	Nargol
	27.	Hajira
	28.	Umarsadi
	29.	Ojhal
	30.	Ubhrat
	31.	Dumas

II DNA sequence of Whale Shark in Gujarat water

Rty 2 CR - mtDNA control region sequence information generated from sample Rty-2 (1397 bp)

TTGGCTCCCAAAGCCAAGATTCTTCCCAAACTGCCCCCTGAGG-
CATCATGCAAATT GCATGGTTTTATGTACGTCAGTATGACATAT-
TAATGATTCAGCCCACATTCCTTA ATATACCACATATGACT-
TACTTTTCTATATCAACTCTAATATACTTTCCACAGGTATATA
CATACTATGTTTAATACTCATTAATTTACTTGCCACTATATTATTACATTATATGAT
TAATCCACATTTCTATAACATATTAGACTTTCCTCAACTAGATATTATTTTCGTAAT
TAATGTACGTCAGTATGACATATTAATGATTCGGCCCACATTCCTTAATATACCA
CATATGACTTACTTTTCTATATCAACTCTAATATACTTTCCACAGGTATATACATAC
TATGCTTAATACTCATTAATTTACTTGCCACTATATTATTACATTATATGATTAATC
CACATTTCTATAACATATTAGACTTTCCTCAACTAGATATTATTTTCGTAATTATTAT
GCAGGTTTGTAAAAACCTGCATTAATCCATTTAAGTACTAATATTACTGCTATAT
CATCTATAATTGATTTAAACTGACATTTGATTACTGCTTAAATTCATTTGGTTCTTA
ATCGTATCAATCATGAATTCACTCTAGTTCCCTTATATTGACATACAGTTCTTAATC
GTATCAATCATGAATTTACTCTAGTTCCCTTATATTGACATACAGTTCTTAATCGTCT
CAGAATTTATTTTCCTCCCAGATTTTTTAGTTTCGGCTTGAAGCTCCGACACCTGC-
CCCGGGAAGGCTGAAACCAGGAACAATAAATATTAAGTTAGAACTTTCCACTCGA
CATCTGCCGTCAATAATCCTCACTACTGCTCATTCGTGGGAAATAGATTGTCAAGT
TACCATAACTGAAAGAGATAATAATAATGGAACCATTAAATGACAACAGTATTGAT
TAATCCAACAATAATTGAAGAGATACATACAAGATTAATCAACAACTTAGGAGATA
AATATTATTTATGAATGTAAAAAACATACCATTATTTAGCACATTCTTGCTTAGTCG
GACATACAAGTATTATATATATACCCCCCTCCTTCACAAAAAAAAAACGACAAAATA
AAAAAAAATTTTTTCCGTAAAAACCCCCCCTCCCCCCTAAATATACAAGGACACCTC
GAAAAACCCCAAAAACGAGGGCCGTGCGTATATTTATTCTAAAACCATGCATA
ATTTTTCACTATACATTGTTACACAATATGATGCTAGTGTAGCTTAATTTAAAG-
TATAG CACTGAAAATGCTAAGATGAAAAATAATATTTTTCCGCAAGCAT-
GAAAGGTTTG-
GTCCTAGCCTTAGTGTTAATTGTAACCAAAATTATACATGC

Rty 3CR - mtDNA control region sequence information generated from sample Rty-3 (1404 bp)

TTGGCTCCCAAAGCCAAGATTCTTCCCAAACTGCCCCCTGAGG-
CATCATGCAAATT GCATGGTTTTATGTACGTCAGTATGACATAT-
TAATGATTCAGCCCACATTCCTTA ATATACCACATATGACT-
TACTTTTCTATATCAACTCTAATATACTTTCCACAGGTATATA
CATACTATGTTTAATACTCATTAATTTACTTGCCACTATATTATTACATTATATGATTA
ATCCACATTTCTATAACATATTAGACTTTCCTCAACTAGATATTATTTTCGTAATTAG
TATGACATATTAATGATTCAGCCCACATTCCTTAATATACCACATATGACTTACTTTTC
TATATCAACTCTAATATACTTTCCATAGGTATATACATACTATGTTTAATACTCATTAAT
TACTTGCCACTATATTATTACATTATATGATTAATCCACATTATATGATCTTCCACATTTC
TATAACATATTAGACTTTCCTCAACTAGATATTATTTTCGTAATTATTATGCAGGTTTGTA
AAATCCTGCATTAATCCATTTAAGTACTAATATTACTGCTATATCATCTATAATTGATTTA
AACTGACATTTGATTACTGCTTAAATTCATTTGGTTCTTAATCGTATCAATCATGAAT
TACTCTAGTTCCCTTATATTGACATACAGTTCTTAATCGTATCAATCATGAATTTACTC
TAGTTCCCTTATATTGACATACAGTTCTTAATCGTCTCAGAATTTATTTTCCTCCCA
GATTTTTTAGTTTCGGCTTGAAGCTCCGACACCTGCCCCGGGAAGGCTGAAACCAG
GAACAATAAATATTAAGTTAGAACTTTCCACTCGACATCTGCCGTCAATAATCCT
CACTACTGCTCATTCGTGGGAAATAGATTGTCAAGTTTACCATAACTGAAAGA
GATAATAATAATGGAACCATTAAATGACAACAGTATTGATTAATCCAACAATAATT
GAAGAGATACATACAAGATTAATCAACAACTTAGGAGATAAATATTATTTATGAAT
GTAAAAAACATACCATTATTTAGCACATTCTTGCTTAGTCGGACATACAAGTATTG
TATATATACCCCCCTCCTTCACAAAAAAAAAACGACAAAATAAAAAAAAATTTTTTCC
GTAAAAACCCCCCCTCCCCCCTAAATATACAAGGACACCTCGAAAAACCCCAAAAAC
GAGGGCCGTGCGTATATTTATTCTAAAACCATGCATAATTTTTCACTATG-
CATTGTTA CACAATATGATGCTAGTGTAGCTTAATTTAAAGTATAGCACT-
GAAAATGCTAAGAT GAAAAATAATATTTTTCCGCAAGCATGAAAGGTTTG-
GTCCTAGCCTTGGTGTTAATTG-
TAACCAAAATTATACATGC

III. Showing Whale Sharks rescued under self-documentation scheme (2005-2025)

SR. No.	Date	Place	Sex	Length (feet)
1	12.16.2005	Veraval	Male	38
2	3.12.2006	Sutrapada	Male	32
3	2.19.2007	Sutrapada	NA	NA
4	2.28.2007	Veraval	NA	35
5	3.7.2007	Sutrapada	Female	40
6	3.25.2007	Diu	Female	40
7	3.26.2007	Dhamlej	NA	NA
8	4.6.2007	Veraval	Male	26
9	4.12.2007	Veraval	Female	32
10	4.16.2007	Veraval	Female	18
11	4.26.2007	Veraval	Male	27
12	5.7.2007	Veraval	Male	18
13	5.22.2007	Veraval	Female	16
14	5.23.2007	Veraval	Female	27
15	5.23.2007	Muldwarka	Female	14
16	5.24.2007	Veraval	Female	32
17	5.29.2007	Sutrapada	Female	33
18	5.31.2007	Veraval	Female	18
19	6.1.2007	Veraval	NA	NA
20	9.17.2007	Veraval	Male	15
21	9.19.2007	Veraval	Male	15
22	10.7.2007	Sutrapada	Male	14
23	10.8.2007	Veraval	Female	20
24	10.8.2007	Veraval	Female	30
25	10.9.2007	Veraval	Male	30
26	10.10.2007	Veraval	Female	15

SR. No.	Date	Place	Sex	Length (feet)
27	10.10.2007	Veraval	Female	15
28	10.10.2007	Veraval	Male	35
29	10.12.2007	Veraval	Male	20
30	10.13.2007	Veraval	Male	37
31	10.14.2007	Dhamlej	Female	30
32	10.17.2007	Veraval	Male	20
33	10.17.2007	Veraval	Female	25
34	10.30.2007	Veraval	Male	15
35	10.17.2007	Veraval	Female	25
36	10.31.2007	Veraval	Male	15
37	11.13.2007	Veraval	Female	20
38	12.23.2007	Veraval	Male	20
39	12.23.2007	Veraval	Female	15
40	1.5.2008	Muldwarka	Female	21
41	1.10.2008	Dhamlej	Female	35
42	1.17.2008	Sutrapada	Female	NA
43	1.23.2008	Veraval	Female	NA
44	1.25.2008	Veraval	Female	NA
45	2.26.2008	Veraval	Male	20
46	3.10.2008	Dhamlej	Female	15
47	4.11.2008	Veraval (Bhidiya)	Female	15
48	4.12.2008	Veraval	Female	35
49	4.12.2008	Veraval	Male	30
50	4.13.2008	Veraval	Male	25
51	4.19.2008	Veraval	Male	15
52	4.19.2008	Veraval	Female	25
53	4.22.2008	Veraval	Male	17
54	4.22.2008	Veraval	Male	24
55	4.22.2008	Mangrol	Female	30

SR. No.	Date	Place	Sex	Length (feet)
56	4.25.2008	Mangrol	Female	25
57	5.6.2008	Veraval	Male	22
58	5.7.2008	Veraval	Male	18
59	5.8.2008	Veraval	Male	20
60	5.9.2008	Veraval	Male	18
61	5.23.2008	Dhamlej	Female	30
62	5.29.2008	Veraval	Male	20
63	6.1.2008	Veraval	Female	20
64	6.2.2008	Veraval	Female	20
65	6.2.2008	Veraval	Male	18
66	6.4.2008	Veraval	Male	30
67	8.20.2008	Veraval	Male	12
68	9.4.2008	Sutrapada	Female	25
69	9.7.2008	Sutrapada	Female	26
70	9.8.2008	Sutrapada	Male	24
71	9.8.2008	Sutrapada	Female	34
72	9.24.2008	Sutrapada	Female	28
73	9.24.2008	Dhamlej	Female	18
74	9.26.2008	Sutrapada	Female	18
75	9.26.2008	Sutrapada	Male	20
76	9.27.2008	Veraval	Male	22
77	9.27.2008	Veraval	Female	30
78	10.1.2008	Sutrapada	Female	18
79	10.1.2008	Dhamlej	Female	15
80	10.3.2008	Dhamlej	Female	15
81	10.4.2008	Sutrapada	Female	30
82	10.4.2008	Sutrapada	Male	15
83	10.8.2008	Dhamlej	Female	16
84	10.8.2008	Dhamlej	Male	15

SR. No.	Date	Place	Sex	Length (feet)
85	10.12.2008	Dhamlej	Female	32
86	10.14.2008	Sutrapada	Female	26
87	10.25.2008	Sutrapada	Male	15
88	11.1.2008	Veraval	Female	18
89	11.3.2008	Veraval (Bhidiya)	Female	20
90	11.7.2008	Veraval	Female	17
91	11.7.2008	Dhamlej	Male	30
92	11.8.2008	Dhamlej	Female	24
93	11.12.2008	Veraval	Male	17
94	11.21.2008	Sutrapada	Female	20
95	12.6.2008	Sutrapada	Female	28
96	12.6.2008	Sutrapada	Female	34
97	12.6.2008	Sutrapada	Male	22
98	12.6.2008	Dhamlej	Female	30
99	12.7.2008	Dhamlej	Female	20
100	12.7.2008	Dhamlej	Female	30
101	12.7.2008	Veraval	Male	20
102	12.7.2008	Veraval	Male	25
103	12.8.2008	Sutrapada	Female	20
104	12.11.2008	Sutrapada	Female	22
105	12.11.2008	Sutrapada	Female	20
106	12.11.2008	Sutrapada	Female	18
107	12.15.2008	Sutrapada	Female	18
108	12.16.2008	Veraval	Female	20
109	12.16.2008	Veraval	Male	25
110	12.20.2008	Veraval	Female	12
111	12.20.2008	Sutrapada	Female	18
112	12.23.2008	Sutrapada	Male	32
113	12.25.2008	Sutrapada	Male	24

SR. No.	Date	Place	Sex	Length (feet)
114	12.26.2008	Veraval	Male	25
115	12.27.2008	Sutrapada (Hirakot)	Male	22
116	1.2.2009	Veraval	Female	12
117	1.3.2009	Veraval	Male	15
118	1.4.2009	Veraval	Female	20
119	1.5.2009	Sutrapada	Male	24
120	1.5.2009	Sutrapada	Female	15
121	1.5.2009	Muldwarka	Female	22
122	1.5.2009	Dhamlej	Male	20
123	1.12.2009	Sutrapada	Female	18
124	1.12.2009	Veraval	Female	12
125	1.13.2009	Veraval	Male	14
126	1.15.2009	Dhamlej	Female	25
127	1.15.2009	Veraval	Male	22
128	1.15.2009	Veraval	Female	25
129	1.15.2009	Sutrapada	Female	12
130	1.16.2009	Sutrapada	Male	22
131	1.16.2009	Sutrapada	Female	20
132	1.22.2009	Sutrapada	Female	15
133	1.23.2009	Veraval	Male	20
134	1.23.2009	Veraval	Female	22
135	1.24.2009	Veraval	Female	20
136	1.24.2009	Veraval	Female	30
137	1.26.2009	Veraval	Female	20
138	1.27.2009	Veraval	Female	15
139	1.27.2009	Veraval	Male	21
140	1.27.2009	Veraval	Female	22
141	1.30.2009	Sutrapada	Female	12
142	2.1.2009	Sutrapada	Male	18

SR. No.	Date	Place	Sex	Length (feet)
143	2.2.2009	Veraval	Female	25
144	2.4.2009	Veraval	Female	25
145	2.6.2009	Sutrapada	Female	20
146	2.7.2009	Sutrapada (Hirakot)	Female	25
147	2.7.2009	Veraval	Female	20
148	2.9.2009	Veraval	Female	20
149	2.9.2009	Veraval	Male	30
150	2.28.2009	Veraval	Female	24
151	2.28.2009	Veraval	Male	18
152	3.9.2009	Veraval	Female	20
153	3.19.2009	Sutrapada (Hirakot)	Male	15
154	3.20.2009	Veraval	Female	30
155	3.23.2009	Muldwarka	Female	19
156	4.2.2009	Veraval (Bhidiya)	Male	24
157	4.6.2009	Veraval	Male	18
158	4.6.2009	Veraval	Female	17
159	4.8.2009	Veraval	Female	19
160	4.8.2009	Sutrapada (Hirakot)	Male	18
161	4.9.2009	Veraval (Bhidiya)	Male	23
162	4.11.2009	Veraval	Female	18
163	4.12.2009	Veraval	Female	26
164	4.12.2009	Veraval	Female	23
165	4.12.2009	Veraval	Male	25
166	4.12.2009	Veraval	Female	27
167	4.15.2009	Veraval	Male	25
168	4.19.2009	Veraval	Male	21
169	4.29.2009	Sutrapada	Female	30
170	4.29.2009	Muldwarka	Female	28
171	4.29.2009	Muldwarka	Female	29

SR. No.	Date	Place	Sex	Length (feet)
172	3.22.2009	Dhamlej	Female	32
173	4.30.2009	Dhamlej	Female	15
174	5.1.2009	Veraval	Male	19
175	5.1.2009	Dhamlej	Male	20
176	5.3.2009	Veraval	Female	25
177	5.3.2009	Veraval	Male	22
178	5.3.2009	Veraval	Male	20
179	5.6.2009	Dhamlej	Female	22
180	5.9.2009	Veraval	Male	21
181	5.9.2009	Veraval	Female	30
182	5.9.2009	Muldwarka	Female	19
183	5.10.2009	Mangrol (Chorwad)	Male	30
184	5.17.2009	Muldwarka	Female	25
185	5.18.2009	Veraval	Male	20
186	5.20.2009	Veraval (Bhidiya)	Male	16
187	11.23.2009	Sutrapada	Male	20
188	12.23.2009	Muldwarka	Female	22
189	12.1.2009	Sutrapada	Male	20
190	12.4.2009	Dhamlej	Female	20
191	12.22.2009	Veraval	Male	22
192	12.26.2009	Veraval	Female	21
193	12.26.2009	Veraval	Female	20
194	12.30.2009	Mangrol (Chorwad)	Male	20
195	1.3.2010	Veraval	Male	23
196	1.4.2010	Veraval	Female	20
197	1.4.2010	Sutrapada	Male	23
198	1.9.2010	Veraval	Female	15
199	1.11.2010	Veraval	Female	18
200	1.12.2010	Veraval	Male	15
201	1.12.2010	Veraval	Male	20

SR. No.	Date	Place	Sex	Length (feet)
202	1.12.2010	Mangrol	Female	22
203	1.13.2010	Veraval	Female	18
204	1.21.2010	Veraval	Female	19
205	1.24.2010	Veraval	Female	17
206	1.28.2010	Mangrol	Female	22
207	2.17.2010	Veraval	Male	21
208	3.21.2010	Veraval	Male	15
209	3.30.2010	Veraval	Female	18
210	3.31.2010	Veraval	Female	22
211	4.4.2010	Veraval	Female	20
212	4.5.2010	Veraval	Male	16
213	4.5.2010	Muldwarka	Male	30
214	4.12.2010	Veraval	Male	22
215	4.13.2010	Muldwarka (Madhvad)	Male	17
216	5.9.2010	Mangrol	Female	20
217	5.9.2010	Veraval	Female	21
218	5.10.2010	Veraval	Female	16
219	5.11.2010	Veraval	Male	22
220	5.11.2010	Veraval	Female	24
221	9.22.2010	Veraval	Female	20
222	9.25.2010	Veraval	Female	20
223	10.1.2010	Muldwarka	Male	19
224	10.2.2010	Muldwarka	Male	21
225	10.3.2010	Dhamlej	Female	22
226	10.9.2010	Veraval	Female	19
227	10.10.2010	Mangrol	Female	17
228	10.12.2010	Muldwarka	Male	30
229	10.12.2010	Sutrapada	Male	15
230	10.13.2010	Veraval	Female	20

SR. No.	Date	Place	Sex	Length (feet)
231	10.14.2010	Veraval	Female	18
232	10.20.2010	Veraval	Female	14
233	11.8.2020	Dhamlej	Female	25
234	10.20.2010	Mangrol	Female	23
235	11.8.2010	Dhamlej	Female	25
236	11.14.2010	Dhamlej	Female	23
237	11.28.2010	Dhamlej	Female	22
238	11.29.2010	Sutrapada	Female	15
239	11.29.2010	Dhamlej	Female	45
240	11.30.2010	Sutrapada	Female	15
241	11.30.2010	Sutrapada	Female	25
242	11.30.2010	Sutrapada	Male	35
243	11.30.2010	Sutrapada	Male	23
244	12.2.2010	Sutrapada	Female	13
245	12.2.2010	Veraval	Male	17
246	12.3.2010	Sutrapada	Male	15
247	12.4.2010	Dhamlej	Female	20
248	12.4.2010	Dhamlej	Male	22
249	12.5.2010	Sutrapada	Female	14
250	12.5.2010	Dhamlej	Female	20
251	12.12.2010	Veraval	Male	16
252	12.13.2010	Sutrapada	Male	15
253	12.13.2010	Sutrapada	Male	25
254	12.13.2010	Sutrapada	Female	22
255	12.13.2010	Sutrapada	Female	18
256	12.15.2010	Sutrapada	Female	40
257	12.16.2010	Sutrapada	Female	22
258	12.14.2010	Sutrapada	Female	30
259	12.25.2010	Sutrapada	Female	25
260	12.26.2010	Sutrapada	Male	25

SR. No.	Date	Place	Sex	Length (feet)
261	12.27.2010	Veraval	Female	22
262	12.28.2010	Sutrapada	Female	25
263	1.5.2011	Sutrapada	Female	25
264	1.7.2011	Dhamlej	Male	23
265	1.11.2011	Veraval	Female	24
266	1.15.2011	Dhamlej	Male	22
267	1.18.2011	Sutrapada	Female	30
268	1.28.2011	Sutrapada	Male	20
269	3.5.2011	Veraval	Female	19
270	3.8.2011	Sutrapada	Female	32
271	3.9.2011	Sutrapada	Male	22
272	3.9.2011	Sutrapada	Female	30
273	3.10.2011	Mangrol	Female	21
274	3.10.2011	Veraval	Female	21
275	3.12.2011	Veraval	Female	25
276	3.13.2011	Sutrapada	Male	20
277	4.1.2011	Sutrapada	Female	20
278	4.11.2011	Veraval	Female	20
279	4.15.2011	Sutrapada	Female	18
280	5.17.2011	Sutrapada	Female	12
281	9.19.2011	Veraval	Female	15
282	9.22.2011	Sutrapada	Female	25
283	9.24.2011	Sutrapada	Female	20
284	9.29.2011	Sutrapada	Female	18
285	9.29.2011	Dhamlej	Female	25
286	9.29.2011	Dhamlej	Male	22
287	9.30.2011	Dhamlej	Female	20
288	10.2.2011	Dhamlej	Female	30
289	10.3.2011	Sutrapada	Male	18
290	10.3.2011	Dhamlej	Female	25

SR. No.	Date	Place	Sex	Length (feet)
291	10.4.2011	Dhamlej	Female	28
292	10.12.2011	Sutrapada	Female	27
293	10.12.2011	Sutrapada	Female	23
294	10.11.2011	Sutrapada	Male	25
295	10.17.2011	Sutrapada	Female	15
296	11.2.2011	Veraval	Female	15
297	11.13.2011	Dhamlej	Female	22
298	11.15.2011	Dhamlej	Female	29
299	12.23.2011	Dhamlej	Female	22
300	12.25.2011	Sutrapada	Female	20
301	12.27.2011	Sutrapada	Female	25
302	12.28.2011	Veraval (Bhidiya)	Female	15
303	1.5.2012	Sutrapada	Female	25
304	1.13.2012	Veraval	Female	8
305	1.13.2012	Veraval	Male	15
306	1.21.2012	Sutrapada	Female	25
307	3.11.2012	Veraval	Female	15
308	4.3.2012	Veraval (Bhidiya)	Male	32
309	4.21.2012	Sutrapada	Male	20
310	5.3.2012	Veraval (Bhidiya)	Female	15
311	5.5.2012	Sutrapada	Female	40
312	10.2.2012	Veraval	NA	15
313	10.3.2012	Veraval	NA	30
314	10.5.2012	Sutrapada	NA	36
315	10.10.2012	Sutrapada	NA	15
316	10.14.2012	Sutrapada	NA	12
317	10.16.2012	Sutrapada	NA	15
318	10.20.2012	Dhamlej	Female	30
319	10.21.2012	Sutrapada	Female	25
320	10.22.2012	Dhamlej	Male	20

SR. No.	Date	Place	Sex	Length (feet)
321	10.22.2012	Dhamlej	Male	30
322	10.24.2012	Sutrapada	Female	18
323	10.27.2012	Dhamlej	NA	25
324	10.29.2012	Dhamlej	Male	28
325	10.31.2012	Sutrapada	Female	45
326	11.5.2012	Veraval	NA	17
327	11.7.2012	Dhamlej	NA	25
328	11.7.2012	Veraval	NA	25
329	11.8.2012	Sutrapada	Female	35
330	11.8.2012	Sutrapada	Female	25
331	11.9.2012	Sutrapada	Female	30
332	11.12.2012	Veraval	NA	20
333	11.12.2012	Veraval	NA	25
334	11.12.2012	Sutrapada	Female	30
335	11.13.2012	Sutrapada	Female	35
336	11.19.2012	Sutrapada	Male	18
337	11.20.2012	Sutrapada	Female	25
338	11.20.2012	Sutrapada	Female	30
339	11.21.2012	Veraval	NA	15
340	11.21.2012	Sutrapada	Female	20
341	11.21.2012	Sutrapada	NA	33
342	11.22.2012	Sutrapada	NA	18
343	11.23.2012	Veraval	NA	20
344	11.30.2012	Sutrapada	NA	35
345	12.6.2012	Sutrapada	Female	30
346	12.6.2012	Sutrapada	NA	25
347	12.6.2012	Sutrapada	Female	26
348	12.7.2012	Sutrapada	Female	35
349	12.8.2012	Sutrapada	NA	25
350	12.12.2012	Sutrapada	NA	30

SR. No.	Date	Place	Sex	Length (feet)
351	12.17.2012	Sutrapada	Female	20
352	12.19.2012	Dhamlej	Male	27
353	12.19.2012	Dhamlej	Female	30
354	12.20.2012	Dhamlej	NA	30
355	12.20.2012	Sutrapada	NA	35
356	12.20.2012	Sutrapada	NA	35
357	12.22.2012	Dhamlej	Male	30
358	12.22.2012	Dhamlej	Female	30
359	12.24.2012	Sutrapada	Female	10
360	12.25.2012	Sutrapada	NA	30
361	12.30.2012	Veraval (Bhidiya)	Female	20
362	1.12.2013	Veraval	NA	30
363	2.26.2013	Veraval	NA	30
364	3.6.2013	Sutrapada	Female	35
365	3.10.2013	Sutrapada	Female	25
366	3.14.2013	Sutrapada	Female	30
367	3.19.2013	Veraval	NA	24
368	3.20.2013	Veraval	NA	25
369	3.24.2013	Veraval	Female	20
370	3.25.2013	Dhamlej	Female	24
371	4.17.2013	Veraval	NA	25
372	5.5.2013	Veraval	Female	12
373	5.6.2013	Sutrapada	NA	20
374	5.7.2013	Veraval	NA	15
375	5.28.2013	Veraval	NA	15
376	9.3.2013	Sutrapada	Male	10
377	9.4.2013	Sutrapada	Male	20
378	9.12.2013	Veraval	NA	25
379	9.12.2013	Veraval	NA	22
380	9.13.2013	Veraval	NA	25

SR. No.	Date	Place	Sex	Length (feet)
381	9.16.2013	Sutrapada	NA	33
382	10.11.2013	Veraval	NA	32
383	10.12.2013	Sutrapada (Vadodara Zala)	Female	30
384	10.13.2013	Dhamlej	Female	25
385	10.14.2013	Veraval	NA	18
386	10.16.2013	Sutrapada	Female	26
387	10.20.2013	Veraval	NA	15
388	11.6.2013	Veraval	NA	28
389	11.12.2013	Sutrapada	NA	25
390	11.16.2013	Veraval	Female	20
391	11.22.2013	Veraval	NA	22
392	11.25.2013	Sutrapada	Male	30
393	11.26.2013	Sutrapada	Male	36
394	11.27.2013	Sutrapada	Female	25
395	12.5.2013	Veraval	NA	24
396	12.15.2013	Sutrapada	Female	28
397	12.16.2013	Sutrapada	Female	20
398	12.18.2013	Sutrapada	NA	30
399	12.20.2013	Sutrapada	Female	32
400	12.21.2013	Sutrapada	NA	25
401	12.21.2013	Chorwad	Female	37
402	12.22.2013	Dhamlej	Female	35
403	12.22.2013	Dhamlej	NA	25
404	12.25.2013	Dhamlej	Female	25
405	12.25.2013	Dhamlej	NA	22
406	12.27.2013	Sutrapada	Female	18
407	12.30.2013	Dhamlej	Female	20
408	1.1.2014	Sutrapada	Female	30
409	1.3.2014	Sutrapada	Male	38

SR. No.	Date	Place	Sex	Length (feet)
410	1.8.2014	Sutrapada	NA	40
411	1.23.2014	Veraval	Female	32
412	2.3.2014	Sutrapada	NA	27
413	2.3.2014	Sutrapada	NA	32
414	2.27.2014	Dhamlej	NA	25
415	2.27.2014	Sutrapada	NA	15
416	3.1.2014	Dhamlej	NA	18
417	3.10.2014	Sutrapada	NA	30
418	3.10.2014	Sutrapada	NA	20
419	3.11.2014	Sutrapada	Male	25
420	3.15.2014	Sutrapada	NA	30
421	3.27.2014	Sutrapada	NA	20
422	4.5.2014	Veraval (Bhidiya)	NA	25
423	4.13.2014	Veraval	Female	32
424	4.14.2014	Dhamlej	Female	30
425	4.18.2014	Sutrapada	NA	20
426	4.18.2014	Sutrapada	NA	25
427	5.13.2014	Sutrapada	Female	28
428	5.13.2014	Sutrapada	NA	20
429	5.27.2014	Sutrapada	Male	34
430	5.27.2014	Dhamlej	Female	30
431	5.29.2014	Sutrapada	NA	25
432	6.5.2014	Dhamlej	NA	25
433	9.1.2014	Dhamlej	NA	25
434	10.2.2014	Dhamlej	Female	35
435	10.12.2014	Sutrapada	NA	30
436	10.12.2014	Sutrapada	Female	20
437	10.15.2014	Veraval	NA	22
438	10.17.2014	Veraval	NA	35
439	10.19.2014	Sutrapada	Female	25

SR. No.	Date	Place	Sex	Length (feet)
440	10.21.2014	Sutrapada	Female	25
441	10.21.2014	Sutrapada	NA	30
442	10.22.2014	Sutrapada	NA	30
443	11.4.2014	Chorwad	NA	25
444	11.5.2014	Sutrapada	NA	28
445	11.5.2014	Veraval	NA	25
446	11.8.2014	Sutrapada	NA	30
447	11.8.2014	Sutrapada	NA	25
448	11.9.2014	Veraval	Female	26
449	11.13.2014	Veraval	NA	32
450	11.14.2014	Chorwad	Female	30
451	11.17.2014	Veraval	NA	20
452	11.17.2014	Veraval	NA	25
453	11.17.2014	Veraval	NA	16
454	11.23.2014	Veraval	NA	28
455	11.25.2014	Sutrapada	NA	20
456	11.25.2014	Sutrapada	NA	22
457	11.28.2014	Sutrapada	NA	28
458	12.2.2014	Sutrapada	NA	20
459	12.4.2014	Sutrapada	NA	28
460	12.4.2014	Sutrapada	NA	30
461	12.4.2014	Veraval	NA	32
462	12.4.2014	Veraval	NA	34
463	12.5.2014	Dhamlej	NA	30
464	12.6.2014	Sutrapada (Vadodara Zala)	NA	28
465	12.7.2014	Chorwad	Female	25
466	12.8.2014	Chorwad	Female	28
467	12.13.2014	Sutrapada	NA	30
468	12.13.2014	Sutrapada	NA	22

SR. No.	Date	Place	Sex	Length (feet)
469	12.16.2014	Sutrapada	NA	25
470	12.18.2014	Sutrapada	NA	25
471	12.23.2014	Sutrapada	Female	25
472	12.25.2014	Sutrapada	NA	25
473	12.27.2014	Sutrapada	Female	30
474	4.1.2015	Veraval	Female	30
475	6.1.2015	Sutrapada	Female	35
476	7.1.2015	Veraval	NA	25
477	12.1.2015	Veraval	Female	20
478	16.1.2015	Sutrapada	NA	25
479	20.1.2015	Sutrapada	Female	40
480	25.1.2015	Dhamlej	Female	35
481	1.2.2015	Veraval	NA	23
482	2.2.2015	Veraval	NA	23
483	3.2.2015	Veraval	NA	23
484	4.2.2015	Sutrapada	Male	30
485	9.2.2015	Sutrapada	NA	25
486	11.2.2015	Sutrapada	NA	30
487	13.3.2015	Sutrapada	Male	35
488	14.3.2015	Sutrapada	NA	30
489	17.3.2015	Sutrapada	Female	25
490	18.3.2015	Veraval	NA	24
491	20.3.2015	Sutrapada	NA	25
492	1.4.2015	Veraval	Female	30
493	1.4.2015	Mangrol	Female	30
494	1.4.2015	Hirakot	NA	28
495	1.4.2015	Sutrapada	Female	20
496	1.4.2015	Mangrol	Male	25
497	1.4.2015	Mangrol	Female	22
498	1.4.2015	Sutrapada	Female	20
499	1.4.2015	Hirakot	NA	25
500	1.4.2015	Sutrapada	Female	25
501	1.4.2015	Hirakot	NA	20

SR. No.	Date	Place	Sex	Length (feet)
502	1.4.2015	Sutrapada	NA	NA
503	1.4.2015	Jaleswar	NA	25
504	1.4.2015	Sutrapada	Female	22
505	1.4.2015	Sutrapada	NA	17
506	1.4.2015	Veraval	NA	20
507	1.4.2015	Veraval	NA	20
508	1.4.2015	Sutrapada	Female	25
509	1.4.2015	Sutrapada	Female	15
510	1.4.2015	Sutrapada	Female	35
511	1.4.2015	Sutrapada	Female	20
512	1.4.2015	Sutrapada	Male	20
513	1.4.2015	Veraval	NA	NA
514	1.4.2015	Mangrol	Male	25
515	1.4.2015	Sutrapada	Male	22
516	1.4.2015	Sutrapada	Male	15
517	1.4.2015	Sutrapada	Female	20
518	1.4.2015	Sutrapada	Male	18
519	1.4.2015	Sutrapada	Female	30
520	1.4.2015	Sutrapada	Male	25
521	1.4.2015	Sutrapada	Female	20
522	1.4.2015	Sutrapada	Female	35
523	1.4.2015	Chorwad	Female	30
524	1.4.2015	Sutrapada	NA	25
525	1.4.2015	Sutrapada	NA	20
526	1.4.2015	Sutrapada	NA	25
527	1.4.2015	Sutrapada	Male	18
528	1.4.2015	Sutrapada	Female	30
529	1.4.2015	Chorwad	Female	22
530	1.4.2015	Dhamlej	Female	33
531	1.4.2015	Sutrapada	NA	30
532	1.4.2015	Veraval	NA	18
533	1.4.2015	Veraval	NA	30
534	1.4.2015	Sutrapada	Female	30

SR. No.	Date	Place	Sex	Length (feet)
535	1.4.2015	Veraval	NA	30
536	1.4.2015	Mangrol	Male	33
537	1.4.2015	Veraval	NA	25
538	1.4.2015	Veraval	NA	25
539	1.4.2015	Sutrapada	Female	28
540	1.4.2015	Sutrapada	Male	20
541	1.4.2015	Sutrapada	Female	25
542	1.4.2015	Sutrapada	NA	25
543	1.4.2015	Sutrapada	Male	30
544	1.4.2015	Sutrapada	Female	18
545	1.4.2015	Sutrapada	Female	18
546	1.4.2015	Sutrapada	Male	25
547	1.4.2015	Mangrol	Male	32
548	1.4.2015	Veraval	NA	22
549	1.4.2015	Veraval	NA	30
550	1.4.2015	Mangrol	Female	36
551	1.4.2015	Sutrapada	NA	28
552	1.4.2015	Veraval	NA	32
553	1.4.2015	Mangrol	Female	36
554	1.4.2015	Sutrapada	NA	NA
555	1.4.2015	Sutrapada	NA	NA
556	1.4.2015	Dhamlej	NA	30
557	1.4.2015	Sutrapada	Female	30
558	1.4.2015	Sutrapada	Female	30
559	1.4.2015	Mangrol	Female	30
560	1.4.2015	Sutrapada	Female	25
561	1.4.2015	Veraval	NA	35
562	1.4.2015	Veraval	NA	36
563	1.4.2015	Jaleshwar	NA	25
564	1.4.2015	Jaleshwar	NA	32
565	1.4.2015	Mangrol	Male	28
566	1.4.2015	Sutrapada	Female	28
567	1.4.2015	Mangrol	Female	30

SR. No.	Date	Place	Sex	Length (feet)
568	1.4.2015	Veraval	NA	30
569	1.4.2015	Sutrapada	Female	32
570	1.4.2015	Sutrapada	Male	33
571	1.4.2015	Sutrapada	Female	35
572	1.4.2015	Veraval	NA	22
573	30.11.2015	Sutrapada	NA	22
574	1.4.2015	Sutrapada	NA	34
575	1.4.2015	Sutrapada	Female	23
576	1.4.2015	Sutrapada	Male	23
577	1.4.2015	Sutrapada	Female	22
578	1.4.2015	Dhamlej	Male	25
579	1.4.2015	Sutrapada	Female	22
580	1.4.2015	Sutrapada	Female	27
581	1.4.2015	Veraval	NA	26
582	1.4.2015	Sutrapada	NA	35
583	1.4.2015	Dhamlej	NA	30
584	1.4.2015	Sutrapada	NA	30
585	1.4.2015	Sutrapada	Male	22
586	1.4.2015	Chorvad	Female	22
587	1.4.2015	Chorvad	Female	30
588	1.4.2015	Sutrapada	Female	20
589	1.4.2015	Sutrapada	Female	30
590	1.4.2015	Sutrapada	Male	22
591	1.4.2015	Sutrapada	Male	25
592	1.4.2015	Sutrapada	NA	32
593	1.4.2015	Mangrol	Female	20
594	1.4.2015	Dhamlej	Male	23
595	1.4.2015	Sutrapada	Female	20
596	1.4.2015	Sutrapada	Female	25
597	1.4.2015	Veraval	NA	32
598	1.4.2015	Dhamlej	Male	32
599	1.4.2015	Veraval	NA	40
600	1.29.2016	Sutrapada	Male	36

SR. No.	Date	Place	Sex	Length (feet)
601	5.4.2016	Sutrapada	Male	24
602	10.4.2016	Mangrol	Female	26
603	13.4.2016	Veraval	NA	26
604	14.4.2016	Sutrapada	Female	30
605	14.4.2016	Mangrol	Female	18
606	14.4.2016	Mangrol	Female	20
607	18.4.2016	Mangrol	Female	22
608	20.4.2016	Sutrapada	Male	24
609	28.4.2016	Veraval	Female	40
610	1.5.2016	Sutrapada	Male	25
611	7.5.2016	Sutrapada	Female	32
612	11.5.2016	Veraval	NA	28
613	12.5.2016	Veraval	Male	24
614	16.5.2016	Veraval	Female	30
615	24.9.2016	Sutrapada	Female	20
616	24.9.2016	Sutrapada	Female	30
617	24.9.2016	Sutrapada	NA	20
618	25.9.2016	Sutrapada	Female	25
619	25.9.2016	Sutrapada	NA	20
620	1.10.2016	Sutrapada	Male	30
621	2.10.2016	Veraval	NA	25
622	2.10.2016	Sutrapada	Female	30
623	6.10.2016	Sutrapada	Female	32
624	6.10.2016	Sutrapada	Female	19
625	15.10.2016	Sutrapada	Female	30
626	15.10.2016	Sutrapada	Female	25
627	15.10.2016	Sutrapada	Male	25
628	17.10.2016	Sutrapada	Female	28
629	17.10.2016	Sutrapada	Male	30
630	20.10.2016	Sutrapada	Female	25
631	20.10.2016	Sutrapada	Female	20
632	22.10.2016	Mangrol	Female	30
633	26.10.2016	Mangrol	Female	10

SR. No.	Date	Place	Sex	Length (feet)
634	26.10.2016	Sutrapada	Female	30
635	4.11.2016	Mangrol	Female	20
636	8.11.2016	Veraval	NA	25
637	10.11.2016	Sutrapada	Female	30
638	18.11.2016	Veraval	NA	35
639	19.11.2016	Veraval	NA	36
640	21.11.2016	Veraval	NA	32
641	21.11.2016	Mangrol	Female	22
642	22.11.2016	Sutrapada	Female	28
643	22.11.2016	Sutrapada	Female	25
644	23.11.2016	Sutrapada	Female	20
645	23.11.2016	Sutrapada	Male	25
646	23.11.2016	Sutrapada	Male	20
647	24.11.2016	Mangrol	Female	20
648	27.11.2016	Mangrol	Female	15
649	28.11.2016	Sutrapada	Female	30
650	29.11.2016	Dhamlej	Female	32
651	30.11.2016	Sutrapada	Female	30
652	30.11.2016	Sutrapada	Male	32
653	30.11.2016	Mangrol	Female	25
654	2.12.2016	Mangrol	Female	22
655	3.12.2016	Veraval	NA	36
656	4.12.2016	Sutrapada	Male	36
657	5.12.2016	Veraval	NA	30
658	5.12.2016	Sutrapada	Male	30
659	5.12.2016	Sutrapada	Female	25
660	5.12.2016	Mangrol	Female	22
661	6.12.2016	Sutrapada	Female	32
662	8.12.2016	Mangrol	Female	30
663	9.12.2016	Sutrapada	Male	21
664	9.12.2016	Sutrapada	Female	32
665	9.12.2016	Sutrapada	Female	25

SR. No.	Date	Place	Sex	Length (feet)
666	12.12.2016	Veraval	NA	35
667	12.12.2016	Veraval	NA	30
668	17.12.2016	Sutrapada	Female	28
669	17.12.2016	Mangrol	Female	25
670	19.12.2016	Sutrapada	Female	20
671	19.12.2016	Sutrapada	Female	25
672	20.12.2016	Sutrapada	Male	25
673	22.12.2016	Sutrapada	Female	25
674	22.12.2016	Sutrapada	Male	30
675	22.12.2016	Sutrapada	Female	20
676	23.12.2016	Sutrapada	Female	20
677	23.12.2016	Sutrapada	Female	27
678	25.12.2016	Sutrapada	Female	30
679	25.12.2016	Veraval	NA	34
680	26.12.2016	Mangrol	Female	27
681	26.12.2016	Sutrapada	Female	30
682	30.12.2016	Sutrapada	Female	20
683	31.12.2016	Sutrapada	Male	27
684	15.1.2017	Sutrapada	Female	25
685	22.1.2017	Sutrapada	Female	32
686	22.1.2017	Sutrapada	Female	26
687	23.1.2017	Dhamlej	Male	32
688	25.1.2017	Mangrol	Female	27
689	27.1.2017	Sutrapada	Male	19
690	27.1.2017	Sutrapada	Female	32
691	30.1.2017	Sutrapada	Female	26
692	4.2.2017	Veraval	NA	38
693	27.2.2017	Dhamlej	Male	30
694	4.3.2017	Sutrapada	Male	32
695	8.3.2017	Veraval	NA	23
696	23.3.2017	Veraval	NA	30
697	13.4.2017	Veraval	NA	36

SR. No.	Date	Place	Sex	Length (feet)
698	18.4.2017	Sutrapada	Female	22
699	25.9.2017	Sutrapada	Female	26
700	9.10.2017	Mangrol	Female	30
701	14.10.2017	Veraval	NA	30
702	17.10.2017	Mangrol	Female	23
703	18.10.2017	Mangrol	Female	21
704	19.10.2017	Mangrol	Female	25
705	1.11.2017	Veraval	NA	30
706	3.11.2017	Veraval	NA	30
707	3.11.2017	Mangrol	Female	22
708	6.11.2017	Sutrapada	NA	22
709	7.11.2017	Sutrapada	Male	18
710	8.11.2017	Sutrapada	Male	18
711	10.11.2017	Sutrapada	Female	20
712	11.11.2017	Sutrapada	Female	24
713	12.11.2017	Sutrapada	Male	22
714	12.11.2017	Sutrapada	NA	21
715	13.11.2017	Sutrapada	Female	21
716	15.11.2017	Veraval	Male	35
717	15.11.2017	Veraval	Female	30
718	17.11.2017	Mangrol	Female	28
719	17.11.2017	Mangrol	Female	25
720	28.11.2017	Veraval	Male	13
721	21.12.2017	Mangrol	Female	21
722	19.2.2018	Veraval	NA	30
723	28.2.2018	Veraval	NA	22
724	23.3.2018	Sutrapada	Female	29
725	3.4.2018	Veraval	NA	35
726	4.4.2018	Veraval	NA	32
727	7.4.2018	Veraval	Male	25
728	7.4.2018	Veraval	NA	30
729	9.4.2018	Mangrol	Female	25

SR. No.	Date	Place	Sex	Length (feet)
730	13.4.2018	Veraval	NA	35
731	16.4.2018	Veraval	NA	15
732	26.4.2018	Veraval	Male	30
733	13.10.2018	mangrol	Female	26
734	17.10.2018	Dhamlej	NA	32
735	18.10.2018	Veraval	NA	35
736	20.10.2018	Veraval	NA	30
737	26.10.2018	Sutrapada	NA	30
738	28.10.2018	Veraval	NA	35
739	15.11.2018	Sutrapada	Male	30
740	21.12.2018	Mangrol	Female	17
741	21.12.2018	Veraval	NA	32
742	16.3.2019	Veraval	NA	30
743	18.3.2019	Veraval	NA	15
744	5.4.2019	Veraval	NA	32
745	11.4.2019	Veraval	NA	30
746	2.5.2019	Mangrol	Male	30
747	3.5.2019	Mangrol	Female	40
748	4.5.2019	Mangrol	Male	25
749	10.5.2019	Veraval	NA	32
750	17.05.2019	Veraval	NA	11
751	30.05.2019	Veraval	NA	25
752	2.6.2019	Veraval	NA	35
753	20.08.2019	Veraval	NA	40
754	19.11.2019	Mangrol	Male	24
755	21.11.2019	Dhamlej	NA	34
756	21.11.2019	Veraval	NA	26
757	24.11.2019	Mangrol	Female	22
758	25.11.2019	Mangrol	Male	20
759	25.11.2019	Mangrol	Female	25
760	25.11.2019	Veraval	NA	28
761	29.11.2019	Mangrol	Female	15
762	4.12.2019	Mangrol	Female	22

SR. No.	Date	Place	Sex	Length (feet)
763	4.12.2019	Mangrol	Male	25
764	6.12.2019	Veraval	NA	30
765	8.12.2019	Mangrol	Female	30
766	10.12.2019	Veraval	NA	26
767	11.12.2019	Mangrol	Female	18
768	11.12.2019	Veraval	NA	22
769	11.12.2019	Mangrol	Female	20
770	12.12.2019	Veraval	NA	36
771	16.12.2019	Mangrol	Male	15
772	18.12.2019	Veraval	NA	24
773	20.12.2019	Mangrol	NA	35
774	20.12.2019	Mangrol	NA	29
775	25.12.2019	Sutrapada	Female	28
776	26.12.2019	Veraval	NA	34
777	27.12.2019	Veraval	NA	24
778	30.12.2019	Veraval	NA	30
779	31.12.2019	Veraval	NA	25
780	1.4.2020	Veraval	NA	20
781	1.5.2020	Veraval	NA	38
782	1.6.2020	Veraval	NA	35
783	1.7.2020	Veraval	NA	29
784	1.8.2020	Veraval	NA	23
785	2.9.2020	Veraval	NA	26
786	29.02.2020	Mangrol	NA	26
787	2.3.2020	Mangrol	Male	20
788	3.20.2020	Veraval	NA	20
789	3.23.2020	Veraval	NA	15
790	3.23.2020	Veraval	NA	30
791	5.1.2020	Veraval	NA	32
792	5.15.2020	Veraval	NA	30
793	5.24.2020	Veraval	NA	32
794	5.25.2020	Veraval	NA	25
795	9.27.2020	Veraval	NA	22

SR. No.	Date	Place	Sex	Length (feet)
796	10.2.2020	Mangrol	Female	36
797	10.6.2020	Mangrol	Male	36
798	10.8.2020	Veraval	NA	30
799	11.26.2020	Veraval	Female	30
800	11.29.2020	Veraval	NA	30
801	12.9.2020	Veraval	Female	18
802	12.18.2020	Veraval	Female	18
803	12.21.2020	Veraval	Female	25
804	12.21.2020	Mangrol	Male	32
805	12.23.2020	Veraval	Female	22
806	12.23.2020	Veraval	Female	30
807	12.27.2020	Mangrol	Female	36
808	5.1.2020	Veraval	NA	28
809	1.12.2021	Mangrol	Male	32
810	1.15.2021	Mangrol	Female	36
811	2.4.2021	Jaleswar	Female	NA
812	2.11.2021	Veraval	NA	25
813	2.15.2021	Mangrol	Female	18
814	2.25.2021	Veraval	Male	26
815	3.10.2021	Veraval	Female	15
816	3.12.2021	Veraval	NA	28
817	3.13.2021	Veraval	NA	25
818	3.17.2021	Veraval	NA	20
819	3.17.2021	Mangrol	Male	22
820	3.18.2021	Veraval	NA	30
821	3.19.2021	Veraval	NA	36
822	3.20.2021	Veraval	Female	25
823	3.22.2021	Veraval	NA	24
824	3.24.2021	Veraval	NA	28
825	3.24.2021	Veraval	Female	20
826	3.25.2021	Veraval	NA	30
827	3.26.2021	Veraval	Female	32
828	3.31.2021	Veraval	NA	25

SR. No.	Date	Place	Sex	Length (feet)
829	4.1.2021	Veraval	Female	37
830	4.13.2021	Veraval	Female	35
831	10.3.2021	Mangrol	Male	25
832	10.30.2021	Veraval	NA	25
833	11.15.2021	Veraval	NA	22
834	11.23.2021	Mangrol	Male	18
835	11.24.2021	Veraval	NA	20
836	11.27.2021	Mangrol	Male	30
837	11.28.2021	Veraval	Female	38
838	11.29.2021	Veraval	NA	40
839	11.30.2021	Veraval	Female	32
840	12.6.2021	Veraval	NA	27
841	12.6.2021	Veraval	NA	32
842	12.6.2021	Veraval	NA	25
843	12.6.2021	Veraval	NA	15
844	12.6.2021	Veraval	NA	18
845	12.7.2021	Veraval	NA	30
846	12.7.2021	Veraval	NA	20
847	12.8.2021	Veraval	NA	25
848	12.8.2021	Veraval	NA	21
849	12.11.2021	Veraval	NA	30
850	12.11.2021	Veraval	NA	19
851	12.12.2021	Veraval	NA	30
852	12.17.2021	Mangrol	NA	25
853	12.21.2021	Veraval	NA	20
854	12.21.2021	Veraval	NA	16
855	12.22.2021	Veraval	Female	20
856	12.22.2021	Veraval	NA	22
857	12.22.2021	Veraval	NA	20
858	12.26.2021	Veraval	NA	20
859	1.2.2022	Mangrol	Male	22
860	1.5.2022	Mangrol	Male	21

SR. No.	Date	Place	Sex	Length (feet)
861	1.13.2022	Veraval	NA	20
862	1.15.2022	Veraval	Female	20
863	1.18.2022	Mangrol	Male	23
864	3.10.2022	Veraval	NA	20
865	3.11.2022	Veraval	NA	23
866	3.31.2022	Sutrapada	NA	15
867	4.8.2022	Veraval	NA	25
868	4.13.2022	Veraval	NA	20
869	4.13.2022	Mangrol	Male	20
870	4.14.2022	Mangrol	Male	15
871	4.16.2022	Veraval	NA	18
872	4.17.2022	Veraval	NA	25
873	4.18.2022	Mangrol	Female	17
874	4.20.2022	Mangrol	Female	18
875	4.24.2022	Mangrol	NA	15
876	4.29.2022	Mangrol	Female	25
877	5.2.2022	Veraval	NA	35
878	5.2.2022	Veraval	NA	26
879	5.4.2022	Veraval	NA	16
880	5.9.2022	Mangrol	NA	20
881	5.20.2022	Mangrol	NA	20
882	10.13.2022	Mangrol	Female	36
883	10.25.2022	Mangrol	Female	20
884	11.4.2022	Bhidia	NA	15
885	11.7.2022	Veraval	NA	14
886	11.21.2022	Mangrol	NA	26
887	12.6.2022	Veraval	NA	21
888	12.7.2022	Veraval	NA	15
889	12.11.2022	Veraval	NA	15
890	12.13.2022	Veraval	NA	16
891	12.13.2022	Veraval	NA	30
892	12.26.2022	Veraval	NA	32
893	12.27.2022	Veraval	NA	32

SR. No.	Date	Place	Sex	Length (feet)
894	12.28.2022	Veraval	NA	28
895	12.28.2022	Bhidia	NA	30
896	12.28.2022	Veraval	NA	35
897	12.30.2022	Veraval	NA	16
898	12.31.2022	Mangrol	NA	27
899	12.31.2022	Mangrol	NA	29
900	1.4.2023	Veraval	NA	28
901	1.9.2023	Veraval	Female	16
902	2.17.2023	Veraval	NA	20
903	2.19.2023	Veraval	NA	16
904	3.1.2023	Veraval	NA	15
905	3.2.2023	Veraval	NA	18
906	3.3.2023	Veraval	Male	18
907	3.11.2023	Veraval	NA	20
908	3.13.2023	Veraval	NA	35
909	3.15.2023	Veraval	NA	16
910	3.16.2023	Veraval	Male	23
911	3.16.2023	Veraval	NA	30
912	3.17.2023	Veraval	NA	21
913	3.28.2023	Veraval	NA	30
914	4.2.2023	Mangrol	Female	20
915	4.4.2023	Veraval	NA	32
916	4.8.2023	Veraval	NA	18
917	4.16.2023	Mangrol	Male	25
918	4.27.2023	Veraval	NA	29
919	4.28.2023	Mangrol	Male	20
920	4.29.2023	Veraval	NA	25
921	5.2.2023	Veraval	NA	30
922	5.3.2023	Veraval	NA	30
923	5.6.2023	Veraval	NA	19
924	5.8.2023	Veraval	NA	25
925	9.17.2023	Veraval	NA	35
926	9.20.2023	Veraval	NA	38

SR. No.	Date	Place	Sex	Length (feet)
927	11.18.2023	Veraval	NA	22
928	11.23.2023	Mangrol	NA	12
929	12.23.2023	Veraval	NA	35
930	12.27.2023	Mangrol	Male	30
931	1.12.2024	Veraval	NA	36
932	1.20.2024	Veraval	NA	35
933	1.16.2024	Veraval	NA	28
934	1.31.2024	Veraval	NA	30
935	2.4.2024	Veraval	NA	34
936	2.10.2024	Veraval	NA	35
937	2.14.2024	Veraval	NA	29
938	2.21.2024	Veraval	NA	35
939	2.23.2024	Sutrapada	NA	20
940	3.4.2024	Veraval	NA	35
941	3.5.2024	Veraval	NA	35
942	3.12.2024	Veraval	NA	40
943	3.17.2024	Veraval	NA	35
944	3.28.2024	Veraval	Male	27
945	4.7.2024	Veraval	NA	26
946	4.7.2024	Veraval	NA	28
947	4.8.2024	Veraval	NA	30
948	4.11.2024	Veraval	NA	28
949	4.15.2024	Veraval	NA	30
950	4.18.2024	Veraval	Female	30
951	4.21.2024	Veraval	NA	24
952	8.19.2024	Veraval	NA	27
953	9.19.2024	Veraval	NA	24
954	9.30.2024	Veraval	NA	35
955	10.8.2024	Chorvad	NA	29
956	10.30.2024	Mangrol	NA	26
957	11.20.2024	Dhamlej	NA	22
958	11.26.2024	Veraval	NA	22
959	11.29.2024	Veraval	NA	23

SR. No.	Date	Place	Sex	Length (feet)
960	12.16.2024	Dhamlej	NA	30
961	12.17.2024	Veraval	NA	25
962	12.19.2024	Veraval	NA	20
963	12.21.2024	Veraval	NA	28
964	12.22.2024	Veraval	Male	28
965	12.22.2024	Sutrapada	NA	30
966	12.23.2024	Veraval	NA	26
967	12.23.2024	Chorvad	NA	28
968	12.26.2024	Veraval	NA	17
969	1.11.2025	Veraval	NA	29
970	1.12.2025	Veraval	NA	28
971	1.14.2025	Chorvad	NA	32
972	1.13.2025	Sutrapada	NA	25
973	1.25.2025	Veraval	NA	24
974	2.11.2025	Sutrapada	NA	26
975	3.4.2025	Sutrapada	NA	32
976	3.4.2025	Veraval	NA	29
977	3.27.2025	Veraval	NA	28
978	3.29.2025	Veraval	NA	30
979	3.30.2025	Veraval	NA	26
980	4.1.2025	Veraval	NA	25
981	4.2.2025	Veraval	NA	30
982	4.5.2025	Hirakot	NA	24
983	4.6.2025	Dhamlej	NA	28
984	4.12.2025	Sutrapada	NA	30
985	4.18.2025	Veraval	NA	24
986	5.9.2025	Veraval	NA	28
987	9.11.2025	Veraval	NA	30

IV. Change in the indicators between 2005 and 2025

Indicator	Baseline	Endline
Can recognize Whale Shark from picture	69%	100%
Aware of the presence of Whale Sharks in Gujarat or India	81%	100%
Aware of legal protection for Whale Sharks	42%	100%
Knows about the harmlessness of Whale Sharks	61%	96%
Believe that Whale Sharks will go extinct if not saved	91%	100%
Believe that Whale Sharks should be protected for nature's balance	73%	100%
Believe that Whale Sharks should be conserved even though it is a migratory species	74%	100%
Willing to eat Whale Shark meat even with the knowledge of its protected status	27%	1%
Would protect Whale Sharks even at the cost of livelihood	71%	99%
Believe that they can make a difference in Whale Shark conservation	73%	100%
Are willing to participate in Whale Shark conservation in future	77%	100%

V. Key performance indicators

Domain	Indicator	Value
Knowledge about	Proportion of respondents that can identify Whale Shark from the	100%
Whale Shark and its conservation	picture	
	Proportion of respondents with knowledge about Whale Shark	62%
	reproduction	
	Proportion of respondents with knowledge about Whale Shark	100
	migration	
	Proportion of respondents with knowledge about Whale Shark	70%
	feed	
	Proportion of respondents that mention at least three threats to	61%
	Whale Shark population	
	Proportion of respondents aware about the legal protection of	100%
	Whale Shark	
	Prevalence of different perceptions about Whale Sharks:	a. Size - 100% b. Danger - 7% c. End-use - 89% d. Sea creature - 91% e. Harmlessness - 74% f. Legal protection - 100%
	Size	
	b. Danger	
	c. End-use	
	d. Sea creature	
	e. Harmlessness	
	f. Legal protection	

	Proportion of respondents aware of WTI's involvement in whale shark conservation campaign	100%
Attitude	Proportion of respondents that have positive feelings for whale shark	100%
	Proportion of respondents who think that Whale Sharks should be conserved	99.25%
	Most cited motivation to conserve Whale Sharks	65%
	Most cited challenge to conserve Whale Sharks	46% - loss of livelihood
	Most cited agency that is perceived to be primarily responsible for Whale Shark conservation	Shared responsibility b/w govt, community, and NGOs - 92%
	Proportion of respondents that think that reduction in fishing from certain regions can help in Whale Shark conservation	86%
	Proportion of respondents that think that conservation campaign had a high impact on building positive attitude towards whale shark conservation	96%
	Proportion of respondents that believe that excessive fishing can impact marine wildlife populations	97%
	Proportion of respondents who promoted Whale Shark conservation in the community	49%
	Prevalence of different barriers in promoting Whale Shark conservation	Lack of knowledge - 79% Limited support from organizations - 71% Lack of time/ resources - 69% Resistance from community members - 38%

Practice	Proportion of respondents who admit them or someone from their friends of family hunting Whale Shark before 2001	18%
	Proportion of respondents that think that conservation campaign had a high influence in stopping Whale Shark hunting	63%
	Proportion of respondents who mention them or someone in their family participating in training or awareness programs	84%
	Proportion of respondents that can recall at least one component of trainings	100% (among those that
		attended training)
	Proportion of respondents that mention them or someone in their receiving financial compensation for damaged net	99% (who reported rescuing)
	Proportion of respondents mentioning positive practice when they last spotted a Whale Shark	Kept a safe distance - 62% Did not feed or interact with it- 12% Avoided using fishing gear near it - 61% Observed quietly and peacefully - 50% Reported the sighting to local authorities-40% Spread awareness about the fish with fellow fishermen - 66%
	Proportion of respondents who think that Whale Shark hunting has decreased	99%
	Proportion of respondents motivated to participate in Whale Shark conservation efforts	100%

Recall	Proportion of respondents that can identify logo/ motto of whale shark conservation campaign	99%
	Proportion of respondents that can name at least three activities conducted during Whale Shark conservation campaign (prompted and unprompted)	unprompted - 100% prompted - 99%
	Most engaging activity/element of the campaign	Whale Shark day - 28%
	Proportion of respondent that can recall involvement of a spiritual leader in the campaign	73%
	Proportion of respondents who reported that the campaign encouraged them to participate and promote Whale Shark conservation	98%
	Proportion of respondents who accepted to continue promoting Whale Shark conservation efforts in the future	93%
	Sources of information about Whale Shark conservation issues	Public engagement activities (Programs in school/ college/ institute) - 82% Social media - 15%

APPENDIX - 6

A. List of foraminifera species encountered from the study area

1. *Ammonia* sp.1
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Rotaliidae
   Genus: *Ammonia*

2. *Ammonia* sp.2
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Rotaliidae
   Genus: *Ammonia*

3. *Ammonia* sp.3
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Rotaliidae
   Genus: *Ammonia*

4. *Discorbis* sp.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Discorbidae
   Genus: *Discorbis*

5. *Elphidium crispum.*
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Elphidiidae
   Genus: *Elphidium*
   Species: Elphidium crispum

6. *Elphidium* sp.2
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Elphidiidae
   Genus: *Elphidium*

7. *Hanzawaia* sp.1
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Anomalinidae
   Genus: *Hanzawaia*
   Species: *Hanzawaia* sp.2

8. *Hanzawaia* sp.2
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Anomalinidae
   Genus: *Hanzawaia*
   Species: *Hanzawaia* sp.2

9. *Nonion* sp.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Nonionoidea
   Genus: *Nonion*

10 *Bolivina striatula*.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Bolivinitidae
   Genus: *Bolivina*
   Species: *Bolivina striatula*

11 *Bolivina* sp.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Bolivinitidae
   Genus: *Bolivina*

12 *Bulimina marginata*.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Buliminidae
   Genus: *Bulimina*
   Species: *Bulimina marginata*

13 *Trifarina* sp.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Uvigerinidae
   Genus: *Trifarina*

14 *Globigerina* sp.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: Rotaliida
   Family: Globigerinidae
   Genus: *Globigerina*

15 *Leptohalysis* sp.
   Phylum: Foraminifera
   Class: Globothalamea
   Order: lituolida
   Family: Reophacidae
   Genus: *Leptohalysis*

16 *Quinqueloculina* sp.
   Phylum: Foraminifera
   Class: Tubothalamea
   Order: Miliolida
   Family: Hauerinidae
   Genus: *Quinqueloculina*

17 *Spiroloculina* sp.
   Phylum: Foraminifera
   Class: Tubothalamea
   Order: Miliolida
   Family: Spiroloculinidae
   Genus: *Spiroloculina*

18 *Spirillina* sp.
Phylum: Foraminifera
Class: Tubothalamea
Order: Spirillinida
Family: Spirillinidae
Genus: *Spirillina*

19 *Lagena* sp.
Phylum: Foraminifera
Class: Incertae sedis
Order: Lagenida
Family: Lagenidae
Genus: *Lagena*

B: List of nematode species encountered from the study area

1. *Halalaimus longicaudatus*
   Phylum: Nematoda
   Class: Adenophorea
   Order: Enoplea
   Family: Oxystominidae
   Genus: *Halalaimus*
   Species: *Halalaimus longicaudatus*
2. *Desmodora scaldensis*
   Order: Chromadorida
   Family: Desmodoridae
   Genus: Desmodora
   Species: *Desmodora scaldensis*
3. *Desmodora schulzi*
   Order: Chromadorida
   Family: Desmodoridae
   Genus: *Desmodora*
   Species: *Desmodora schulzi*
4. *Catanema* sp.
   Order: Chromadorida
   Family: Desmodoridae
   Genus: Catanema
5. *Tricoma* sp.
   Order: Chromadorida
   Family: Desmoscolecidae
   Genus: *Tricoma*
6. *Camacolaimus barbatus*
   Order: Chromadorida
   Family: Leptolaimidae
   Genus: *Camacolaimus*
   Species: *Camacolaimus barbatus*
7. *Dorylaimopsis* sp.
   Order: Chromadorida
   Family: Comesomatidae
   Genus: *Dorylaimopsis*
8. *Metalinhomoeus longiseta*
   Order: Monhysterida
   Family: Linhomoeidae
   Genus: *Metalinhomoeus*
   Species: *Metalinhomoeus longiseta*

APPENDIX - 7

Whale Shark Rescued along Kerala Coast (2018-2025)

Sl. No.	Name	Date	Approx. Length	Type of net	District
1	Mr.Abdul Salam	Dec-18			Malappuram
2	Mr.Babu	Jan-20			Calicut
3	Mr.John Martin	Dec-20			Trivandrum
4	Mr.Maheen	Apr-21			Trivandrum
5	Mr.Bruno Gomez	Feb-22			Trivandrum
6	Mr.Jose R	15-Dec-22	25ft -30ft	Shore seiner	Trivandrum
7	Mr.Nixon S	21-Dec-22	28ft	Shore seiner	Trivandrum
8	Mr.Asharaf	23-Jan-23	22ft-25ft	Shore seiner	Trivandrum
9	Mr.Paulose Bernald	08-Feb-23		Shore seiner	Trivandrum
10	Mr.Asharaf	26-Mar-23		Shore seiner	Trivandrum
11	Mr.Kunjumon	16-Apr-23		Shore seiner	Trivandrum
12	Mr.Sabu Richard	06-Nov-23	20ft	Ring Net	Trivandrum
13	Mr.Shihabudheen	24-Nov-23	23ft	Shore seiner	Trivandrum
14	Mr.Shinju	04-Dec-23		Shore seiner	Trivandrum
15	Mr.Raju Stephen	28-Dec-23	22ft	Shore seiner	Trivandrum
16	Mr.Joboy Lopez	12-Jan-24	18ft	Shore seiner	Trivandrum
17	Mr.Simon Saju	13 January 2024		Shore seiner	Trivandrum
18	Mr. Sajeer Fazil	2023	3 Whale Shark	Ring net	Trivandrum

Sl. No.	Name	Date	Approx. Length	Type of net	District
19	Mr. Sajeer Fazil	2023	in	Ring net	Trivandrum
20	Mr. Sajeer Fazil	2023	Net	Ring net	Trivandrum
21	Mr.Abdul Rehman	19 March-2024	14ft	Shore seiner	Trivandrum
22	Mr.Abdul Rehman	19 March-2024	24 ft	Shore seiner	Trivandrum
23	Mr.Abdul Rehman	19 March-2024	24 ft	Shore seiner	Trivandrum
24	Mr. Halaudeen	19 March-2024	35ft	Shore seiner	Trivandrum
25	Mr. Sibil M	23 March-2024	26ft	Shore seiner	Trivandrum
26	Mr John	6 April 2024	9 ft	Shore Seiner	Trivandrum
27	Mr.Abubakar	03 October	26ft	Shore Seiner	Trivandrum
28	Mr.Jibin B	9 November 24	16ft	Purse seiner	Trivandrum
29	Mr Andrews Antony	10 November 24	9ft	Gill Net	Trivandrum
30	Mr. Gopi Cv	29 November 24	16ft	Ring Net	Thrissur
31	Mr.Sajeer Fazil	4 December24	16ft	Ring Net	Trivandrum
32	Mr.Abdul Rahuman	15 December 24	14ft	Shore seiner	Trivandrum
33	Mr.Ashraf Ali	17 December 24	9ft	Shore seiner	Trivandrum
34	Mr.Davidson	6 January 25	14ft	Shore seiner	Trivandrum
35	Mr.Rayees N K	10 January 25	10ft	Ring net	Kannur
36	Mr Antony	14 January 2025	10ft	Shore seiner	Trivandrum

Sl. No.	Name	Date	Approx. Length	Type of net	District
37	Mr Shinju	1 March 2025	10ft	Shore seiner	Trivandrum
38	Mr Shinju	1 March 2025	16ft	Shore seiner	Trivandrum
39	Mr Vincent	3 March 2025	14ft	Shore seiner	Trivandrum
40	Mr Abdhul rahuman	3 March 2025	10ft	Shore seiner	Trivandrum
41	Mr Baiju	4 March 2025	16ft	Shore seiner	Trivandrum
42	Mr Peter sunil	5 March 2025	14ft	Shore seiner	Trivandrum
43	Mr Peter Sunil	5 March 2025	14ft	Shore seiner	Trivandrum
44	Mr Johnson	6 March 2025	16ft	Shore seiner	Trivandrum
45	Mr Peter Sunil	7 March 2025	9ft	Shore seiner	Trivandrum
46	Mr Jelastin	8 March 2025	14ft	Shore seiner	Trivandrum
47	Antony Mariyapam	27 April 2025	8ft	Ring Net	Trivandrum
48	Thomas Abraham	29 April 2025	12ft	Ring Net	Trivandrum
49	Thomas Abraham	29 April 2025	16ft	Ring Net	Trivandrum
50	Mr Abdhul rahuman	1 May 2025	6ft	Shore seiner	Trivandrum

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This report highlights the various aspects of 23 years of the extremely successful whale shark conservation project of the Wildlife Trust of India and its partners which transformed the once heavily hunted shark to a flagship of marine conservation.

Spearheaded by the Wildlife Trust of India, the Whale Shark Conservation Project initiated a groundbreaking public-private effort to transform local fishers from hunters into protectors in Gujarat—resulting in it being the first fish to be protected under the law in India, having the first whale shark day for any state and its turning into a local icon culminating in not only the complete stopping of the organised killing but also the voluntary release of over 1,000 whale sharks by fishers. A detailed coastal survey conducted across nine states identified five new aggregation zones and provided vital insights into whale shark ecology, threats, and community awareness. Today, new conservation efforts across Gujarat, Kerala and Lakshadweep are helping secure a hopeful future for this iconic species along India's coastline.

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