Whale Shark conservation and ecotourism at Panaon Island, Southern Leyte

Large Marine Vertebrates Project Philippines: 2015 Seasonal Report

by Gonzalo Araujo & Jessica Labaja

This report presents the seasonal results from the LAMAVE whale shark research and conservation work based in Pintuyan, Southern Leyte. A total of 49 whale sharks were identified throughout the season, most of which were juvenile males with a mean total length of $5.4 \pm 1.0$ m. There was a total of 292 individual whale shark encounters resulting from a minimum of 158 survey trips onboard pumpboats or tourist vessels. In-water tourist-whale shark interactions were recorded on 126 occasions resulting in insightful data on human-wildlife interaction. Temperature-depth-recorder (TDR) tags were deployed on three individuals, and satellite tags were deployed on two others, with the purpose of understanding the local habitat use and fine scale movements of the species. Education is a pivotal component of conservation, and throughout the season schools and other stakeholders were targeted to deliver it.
Introduction

The whale shark *Rhincodon typus* is the world’s largest fish and inhabits tropical and sub-tropical waters throughout all oceans (Rowat & Brooks, 2012). They feed primarily on surface zooplankton but are known to feed on sergestid shrimps, fish and coral spawn, as well as demersal macroplankton and small fishes (Rohner et al., 2013; Heyman et al., 2001; Motta et al., 2010). Their aggregation sites across the globe are linked to primary productivity, suggesting their movement and distribution is driven by food (Graham & Roberts, 2007; de la Parra Venegas et al., 2011; Fox et al., 2013; Robinson et al., 2013).

Whale sharks are widely distributed across the Philippine archipelago with reports from fishermen and media occurring year-round. There are three main whale shark tourism endeavours in the Philippines, and are all very different from each other. In 1997, an aggregation of whale sharks was reported in Donsol Bay, in the province of Sorsogon, attracting tourists and hunters alike. Hunters travelled from the Bohol Sea where whale shark hunting was a profitable industry where up to 100 whale sharks were landed per year (Alava et al., 2002). Seven whale sharks were fished in Donsol, which led to a media and public outcry (Quiros, 2005). The President signed a Fisheries Administrative Order (FAO 193) prohibiting the catch and trade of whale sharks and manta rays (*Manta birostris*) in 1998, making the Philippines the first country in South East Asia to actively protect the species nationally. With the help of WWF-Philippines, the fishing town of Donsol developed the first whale shark ecotourism endeavour in the country (Pine et al., 2007). Tourism in Donsol grew steadily reaching up to 28,000 tourists in 2013. Over 400 individual whale sharks have been identified in Donsol to date (Wildbook for Whale Sharks: www.whaleshark.org).

In late 2011, a different whale shark tourism endeavour would develop in the fishing community of Tan-awan, municipality of Oslob in southern Cebu. For decades, the locals remember seeing whale sharks or ‘tuki’ cruising through their coastline. The fishermen of Tan-awan could lure whale sharks away from fishing operations by feeding them the same prey there were fishing for. A tourist experienced this unique behaviour of the whale sharks, filmed it and uploaded it to an online social media website. Within weeks, hundreds of people were visiting the waters off Tan-awan to observe these hand-fed whale sharks. The local government imposed a Municipal Ordinance on the 7th January 2012 to try and regulate the tourism activities with the whale sharks. In 2014 close to 200,000 tourists visited Oslob. Unfortunately little has been done to address the provisioning activities, which might have dire ecological implications for the whale sharks (Araujo et al., 2014). Over 200 individual whale sharks have been identified at Oslob, with some individuals residing for prolonged periods of time at the site due to the provisioning activities (Araujo et al., 2014).

A third small-scale whale shark tourism operation started in 2006 from Barangay Son-ok in the municipality of Pintuyan, Southern Leyte. The local fishermen formed a People’s Organisation, KASAKA, and the municipality passed an ordinance for the regulation of the whale shark tourism in their waters. KASAKA has since been receiving tourists every season (November-June) with up to 2,000 tourists in 2013. This is a great alternative livelihood programme, creating jobs that aren’t consumptive usage of marine ecosystems. The seemingly flourishing industry plummeted in 2014 following the devastating super-
Whale Shark conservation and ecotourism at Panaon Island, Southern Leyte

typhoon Haiyan that hit the island in November 2013. The LAMAVE team was in Pintuyan for the 2014 season and saw too few whale sharks to sustain reliable tourism. The LAMAVE team identified 92 individual whale sharks during the 2013 season, compared to a mere 7 individuals in 2014 (Araujo et al., in review).

Photographic identification (photo-ID) is a powerful, minimally invasive tool used to describe animal populations (Marshall & Pierce, 2012). Whale sharks have unique spot patterns on their body that work like fingerprints and do not change overtime (Arzoumanian et al., 2005). By using their unique spot pattern, researchers are able to identify individual whale sharks over time and at different locations. Tourists can be enlisted as citizen scientists and help collect identification data. This approach has been successfully used in various marine and terrestrial species (Vianna et al., 2014). Seeing as the whale shark tourism in Southern Leyte operates out of Pintuyan with KASAKA, the LAMAVE team has been conducting systematic online searches for identification photographs of whale sharks in the region, therefore expanding the spatiotemporal data available from direct research.

Panaon Island lies at the easternmost entrance to the Bohol Sea, off Leyte Island in the Eastern Visayas region (Fig. 1). Its southern tip is exposed to the Bohol Jet, a strong southwestward-flowing surface current that flows into the Bohol Sea from the Pacific Ocean (Cabrera et al., 2011). These rich waters host one of the highest biodiversity of marine megafauna in Asia with at least 19 cetacean species, five species of Mobulid rays, and four species of sea turtles (Ponzo et al., 2011; Freeman et al., 2014; Verdote & Ponzo, 2014). To the west of Panaon Island lies Sogod Bay, reaching a maximum depth of 1,400 m in the central channel and receives over 2 m of rainfall annually, holding rich tuna, flying fish, herrings, anchovies and Spanish mackerel populations (Calumpong, Raymundo & Solis-Duran, 1994). Seasonality is shaped by the occurrence of the South West Monsoon, locally known as ‘habagat’.

In the present Project, researchers were based in the town of Pintuyan, southwest of Panaon Island. The Project’s objectives included:

- The development of new regional guidelines for whale shark interaction tourism in the Visayas based on scientific data.
- Increased public awareness and education through social media and IECs.
- The supplementation of interactive educational sessions in local schools to raise overall ocean awareness, with particular focus on plastic and chemical pollution.
- The effective change in behaviour perceived through wildlife watching activities as a sustainable alternative livelihood for local communities.
- Determine a better population assessment of the species at Panaon Island and their habitat use. Start the groundwork of a long-term plan to create a whale shark sanctuary in Sogod Bay, Southern Leyte, and a migratory protected corridor in the Northern Bohol Sea.

This report represents the results from the 2015 field season.
Methodology

Whale shark surveys and population assessment

Haphazard boat surveys were conducted in the municipalities of Pintuyan and San Ricardo between 30 and 200 m from shore. Two survey platforms were employed: onboard small motorised pumpboats (outriggered canoes) measuring ~4.5-6 m in length and holding researchers above the surface, and onboard large tourist vessels measuring ~10-15 m in length and holding researchers ~1-1.5 m above the surface. The height of the vessel influences the angle of view into the water and affects the likelihood of sighting a whale shark in the water. Surveys were supported by spotters who would look for whale sharks in the water on small paddleboats. GPS data was collected on most surveys.

Upon sighting a whale shark, researchers would be dropped in the water close to the whale shark. The animal would be approached from the left flank and photographed behind the gill slits and above the pectoral fins. This is the international standard for whale shark identification (ID). The same ID photograph is used by the “Interactive
Individual Identification Software” (I3S) (Van Tienhoven et al., 2007), and the online database “Wildbook for Whale Sharks” (www.whaleshark.org) for individual identification. Researchers would also photograph the area between the pelvic fins of the whale shark and determine the sex of the animal as male (presence of claspers) or female (absence of claspers). Each individual whale shark encountered is recorded on a spreadsheet and two senior researchers confirm identity. These data are useful for understanding the residency and habitat use of the various individuals encountered, therefore describing the significance of the study site for the species.

In support of photo-ID, researchers also collected tissue samples from whale sharks when possible. Using a Hawaiian sling (JBL Spear Pole, www.jblspearguns.com) with a modified hollowed tip, the whale shark is shot between the first dorsal fin and the first lateral ridge. A small sample measuring ~3 cm in length and 0.5 cm across is collected. The tissue sample is split into three parts: one third is stored in 95% ethanol for genetic studies; one third is frozen for stable isotope (SI) analysis; and one third is also frozen for fatty acid (FA) studies. Genetic studies can reveal from what geographic genetic stock the whale sharks belong or mix with (see Vignaud et al., 2014). Stable isotope analysis can tell us on what geographical prey the whale sharks have been feeding on, adding extra insight into the movement patterns of whale sharks (see Borrell et al., 2011). Fatty acid studies look into the signature of long chain polyunsaturated fatty acids in the whale sharks’ tissue, and therefore provide insight about the dietary preference of the world’s largest fish. This information can be used to identify critical habitats of the species (see Rohner et al., 2013).

Telemetry studies

Three temperature-depth-recorder (TDR) tags were acquired from CEFAS Technology (www.cefastechnology.co.uk) for deployment on whale sharks. The tags are tethered by a 10 cm surgical-grade stainless steel dart that penetrates the whale shark, using the spear pole described above. The tags record temperature and depth at set time intervals, and the data can be used to infer the whale shark’s local habitat usage. Two tags were deployed on April 2nd and April 3rd 2015 on 30 s sampling intervals for a maximum recording time of seven months. One tag was deployed on March 2nd 2015 with a sampling interval of 15 s, and a max. recording time of three and one half months. These tags need to be manually retrieved from the whale sharks, posing a high risk of tag loss or non-retrieval. Because of this factor, the whale sharks on which these tags were deployed were specifically selected. Using residency and re-sighting data from the previous seasons, individuals with strong site fidelity and recurrence at the site were selected for TDR tag deployment.

Different types of tags were secured through collaboration with the Marine Megafauna Foundation (www.marinemegafauna.org). Satellite tags can track whale shark movements over short and long time periods (Berumen et al., 2014). The tags employed on this study were SPOT5 tags from Wildlife Computers Inc (www.wildlifecomputers.com) that can track short-term movements of whale sharks in almost real-time. The tags were attached to the whale sharks using a stainless steel
anchor, and tethered by a stainless (150 lbs) cable of approx. 175 cm in length. Upon surfacing, the tag’s wet/dry sensor turns the tag on and transmissions of estimated location are made to the ARGOS satellite system. Transmissions vary in accuracy from B, A, 0, 1, 2 and 3, with 3 being the most accurate to 150 m. Most studies discard B and A transmissions unless they successively transmitted with a higher accuracy nearby. Two satellite tags were successfully and opportunistically deployed on whale sharks on April 9th and April 10th 2015.

Tourist Interactions and Guidelines

Throughout the 2015 season, in-water tourist-whale shark interaction data was collected. Upon encountering a whale shark, a researcher would get in the water and record whale shark behaviour and potential responses to anthropogenic stimuli. The aim of such data is to establish science-based guidelines to whale shark interactions. A summary of behaviours and any associated responses and stimuli is summarised in Table 1. Environmental variables were also recorded to include visibility, current and weather conditions. All variables were tested to try and understand whale shark response to different tourist behaviours such as freediving or minimum distance to the animal. There is a code of conduct in place based on Donsol, but interaction procedures vary from site to site. It might be important to have site-specific regulations develop from standardized general guidelines, potentially on a national level.

Since LAMAVE first started working in Pintuyan, the whale shark tour operators that visit the area offered support. This has been paramount in LAMAVE’s efforts to collect tourist data. Having a researcher onboard has the added benefit of enhancing the tourists experience by sharing extra knowledge about the whale sharks biology, ecology and local habitat use.

<table>
<thead>
<tr>
<th>In-Water Code</th>
<th>Event</th>
<th>Definition</th>
<th>Behavioural Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>GL</td>
<td>Gliding</td>
<td>Gliding through the water column (no movement of the caudal fin)</td>
<td>No Avoidance</td>
</tr>
<tr>
<td>FS</td>
<td>Fast Swimming</td>
<td>A quick acceleration, swimming at a considerably faster rate</td>
<td>Avoidance</td>
</tr>
<tr>
<td>SS</td>
<td>Slow Swimming</td>
<td>Swimming at a slow or constant speed</td>
<td>No Avoidance</td>
</tr>
<tr>
<td>CD</td>
<td>Change of Direction</td>
<td>A directional change by the shark (state direction and degree of change)</td>
<td>Avoidance</td>
</tr>
<tr>
<td>NR</td>
<td>No reaction</td>
<td>No reaction from the shark in response to a particular event</td>
<td>No Avoidance</td>
</tr>
</tbody>
</table>
### Table 1. In-water codes and definitions collected during whale shark-tourist interactions.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Definition</th>
<th>Avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>VS</td>
<td>Violent shudder</td>
<td>Head and tail or entire body shaking</td>
<td>Avoidance</td>
</tr>
<tr>
<td>CG</td>
<td>Coughing</td>
<td>Flushing of water back out of the mouth and through the gills</td>
<td>No Avoidance</td>
</tr>
<tr>
<td>BNK</td>
<td>Banking</td>
<td>Shark banks to display its tough and protective dorsal side to the potential threat</td>
<td>Avoidance</td>
</tr>
<tr>
<td>PF</td>
<td>Passive Feeding</td>
<td>Swimming in the water column with mouth held slightly agape, state degree of mouth opening (%)</td>
<td>No Avoidance</td>
</tr>
<tr>
<td>AF</td>
<td>Active Feeding</td>
<td>Actively feeding shark usually underwater gulping, surface gulping or ram feeding</td>
<td>No Avoidance</td>
</tr>
<tr>
<td>DV</td>
<td>Dive</td>
<td>Diving behaviour, including (SD) Steep Dive of 45-90, (GD) Gradual Dive and (PD) Parabola Diving</td>
<td>Avoidance</td>
</tr>
<tr>
<td>FD</td>
<td>Fredive</td>
<td>Swimming towards the shark underwater, state the distance of the diver from shark</td>
<td></td>
</tr>
<tr>
<td>TCH</td>
<td>Touching</td>
<td>Both accidental and intentional touching and contact with the shark</td>
<td></td>
</tr>
<tr>
<td>FP</td>
<td>Flash Photography</td>
<td>Observed flash photography of the shark</td>
<td>N/A</td>
</tr>
<tr>
<td>SE</td>
<td>Splash Entry</td>
<td>Splash entry when entering the water from aboard spotter or tourist boats</td>
<td></td>
</tr>
<tr>
<td>RB</td>
<td>Roadblock</td>
<td>Obstructing the path of the whale shark</td>
<td></td>
</tr>
</tbody>
</table>

**Information, Education and Communication (IEC) campaigns**

**Schools**

Any fruitful conservation initiative has education at its root. Apart from LAMAVE, there are another two NGOs doing education work in the area: Coral Cay Conservation ([www.coralcay.org](http://www.coralcay.org)) and Ocean-action Resource Centre ([www.oceanactionresourcecentre.org](http://www.oceanactionresourcecentre.org)). LAMAVE coordinated with both to ensure there is no overlapping of materials and focus. LAMAVE originally developed educational modules that would supplement the Philippines Department of Education’s curriculum.
The modules were centred on ocean health and large marine vertebrates of local waters, including their biology, ecology and threats. There are two local high schools that were targeted to include grades 7, 8, 9 and 10, and three elementary schools covering grades 5 and 6. PowerPoint presentations were developed to include videos, interactive games and other characters to reinforce the material at hand.

**Workshops**

As part of LAMAVE’s dedicated conservation efforts in Southern Leyte, a strong relationship is held with KASAKA. They run the ecotourism activities with the whale sharks and pride themselves in the work that they do. LAMAVE set up workshops to improve their knowledge on whale shark biology and ecology, as well as ways of improving interaction procedures. The purpose of such workshops is to empower KASAKA members and enable them to conduct great work. As part of our mission to support alternative livelihood programmes, it is important to provide capacity building.

Map depicting where whale sharks were encountered during the 2015 season (green dots).
Results

Survey Effort

Researchers were onboard a total of 158 whale shark surveys, on both tourist vessels and small, survey-dedicated pumpboats. Table 2 details the number of whale shark surveys per boat trip. The overall mean survey time was 03:14 ± 00:48 (minutes ± S.D.) keeping to the 03 hrs mark imposed in the Pintuyan ordinance, and a maximum of 06:02. A total of 504 hours and 13 minutes were spent on survey between February and June looking for whale sharks. A maximum of 11 whale sharks were encountered in a single survey trip, with a mean of 1.56 ± 1.83 S.D per survey. On 63 surveys, no whale sharks were encountered (n = 158), 37 of which were dedicated surveys on a pumpboat (59%). A seasonal pattern was observed with peaks in February and March, and a good relationship between the number of individual whale sharks encountered per survey trip and total number of whale sharks identified in the area on that day (Fig. 2).

<table>
<thead>
<tr>
<th>Survey Vessel</th>
<th>Number of Trips</th>
<th>Mean Survey Time (hh:mm)</th>
<th>S.D. (hh:mm)</th>
<th>Mean Number of Whale Sharks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cruise Ship</td>
<td>1</td>
<td>2:42</td>
<td>0:00</td>
<td>1.00</td>
</tr>
<tr>
<td>DOT</td>
<td>1</td>
<td>1:39</td>
<td>0:00</td>
<td>3.00</td>
</tr>
<tr>
<td>Fun in the Sun</td>
<td>1</td>
<td>2:15</td>
<td>0:00</td>
<td>2.00</td>
</tr>
<tr>
<td>Sogod Bay Scuba Resort</td>
<td>22</td>
<td>3:47</td>
<td>0:34</td>
<td>1.95</td>
</tr>
<tr>
<td>Leyte Divers</td>
<td>4</td>
<td>3:07</td>
<td>0:59</td>
<td>2.00</td>
</tr>
<tr>
<td>Southern Leyte Divers</td>
<td>12</td>
<td>2:55</td>
<td>0:37</td>
<td>1.50</td>
</tr>
<tr>
<td>Padre Burgos Castle Resort</td>
<td>16</td>
<td>3:06</td>
<td>0:29</td>
<td>1.81</td>
</tr>
<tr>
<td>Peter's Dive Resort</td>
<td>17</td>
<td>2:51</td>
<td>0:54</td>
<td>1.53</td>
</tr>
<tr>
<td>Philippine Siren</td>
<td>1</td>
<td>3:08</td>
<td>0:00</td>
<td>1.00</td>
</tr>
<tr>
<td>Survey Pumpboat*</td>
<td>65</td>
<td>3:26*</td>
<td>0:51</td>
<td>3.22</td>
</tr>
<tr>
<td>Sail Boat</td>
<td>1</td>
<td>2:48</td>
<td>0:00</td>
<td>3.00</td>
</tr>
<tr>
<td>Sea Quest</td>
<td>4</td>
<td>2:34</td>
<td>0:24</td>
<td>1.00</td>
</tr>
<tr>
<td>Seadoors</td>
<td>1</td>
<td>1:34</td>
<td>0:00</td>
<td>0.00</td>
</tr>
<tr>
<td>Tourist Pumpboat</td>
<td>1</td>
<td>2:56</td>
<td>0:00</td>
<td>2.00</td>
</tr>
<tr>
<td>Whale Shark Divers</td>
<td>8</td>
<td>2:55</td>
<td>0:15</td>
<td>2.00</td>
</tr>
<tr>
<td>Blue Abyss</td>
<td>3</td>
<td>2:57</td>
<td>0:46</td>
<td>1.33</td>
</tr>
</tbody>
</table>
Population structure and residency

The 2015 whale shark season started in early November 2014 and run through to late June 2015. The first whale shark encounter was recorded on November 14, 2014 and the last was recorded on June 8, 2015. The season yielded a total of 49 individually identified whale sharks ranging between 3.5 m and 8.0 m, mean 5.4 ± 1.0 m (n = 49). Individuals were significantly male biased with 31 males, 5 females and 13 of undetermined sex ($\chi^2 = 18.8$, $P < 0.001$). Only one individual was considered to be mature, an 8.0 m male encountered on March 3rd, 2015, based on clasper morphology (Norman & Stevens, 2007). Propeller scars were noted on 53% (26) of whale sharks identified, varying from a single strike to multiple continuous lacerations slightly S-shaped (definitions adapted from Araujo et al., 2014).

A total of 292 encounters with whale sharks were recorded throughout the season, where an encounter is defined as a successfully identified individual at a specific time and place. A maximum of 12 individuals were identified in a single day on February 16th and March 5th. A mean of 2.6 ± 2.9 whale sharks were encountered per day between February 4th and
June 15th. March had the highest encounter rate, with 4.4 ± 3.1 whale sharks per day (max. 12). March appears to have been the seasonal peak for the species at the study site (Fig. 3). Unfortunately only citizen science identification photographs were available for January and were excluded from this analysis to avoid bias.

![Fig. 3. Number of individual whale sharks identified per month (red bars) and the monthly mean number encountered daily (blue bars).](image)

Of the 49 whale sharks identified throughout the season, 18 had previously been identified at the study site and the remaining 31 (61%) were new to 2015. Twenty nine percent (29%) of the individuals were only seen once and 47% (23) of them were resighted 5 or more days (max. 25). Interestingly, of those 23 individuals, 15 (65%) had been sighted at the study site in at least one previous season. These data are summarised on Fig. 4.
Telemetry

Temperature-Depth-Recorder (TDR) Tags

The three TDR tags were deployed on individuals who had been sighted at the study site in previous years in order to have a higher probability of re-sighting the animal in consecutive years and manually retrieving the tags. These three individuals were all male of estimated total lengths between 6.0 and 6.5 m (Table 3).

<table>
<thead>
<tr>
<th>Shark ID</th>
<th>Est. length (m)</th>
<th>Sex</th>
<th>Date 1st Sighted</th>
<th>Days Sighted in 2015</th>
<th>Date Tagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSR-12</td>
<td>6.0</td>
<td>M</td>
<td>08-Feb-2013</td>
<td>8</td>
<td>02-Apr-2015</td>
</tr>
<tr>
<td>LSR-18</td>
<td>6.5</td>
<td>M</td>
<td>14-Feb-2013</td>
<td>25</td>
<td>03-Apr-2015</td>
</tr>
<tr>
<td>LSR-24</td>
<td>6.5</td>
<td>M</td>
<td>26-Feb-2013</td>
<td>17</td>
<td>02-Mar-2015</td>
</tr>
</tbody>
</table>

Table 3. Individuals selected for TDR tag deployment.

Unfortunately none of the sharks were resighted at the study sight after a minimum time frame for sufficient data to be collected by the tags. Two of the tags (LSR-12 and LSR-18) will be collecting data until Nov 15th 2015, whereas the tag on LSR-24 stopped collecting data on Jun 15th 2015. The team will restart the work in Southern Leyte in early November and hopefully the tags will be opportunistically retrieved as soon the whale sharks return to the study site.
Satellite Tags

Two SPOT5 tags were opportunistically deployed on whale sharks on April 9\textsuperscript{th} 2015 (LSR-25) and on April 10\textsuperscript{th} 2015 (LSR-136). Both LSR-25 and LSR-136 were juvenile males of 5.0 and 5.5 m estimated total length respectively. Both individuals were not considered to be ‘residents’ at the study site seeing as they had only been sighted once during the 2015 season at the time of tagging. The tracks show LSR-136 moved northeast of Panaon Island and stayed around the Leyte Gulf, later returning to the eastern coast of Leyte Island (Appendix 1). The tag detached on approx. June 1\textsuperscript{st} 2015 near Barangay Santa Cruz, Tanauan, Leyte. The senior author visited the site to try and retrieve the tag on June 15\textsuperscript{th} 2015 but had no luck. Individual LSR-25 first moved towards Dinagat Island and possibly north of the Surigao Strait, and then back towards San Ricardo around April 18\textsuperscript{th}. It subsequently transmitted from Pintuyan/San Ricardo waters before transmitting from Siargao Island on May 1\textsuperscript{st} and back in San Ricardo on May 2\textsuperscript{nd}. Subsequent transmissions see the whale shark moving north, through the Surigao Strait and into the Leyte Gulf. Early June it transmitted from the eastern coast of Leyte Island before crossing the Gulf towards southern Samar. The tag detached approx. mid June near Giporlos, southern Samar (Appendix 2).
In-water whale shark interactions

During the 2015 season, a total of 126 tourist-whale shark interactions were recorded between February and May. Interactions were recorded with 34 individual whale sharks as identified through photo-ID (see above), 25 of which were male, 5 were female and 4 were of undetermined sex. The mean interaction duration was 07:53 ± 10:23 (minutes ± S.D.), with a maximum of 60:00. Avoidance behaviours, as those described in Table 2, were observed on 39% of in-water interactions with tourists (n = 126). Interactions where no avoidance was recorded had a mean duration of 05:34 ± 05:58, whereas interactions where avoidance was recorded were 11:33 ± 14:13, significantly longer (MWM, P < 0.001).

Free divers were observed on 93 occasions, and led to whale shark avoidance behaviour on 20 of those (21.5%). Road blocking was observed on 8 occasions leading to avoidance on 75% of those events (6). Splash-entry in the water by tourists was observed on 19 occasions with 9 of those events leading to whale shark avoidance behaviour (47.4%). There were only 3 active touches on a whale shark by a tourist, 2 of which led to avoidance by the animal (66.6%). There were no flash, strobe or light use recorded on any of the interactions. On 38 interactions tourists were recorded as closer than 4 m from the whale shark (30%, n = 126), with a maximum of 5 tourists within 4 m. On 61% of interactions there was a motorised vessel within 20 m of the whale shark with a maximum of 4 vessels within a single in-water interaction.
Feeding behaviour was observed on 33% of interactions (n = 126). The mean interaction duration was 14:23 ± 14:16 minutes when the whale shark was feeding, and 04:39 ± 05:28 minutes when whale sharks were not recorded feeding, showing a significant difference in interaction duration (MWM, P < 0.001). Interaction duration was not influenced by shark size, or by the number of previous encounters with the individual during the 2015 season ($r^2 < 0.01$).

A total of 570 tourists were recorded on the official logbook throughout the 2015 whale shark season.

**IEC Campaigns: Schools**

During March 2015, two local high schools were targeted for LAMAVE’s pilot modules on Ocean Health and Large Marine Vertebrates. The modules complemented the Department of Education’s science curriculum. Grades 7, 8 and 9 at Pintuyan National High School (PNHS) received the abovementioned modules with a total of approx. 170 students. Videos were highly effective at engaging the students on the content at hand, as did group activities. Modules were adapted for consecutive modules of the same grades based on level of response and interaction. Pintuyan National Vocational High School (PNVHS) grades 7, 8 and 9 received a compiled version of the two modules due to time restrictions. Grade 10 received the two full modules and interactive activities. A total of approx. 350 students were reached at PNVHS. Students who actively participated during modules were selected in each grade to lead future ocean related activities. The school year ended March 27th 2015.

![Fig. 7. Ms Labaja engaging students at Pintuyan National High School.](image-url)
Classes resumed on June 1\textsuperscript{st} 2015. Having covered the two local high schools at the end of the previous school year, three local elementary schools were targeted for IEC modules. The modules were adapted from the higher grade ones to suit the curriculum of grades 5 and 6. Some concepts were removed and others simplified. Buena Vista is a mountain Barangay with a small elementary school where grades 5 and 6 share the classroom. Ocean Health and Large Marine Vertebrates modules were delivered to approx. 20 students. Students engaged well with the modules and the teacher expressed interest in receiving LAMAVE again for further modules to cover ecology-related topics. Notes were taken on the effectiveness of the modules, and adapted to delivery at Pintuyan Central Elementary School. Grades 5 and 6 were taught reaching approx. 240 students. Barangay Son-ok had a recently built A/V room and received the team for Grades 5 and 6 modules, totalling approx. 50 students.

Educational modules in both elementary and high schools were successful with incredible receipt from the students, prompting the importance of education campaigns to bring about behavioural change in light of the fragility of marine resources. High schools were reached at the end of the school year and follow-up involvement in the community was low, possibly due to the imminent summer holidays. Contrastingly, elementary schools were targeted at the beginning of the school year and a Costal Clean-up activity intended as a follow up, received approx. 50 children that helped collect and segregate trash from the coastline of Poblacion, Pintuyan (Fig. 8).
During the summer holidays (April and May), with help from the mayor, the LAMAVE team held weekly Friday ‘Movie Nights’ in which ocean-related documentaries were shown at the local basketball court. There were on average 25 attendees, many of which were students from the high schools previously taught. An approximate total of 160 people attended the Movie Nights during April and May.

**Workshops**

Throughout the season we worked closely with KASAKA. Two workshops were held throughout, the first one refreshing KASAKA members on whale shark biology and ecology, and a second one focusing on the role of the guides and interaction procedures. KASAKA members are required to assist to official meetings, which the workshops followed, having all 29 members present.

The whale shark biology and ecology workshop was held during February 21\textsuperscript{st} and 22\textsuperscript{nd} 2015. It was split into two: presentation modules, and a quiz. KASAKA members were given a series of PowerPoint presentations covering whale shark biology, ecology and conservation aspects of the species, and concluded with a comprehensive multiple-choice questionnaire. Members were split into six groups to go over the questions, debate them and finally answer them. LAMAVE members interacted with them without providing direct answers but helping them get to the right ones when in doubt. Four out of six groups got 22/22 whereas the remaining two groups scored 18/22 and 20/22 respectively. This was an overall successful workshop and concluded with great results and comprehensive knowledge about the species.

![Fig. 9. Mr Araujo conducting a workshop for the guides of KASAKA.](image)
The second workshop was aimed at the KASAKA tour guides. There are five active guides and a sixth one who is available on occasion. The workshop was held on the March 16th and 17th 2015. On first instance, the guides were given a presentation reviewing the interaction guidelines as set in the Municipal Ordinance and the associated Code of Conduct for whale shark interactions. The presentation also covered whale shark approaching procedure, positioning of vessel, direction of captain, direction of spotters, distances and speeds, and tolerance. It became apparent that language barrier would be a limiting factor of the guide’s decision making onboard tourist vessels. For the second day of the workshop, we therefore prepared a script that would cover the most commonly encountered scenarios aboard a tourist boat. Researchers are normally onboard tourist vessels also and can assist the guide when necessary, without interfering with their role. The script was designed to support the guide’s communication ability and therefore instate a more comprehensive briefing on both tourists and skippers.

**Solid Waste Management (SWM)**

Closer involvement and education with the municipality of Pintuyan highlighted some of the strengths and weaknesses. Ocean health education is a useful module to educate children about the interconnectedness of ecosystems and the impact human activities can have on marine resources. Particular stress was made on plastic usage and disposal. However, a close relationship with the Municipal Agricultural Office (MAO) revealed a lack of infrastructure and resources for appropriate waste management. LAMAVE therefore helped the MAO launch an IEC campaign that focused on waste segregation and recovery of recyclable materials. LAMAVE put together a PowerPoint presentation in both English and Visayan, which was briefed to the MAO officers and barangay captains. The IEC was aimed at rural barangays (3) and coastal barangays with MPAs (5). If they are successful, they will be rolled out in urban barangays with support from the mayor. IECs started on June 10th and are still ongoing. The IEC was designed in accordance with the National Solid Waste Management Framework (to follow Republic Act 9003 to provide for “an Ecological Solid Waste Management Program”).

A successful SWM system in Pintuyan can be used as a positive scheme to be followed by other municipalities in the Bay, with a direct and indirect benefit for marine ecosystems. LAMAVE will continue to support the program by assisting with IECs and potentially helping neighbouring municipalities roll out a similar program.

**Discussion**

The 2015 whale shark season was an interesting one from many aspects. As highlighted in our previous work where the reason for the movement and occurrence of whale sharks at the study site was still in question (Araujo et al., under review) seems to have been partially addressed. Whale sharks were encountered feeding on sergestid shrimps (Lucifer sp.) on multiple days in the months of February and March, having up to 12
individual whale sharks feeding in a small area (GA, pers. obs; Fig. 10). Comparable observations of whale sharks feeding on a similar prey were reported by Rohner et al. (2015). The underlying reason for having identified 93 whale sharks in the 2013 and 2014 seasons remained in question, yet this season provided this key information.

A total of 49 individual whale sharks were identified in the 2015 season, 10 of which were identified by citizen scientists. This is a remarkable contribution, and highlights the potential benefit of close collaboration with dive and tour operators. Whale sharks were mostly male and all but one were juveniles, consistent with previous reports from the area, as well as other coastal aggregations around the world, including that one at Oslob in Cebu province (Araujo et al., under review; Araujo et al., 2014; Rowat & Brooks, 2012).

Over half of the whale sharks identified during the 2015 season had propeller scars on them (53%). This is a significant number of the aggregation, and highlights the risks anthropogenic factors can have on the species. Small propeller scars from fishing pumpboats might not be life threatening on a large fish like the whale shark, yet the long-term impact on the animal’s behaviour remains in question. Association of boats with strikes could lead to the animals to avoid them, or a particular area, which would present a problem when tourism endeavours rely on finding the whale sharks from vessels with propellers. Across the Bohol Sea, whale sharks aggregating at Oslob, also had a large
proportion of individuals with propeller scars (47%, n = 158; Araujo et al., 2014), stressing the risk of vessel collision with the species in a majorly coastal-dwelling country.

Whale sharks were encountered between November and June, with peak season occurring in March. Thirty five (35) individuals were identified throughout this month with a mean of 4.4 per day. LAMAVE’s seasonal work began on February 4th, possibly missing the start of the season in December 2014 or January 2015. Up to 12 individual whale sharks were identified in a single day, making it a site record to date (Araujo et al., under review, reported a maximum of 9 individuals during the month of May 2013). Over 71% of whale sharks were resighted at least once throughout the season, with some individuals resighted on up to 25 different days (LSR-18), spanning over ~2.5 months (January 26th – April 10th). This high level of site fidelity is interesting and sheds some light into the local habitat use by the species. The fact that 63% of individuals resighted on at least 5 different days had been identified in a previous season, and the feeding behaviour observed during this 2015 season, implies that at least some whale sharks return to the same aggregating site to feed. This ability to return to feeding sites with a spatially distributed prey, also suggests whale sharks can create a spatial map. This ability has also been documented in other species of elasmobranchs including freshwater stingrays (*Potamotrygon motoro*), bamboo sharks (*Chiloscyllium punctatum* and *C. griseum*), Port Jackson sharks (*Heterodontus portusjacksoni*) and lemon sharks (*Negaprion brevirostris*) (Edren & Gruber 2005; Schluesssel & Bleckmann 2005, 2012; Guttridge & Brown 2014). The study site lies on the eastern entrance to the Bohol Sea, bringing in the Bohol Jet from the Pacific Ocean, creating a migratory corridor for widely distributed species (Cabrera et al., 2011). This could explain the high level of transience; those individuals that were only sighted once at the study site (29%), whereas those individuals that had previously visited the site and benefited from the food bloom would likely reside longer. Caution must be taken when inferring whale shark movement, seeing as a non-identified individual in an area does not necessarily mean the animal is not there.

The tags deployed at the study site will hopefully help explain some of the behaviour of the sharks whilst they are sighted there. The TDR tags will hopefully be manually retrieved during the next season, and analysis will follow soon after. The satellite tags show some incredible movement by the two juvenile male whale sharks, and highlighted the mobile nature of the species. Transmissions are not accurate enough to depict daily travelling distances, but one can infer that they are moving far and wide on a daily basis. During the 2014 season, one individual (LSR-18) was encountered in barangay Cali-an, Liloan, one day and in San Ricardo the following, covering a minimum distance of 30 km in under 24 hours (Araujo et al., under review). This stresses the importance of protecting large habitat areas, and not single, small sections, at least when largely distributed species are in question such as the whale shark. Threats like collision with boats also pose a problem, as with such wide-ranging movements, the source cannot be pinned down to a single area.

In-water interactions with whale sharks bring in tourists from all over the world and can support highly profitable endeavours (Cagua et al., 2014). The 2015 whale shark season in Southern Leyte saw just short of 600 tourists, a significant decrease from the 2013 season when close to 2,000 tourists were recorded (KASAKA Logbook). This drop in
Whale Shark conservation and ecotourism at Panaon Island, Southern Leyte

tourism was mirrored all across Southern Leyte following supertyphoon Yolanda that made landfall in the Philippines on November 8th 2013. Tour operators come mostly from Padre Burgos, across Sogod Bay, and Yolanda massively affected their businesses as well (GA, pers. comm.). The 2014 whale shark season was a poor one, with only 7 individual whale sharks identified between February and June. The lack of whale shark sightings, possibly linked to the localised effects of the tropical cyclone, and the drop in tourists to the area, unfortunately had profound effects on the whale shark-dedicated tourism, including the closure of various resorts in Padre Burgos.

On a positive note, the whale shark interaction led by KASAKA in neighbouring waters is still rated as the best in South East Asia. This is mainly due to the remoteness and natural beauty of Panaon Island, the overall good visibility in the water, the community-run ecotourism where most of the profits stay with them, the generally good success rate with whale sharks during the season, and finally by zero-tolerance code of conduct policy. These factors that make the whale shark industry in Panaon Island unique, promises a recovery despite the crippling consequences of Yolanda. The in-water data collected on the tourist-whale shark interactions is essential for the development and enforcement of current and future guidelines and code of conduct. Most codes of conduct, on the lack of qualitative data, are based on the precautionary principle in which preventative measures are taken even if cause and effect information is unclear (Kriebel et al. 2001).

Avoidance behaviour was observed on 39% of encounters (n= 126). Some actions by tourists led to avoidance on more occasions: free diving (21.5%), road blocking the whale’s sharks path (75%), splash entry into the water (47.4%), and actively touching the whale shark (66.6%). On 30% of interactions tourists were less than 4 m from the whale shark, and on 61% a motorised vessel was within 20 m of the animal. These results were used during a meeting with key stakeholders in Padre Burgos on March 27th. Operators understood these numbers, and by working closely with KASAKA, these actions will try to be mitigated to minimise whale shark disturbance. Several meetings were held with KASAKA to explain these numbers and address any questions from the members. These data are also important when considering general whale shark interaction guidelines.

Throughout the season IEC campaigns were delivered at local elementary and high schools. Interactive modules proved to be the most successful at delivering key content, and so did activities. It might be more efficient to deliver modules before the end of the school year as students might face fewer distractions. Follow up activities, such as beach cleanups and movie nights, can be very useful at engaging students on a different level and further conceptualise what was delivered during the modules.

Future Work

The whale sharks occurring in the waters off Pintuyan and San Ricardo directly support two alternative livelihood programmes: the whale shark watching ecotourism with KASAKA, and the handmade stuffed whale shark toys by Sea Breeze Women’s Association. Understanding why the whale sharks visit the area every season, how long
they stay, and how far they move are key questions that we aim to answer with our dedicated effort, and for the direct interest of the parties involved. Having observed the whale sharks feeding on a particular type of prey at the study site was an important finding, one that will guide the next step, which is why and what triggers the bloom of these sergestid shrimps. Similarly, how the whale sharks predict and find the blooming prey remains unclear, though it appears spatial mapping might be one of their tools.

In-water interaction data can be used to help manage the industry, and with close collaboration with KASAKA, any disturbances to the animals can be minimised. We maintain a good working relationship with the tour operators that visit Pintuyan, and we will aim to conduct capacity building with their captains and skippers during our next season. Working closely with the industry is key, and benefits include daily whale shark sighting reports, having a researcher onboard engaging with their tourists, and overall working for the protection of the whale shark which also benefits the industry overtime.

Education about ocean health and waste is essential, yet is only a small link in the chain. Proper disposal and having the infrastructure to address the waste management is another link. The health of adjacent ecosystems, including the whale sharks and its prey, are another. Future IEC campaigns will target adult coastal community members, including fishermen, and focus on ocean health and large marine vertebrates that inhabit their local waters. This will help communication between school students and their parents about some of the threats to our oceans, and how by working together, they can be mitigated. Future activities will include snorkelling days and ‘be a scientist’ day when chosen high school students will be taken out on survey and experience real-life scientists at work, following parental consent. During the 2016 whale shark season, modules will be delivered at schools that were not reached this season, and new modules building up on the past ones will be delivered at those already visited. LAMAVE is closely collaborating with Ocean Action Resource Centre (www.oceanactionresourcemcenter.org) in helping bridge conservation and communities through education.

Citizen science is a powerful tool and should be encouraged. Engaging tourists into taking photographs and contributing to the protection of the world largest fish is promising. Conducting presentations and producing materials for tourists to read on, will help collect valuable whale shark sighting data.

Recommendations

The current tourism ordinance of Pintuyan states that any organised People’s Organisation can run whale shark watching ecotourism. Although this is an encouraging idea, the limited number of tourists that visit the area per season is very small to create real benefit to multiple POs. Creating alternative livelihood programmes should generate a sustainable alternative source of income to replace an existing, unsustainable one. The current level of tourism cannot fully provide KASAKA members an alternative livelihood, but more of a supplemental income. We advise the consolidation of the ecotourism in the area, driven by whale shark interaction, and support KASAKA, and other POs, in their endeavours.
We suggest the creation of an accreditation system in keeping with any National Guidelines requiring boat guides and captains undergo training through workshops from specialists and rigorous tests. Safety at sea is very important, and knowing what to do when is imperative. LAMAVE is willing to collaborate with responsible agencies in delivering such content. We advise that everyone involved with whale shark interaction should have proper training and certification.

Create a whale shark reporting system in the municipalities of Pintuyan and San Ricardo, where local fishermen can keep a ‘logbook’ of when the species is present in the area. During the 2016 whale shark season, LAMAVE will aim to conduct IECs with coastal fishermen, and with permission from the mayors, we will include the reporting logbook. This can provide information about the year-round presence of whale sharks in the area.

It is advisable that the municipalities of Pintuyan and San Ricardo develop a joint ecotourism endeavour that will include whale shark watching. This joint endeavour should aim at having strict rules and regulations, a zero tolerance policy, and well-organised and safe infrastructure (boats, briefing area, etc).

Recommendations on the whale shark interaction procedure based on data collected and described in the results can be the baseline of any future guidelines. Most actions seem to occur when there is overcrowding around a single whale shark, especially when there are more than 1 tourist vessel in the interaction area. Therefore, if a scheduling system that is limited per time and number of boats (ideally one vessel per slot) is created, no overcrowding would be observed, leading to less disturbance to the whale sharks and higher customer satisfaction. The minutes are attached from the whale shark interaction stakeholders Padre Burgos meeting on March 27th, where recommendations were made on the interaction procedure (limiting speed, number of people and vessels, time).

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Whale Shark conservation and ecotourism at Panaon Island, Southern Leyte

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Appendices

Appendix 1: Individual LSR-136 (5.5 m male) selected satellite transmissions.
Appendix 2: Individual LSR-25 (5 m male) selected satellite transmissions.