ADVANCING SEABIRD CONSERVATION IN PERU'S ARTISANAL FISHERY THROUGH EDUCATION AND RESEARCH

Final Report to the
Conservation Leadership Programme

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Conservation Leadership Programme

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EXECUTIVE SUMMARY

From May 2005 to May 2008 Pro Delphinus monitored with onboard observers 242 artisanal fishing trips from 9 ports. The majority of trips monitored were of surface longlines or surface drift gillnets, although bottom set nets and trammel nets were also monitored. A total of 84 seabirds were observed captured including Critically Endangered, Endangered, Vulnerable and Near-threatened species like the waved albatross, black-browed albatross, Humboldt penguin, white-chinned petrel, pink-footed shearwater and sooty shearwater. The majority of these takes were by gillnet vessels. Seabird interactions came in the forms of bycatch and targeted take (particularly of waved albatrosses) with bycatch being either retained or discarded. Targeted take and retained bycatch was used for human consumption. The bycatch rate for longline vessels for the ports of Ilo and Salaverry were 0.003±0.056 catch.set^{-1} (mean±SD) and 0.025±0.158 catch.set^{-1}, respectively. Gillnet bycatch for Salaverry was estimated to be 0.111±0.743 catch.set^{-1} with a combined bycatch and targeted catch rate of 1.34±3.66 catch.trip^{-1}. Total annual seabird catch by gillnet vessels for the port of Salaverry was estimated at 697 animals.

Throughout the course of the project we also (1) held regular seabird conservation workshops at ports along the coast targeting fishermen, local officials, and students, (2) produced numerous seabird conservation educational materials in Spanish and (3) participated in publications and national and international meetings and conferences to discuss seabird conservation in the region. This research makes clear the need for the continuation and expansion of similar efforts in Peru to better understand and mitigate seabird-fishery interactions. A series of recommendations for future research and conservation efforts is presented.

1. INTRODUCTION

Beginning in 2003 Pro Delphinus (PD) began actively investigating seabird interactions with artisanal fisheries in Peru. Since that time, PD has conducted interviews with fishermen in 39 ports, recovered and report seabird bands, conducted numerous educational workshops in many ports with fishermen, local officials, and students, and has initiated an onboard observer program to monitor seabird interactions with longline and gillnet fisheries. Support for much of the onboard observer work and educational workshops came from the BPCP in 2005-2006 under our project titled "Assessment of seabird bycatch in Peruvian artisanal fisheries".

The onboard observer program has documented seabird interactions with both longline and gillnets fisheries. These interactions take the form of bycatch and targeted take for human consumption (Awkerman et al. 2006, Pro Delphinus 2006, Mangel & Alfaro Shigueto 2005, Mangel & Alfaro Shigueto 2006). These interactions include the take of Critically endangered, Endangered, Vulnerable and Near-threatened species (IUCN, 2008). Observed longline bycatch has been of black-browed albatrosses *(Thalassarche melanophrys*). Gillnet bycatch impacted black-browed albatrosses, guanay cormorants (*Phalacrocorax bougainvillii*), Humboldt penguins (*Spheniscus humboldti*), sooty shearwaters (*Puffinus griseus*), white-chinned petrels (*Procellaria aequinoctialis*) and pink-footed shearwaters (*Puffinus creatopus*). We have also documented the targeted take of seabirds, primarily waved albatrosses (*Phoebastria irrorata*), for human consumption. Also as part of this project we continued the recovery of seabird bands. This information has further helped us define the scope of seabird interactions with fisheries and the species affected.

Workshops with students, local officials and fishermen held during the project proved an effective means of raising awareness, distributing educational materials, and developing relationships with residents in port communities throughout the country. Over 20 workshops were held and more than 400 fishermen, students, and local officials attended.

As part of this project's previous final report we developed a series of recommendations for future work that would build upon past successes and advance seabird conservation in Peru. The current project was designed to implement many of the recommendations outlined in that report. Chief among those recommendations we listed was the identification and training of community leaders, in the form of a "fisherman ambassador", to assist in promoting seabird conservation. We also conducted fishing gear experiments to better understand how that gear operates in the water. Such experiments are important in selecting appropriate mitigation measures. We also felt it was important to continue and expand onboard observer work. Such work is crucial to quantifying seabird interactions, species affected and important geographic areas for conservation.

These particular components were selected for this project because they would help define future directions of a seabird conservation program in Peru. We felt that ongoing educational efforts would gain most from identification of a fellow fisherman who can both advise us on fishing related issues and work closely with local fishermen along the coast to learn from them and promote seabird conservation. Continuing observer coverage is also urgently needed and is crucial for developing a fuller understanding of the problem and possible solutions. Finally, gear experiments were necessary to better understand how gear operates in the water and to adapt mitigation measures accordingly.

2. PROJECT OBJECTIVES

The project purpose was to build upon past advances in seabird conservation efforts in Peru by (1) continuing to improve our understanding of seabird interactions with the artisanal fleet, (2) generating and disseminating information on seabird/fishery interactions in this poorly studied geographic area, and (3) moving toward the identification and implementation of effective mitigation measures – thereby achieving the overall goal of a more sustainable, responsible and seabird friendly fishery.

The project specific objectives were:

(1) To identify a "fishermen ambassador" to promote seabird conservation among Peru's artisanal fishermen.

(2) To continue educational and training workshops with fishermen and local officials to promote seabird conservation and information dissemination regarding project findings and possible means to mitigate seabird bycatch.

(3) To encourage local researchers and students, through training courses, to get involved in or develop research studies of endangered marine fauna.

(4) To monitor seabird interactions in artisanal gillnets and longlines using onboard observers.

(5) To characterize and quantify aspects of the artisanal fishing process and gear characteristics.

3. METHODS

3.1 Outreach and education

A main focus of this project was to identify a "fisherman ambassador" who would work in port communities to promote seabird conservation and advise Pro Delphinus on fisheries related issues. The work of the ambassador is further detailed in the 'Results' and 'Discussion' sections.

We continued with seabird conservation and training workshops in nine ports along the coast. These were coordinated through the Peruvian Navy and local fishermen associations at each port. Spanish language materials on seabird conservation and mitigation measures - some of which were produced during the project (see Appendices) - were used and provided to attendees. Typically, in a given port several talks were held, separately targeting fishermen or local officials.

We also conducted classes on seabird biology and conservation with science students at the Universidad Cayetano Heredia in Lima and with elementary school students in Ilo, Lima and Piura. This work was intended to promote student involvement in research and conservation locally and to introduce young researchers to marine conservation themes.

3.2 Onboard observer program

Observer methods have been detailed in previous final reports (Pro Delphinus 2006). A total of 93 fishing trips in 6 ports were observed from March 2007 to March 2008. Observers were trained in seabird bycatch monitoring, data collection, and seabird identification. Observers were provided all necessary materials (i.e. data sheets, GPS units, disposable cameras, etc.). Observers were fisheries technicians, biologist or experienced captains, and operated on both longline and gillnet vessels. Observers

worked throughout the entire year to cover both the shark and mahi mahi seasons. Data were managed in a relational database.

3.3 Fishing gear experiments

TDRs were deployed on four fishing trips, two out of the port of Salaverry in central Peru and two out of the port of Ilo in southern Peru. Given the variation in gear design based upon target species, one trip in each port was on a vessel targeting sharks while the other was on a vessel targeting mahi mahi. TDRs were deployed on a total of 20 sets.

Observers were trained in TDR deployment and data recovery techniques. Observers were also provided with data sheets and a Spanish language guide on TDR configuration, deployment and data collection. Data collected included variable such as: target species, gear configuration, set and recovery time and location, weather conditions, set direction, bait type and state, etc. Except for the first trip, water entry and exit of the TDRs was monitored by the observers and data was downloaded following each set. TDRs were set to monitor depth every second and external temperature every 30 seconds.

Following the initial deployment of the TDRs it became apparent that the weight of the TDR itself (~40g) could be affecting the sink rates of the branchlines. This is due to the fact that Peruvian fishers use small weights on branchlines for sharks (~ 40g) and often use no weight during mahi mahi sets. To avoid biasing the sink rate data we fashioned out of styrofoam small floats that were taped to the TDRs and used on all subsequent deployments. The floats were designed to make the TDRs approximately neutrally buoyant.

TDRs were deployed in a number of configurations. In general, gear design differed based upon the variables listed below:

1. Target species: sharks vs. Mahi mahi
2. Use of cable or nylon monofilament leaders
3. Use of weights
4. Design of branchlines (including use of “tanza” and “driza”[1])
5. Presence/absence of float at connection of branchline with mainline

3.4 Beach walks

In order to compile more data on seabird mortality, beachcast bird surveys were started intermittently in 2003 and, since April 2007, these walks have been conducted every one to two months. The 12km long Ite beach, located in southern Peru near the port of Ilo, has been surveyed 9 times from April 2007 - July 2008. Additionally, two other beaches have been identified and surveyed: Enersur and Bombom, also in southern Peru.

Beach walks were performed in a designated stretch of the beach by at least two persons trained in seabird identification who were carrying spray paint with which seabird skulls (and marine mammals) were marked to avoid recounting in future surveys. All seabird carcasses were counted and identified. Samples (typically skulls) and photographs of carcasses were also frequently collected to assist with documentation and species identification.

[1] “Driza” is the term used to refer to nylon multifilament cord used on branchlines. “Tanza” is the term used for nylon monofilament. Tanza sections can include thicker diameter monofilament placed above a smaller diameter monofilament leader or “reinal”.

4. RESULTS

4.1 Outreach and education

4.1.1 Selection and work of our "Fisherman ambassador": Following a recommendation from our 2005-2006 project's final report, the identification and training of community leaders to promote seabird conservation, fisherman Francisco "Chaval" Bernedo was selected among the fishing community in Ilo as our seabird project's "fishermen ambassador". Chaval, who has been fishing for over 20 years, has also worked as an onboard observer for Pro Delphinus since 2006. His leadership skills, motivation, interest in marine fauna conservation, and good rapport with fishermen were key to being selected to promote seabird conservation in port towns.

Chaval, together with Pro Delphinus team members, conducted talks about seabird conservation with fishermen and local authorities in nine of the principal ports along the Peru coast. He not only shared his experiences with seabirds and fisheries, but also introduced talk attendees to seabird conservation initiatives taking place in other countries - Chaval had the opportunity to participate in the 1st South American Fishers Forum in Brazil in December 2006. Also, as part of his role as the ambassador for seabird conservation, Chaval gathered information about the differences in the fishing gear used, as well as fishermen's seabird knowledge in most of the sites he visited by talking one-on-one with local fishermen. He was also actively involved in the fishing gear experiments conducted (deployment of TDRs) and bi-monthly beach surveys to quanitify beachcast carcasses of seabirds, marine mammals and other fauna.

4.1.2 Educational workshops

4.1.2.1 Conservation training workshops with fishermen: A total of 13 workshops were conducted with an attendance of approximately 187 fishermen (Appendix 1). Nine ports were visited and workshops were conducted with the assistance of Chaval, our fishermen ambassador. Educational material such as Peruvian seabirds guide, seabird safe management and handling, and seabird conservation brochures were distributed to all participants, as well as seabird stickers, posters and t-shirts. Workshops were aimed at raising awareness on marine and seabird conservation among fishermen. These workshops also became an excellent opportunity for collecting information not only regarding the types of seabirds fishermen see and catch but also information regarding fishing gear characterisitcs and how those characteristics change from port to port.

Several comments from the talks were of note. First, talks held in the port of Ilo included the participation of women who are sometimes boat owners or administrators. Second, fishermen from the port of San Juan mentioned that the seabird species most frequently caught were Humboldt penguins and guano birds such as boobies and cormorants. They noted that this catch mainly occurred in gillnets. In the southern ports, fishermen confirmed the use of albatross feathers for lures during the 'bonito' season (*Sarda chilensis chilensis*). This practice was also mentioned during the ACAP Waved Albatross Action Plan meeting in Lima. However, this practice likely no longer occurs. In later discussions with fishermen they indicated that they now use lures made of goat hair to replace those made of albatrosses feathers (see photo in Appendix 4). Also, fishermen acknowledged the occasional consumption of albatross meat while at sea.

In general, for those ports visited, the black-browed, grey-headed and Buller's albatrosses were noted as the most commonly observed albatross species. Waved albatross were reported as less frequently observed.

Several recommendations were developed throughout the course of the talks:

- Conduct workshops before the beginning of the fishing season for ports with high seabird interactions.
- Explore more the interactions of sea lions with fisheries.

4.1.2.2 Conservation training workshops with local officials: A total of eight workshops were held in eight ports (Appendix 1). Seventy-five local marine officials from the General Office of Captainships and Coastguards (DICAPI in spanish) participated. DICAPI officials are in charge of law enforcement regarding marine endangered animals, fishing quotas, etc. Educational packets including seabird conservation brochures, identification guide and a copy of current laws regarding status and conservation of seabirds and other marine endangered animals were distributed in all of the DICAPI offices visited.

4.1.2.3 Classes with university and elementary school students: A total of seven training courses in 5 schools were held (Appendix 1). Approximately 220 students attended the classes. Approximately 90% of the student participants were from fishing communities. Workshops were specifically designed for university and elementary school students and included topics on seabird conservation and conservation of the marine environment. Elementary school activities consisted of activities such as reading stories, painting competitions, and beach cleanups. Students from Lima were actively involved in raising awareness as part of their educational program and requested from Pro Delphinus a more in depth knowledge on marine endangered fauna.

Just prior to the start of this project we also completed a 2 credit university level course on seabird biology and conservation with 83 students at the Universidad de Trujillo, near the port of Salaverry. This course was attended not only by students in Trujillo but also by students from several other universities who travelled to Trujillo for the course.

4.1.3 Materials produced during the project: Appendix 2 Figures 1 through 6 show the updated educational materials produced for the project. These include a revised seabird identification brochure based upon an earlier version. Stickers were also produced for a second time and in greater quantity. A new handout was also created that details safe handling and release procedures for seabirds that are captured alive. Other materials produced include wallet-sized calendars and Humboldt penguin conservation brochures and stickers.

Two t-shirts (Appendix 2, figures 7 and 8) were also designed. One was targeted to fishermen and stresses the role of a responsible fisherman and encourages their participation in seabird conservation. The second is meant for a younger audience and features penguins and a “clean ocean” theme.

We also note that the Peru office of Conservation International drew attention to the project through a posting to their website (Appendix 3). Peru’s ministry of Fisheries (PRODUCE) also requested copies of all PD educational materials. We provided 2,000 copies of these materials which PRODUCE could use and distribute through their offices at ports along the coast.

Additionally, as an alternative means to raise awareness about waved albatrosses among the fishing community, a comic book titled “Vivan los pajarotes” was produced with the aid of fishermen themselves (Appendix 2, Figures 9 and 10; Appendix 4). The central theme of the comic book was ‘los pajarotes’ – the common name for albatrosses in Peru. The comic book mixes in themes such as albatross biology and conservation and threats they face and presents the information in a comic format and using their slang and typical personages in port towns.

We also produced two informational radio advertisements that are regularly broadcast on the radio in the port of Ilo. They provide general and specific information on seabirds, what to do with entangled birds and to whom this information should be provided.

Finally, we also prepared several murals at the port of Salaverry (Appendix 4) that ask for the help of fishermen in managing their garbage at sea and to not consume se turtle and seabird meat.

4.1.4 Participation in documents and meetings: In the past year PD and its members have been actively involved in a number of national and international meetings, conferences, and peer reviewed publications regarding seabird conservation and fisheries interactions. These activities are summarized below.

- Collaboration with information provision and reviews of the Action Plan for the Waved Albatross, prepared by Dr. Jaime Janhcke.
- Participation in the Workshop on an Action Plan for the Waved Albatross, coordinated by ACAP and the Ecuadorian and Peruvian Governments, Lima, Peru, 11-12 June 2007. Four staff members attended and actively participated in the meeting.
- Participation in the ACAP 3rd Meeting of the Advisory Committee and the preceding Bycatch Working Group held in Valdivia, Chile, 17-21 June 2007.
- Participation in the Birdlife International/American Bird Conservancy Workshop on Seabird-Fishery interactions in Peru held in Lima, Peru, 25-27 June 2007. Comments on the meeting's final report were provided to organizers ABC and Birdlife.
- We also note the recent publication: Awkerman, J., M. Wesdtbrock, K. Huyvaert and D. Anderson. 2007. Female based sex ratio arises after parental care in sexually dimorphic waved albatross (*Phoebastria irrorata*). The Auk 124(4): 1336-1346. This work was based in part on band return data collected as part of this ongoing project.

4.2 Onboard observer program

From March 2007 - March 2008 we observed 93 fishing trips (551 sets) for seabird interactions. These consist of 45 longline and 48 gillnet trips. Trips monitored were from a total of 6 ports however the majority of trips monitored were from the ports of Ilo, Salaverry, and San Jose. Trips monitored out of Ilo were exclusively of longline vessels. Trips from San Jose were of surface driftnets and bottom set nets, including trammel nets. Trips from Salaverry consisted of both longlines and surface drift gillnets.

During the study period a total of 7 seabirds were documented as captured. These include 2 waved albatrosses captured with hook and line to be eaten by the boat crew and 1 waved albatross, 2 Humboldt penguins and 2 white-chinned petrels that were entangled in gillnets. The albatross and 1 petrel were released alive while the other animals died in the nets (1 of the 2 penguins was eaten by the crew).

4.2.1 Observer effort: To provide a more useful overview of longline bycatch we will present results based upon the entirety of the PD seabird bycatch monitoring project.

From May 2005 to May 2008 we surveyed a total of 242 fishing trips. Sampled ports were Paita, Constante, Supe, Salaverry, Chimbote, Ancón, Callao, Pucusana, San Juan and Ilo (Figure 1; Table 1). The number of ports sampled increased in comparison to our previous final report in 2006. Additional observers were placed in northern Peru ports such as Paita, Constante, Supe and San José to accomplish one of our objectives for the 2007 CLP project - to expand our onboard observer program in the northern part of the country.

Table 1. Number observer trips by port and gear type, May 2005-March 2008.

Port	Longline	Gillnet	Mixed Net*	Trammel Net
Paita	4			
Constante		7		
San José		18	7	6
Salaverry	24	55		
Chimbote	2			
Supe		1		
Ancón	2			
Callao	13			
Pucusana	12			
San Juan	1			
Ilo	90			
TOTAL	148	81	7	6

* Mixed net refers to vessels that set multiple gear types during a set, i.e. surface and bottom set nets.

The majority of fishing trips monitored comprised vessels using longlines (61%) and gillnets (33%; Table 2). Other fishing gear used in remaining fishing trips observed were mixed nets and trammel nets. Longlines were set almost exclusively at the sea surface, while gillnets were set either on the surface (76%) or at mid-water/bottom (24%). Observer effort on gillnet vessels was limited to the northern Peru in the ports of Constante, Supe, San José and Salaverry.

Table 2. Observer trips by fishing gear type and fishing depth.

Gear type	Superficial	Mid-water	Demersal	Superficial & Demersal
Longline	146	1	1	
Gillnet	61		19	1
Mixed Nets			7	
Trammel Net			6	

Most of the trips observed (87%) targeted mahi-mahi and sharks, which are the species and group of species responsible for the two major artisanal fisheries in Peru. Longlines, gillnets and mixed nets were used to capture sharks while only longlines were used to capture mahi-mahi. Other cartilaginous fishes captured were guitar fish, rays and smooth-hounds. These were captured using gillnets. Bonito, Peruvian weakfish, eels, Peruvian rock seabass, sole, mullet and flying fish were also targeted by some observed gillnet vessels.

4.2.2 Seabird interactions: Since May 2005, a total of 84 seabirds were captured in the 242 fishing trips monitored along the Peruvian coast (Table 3). Among the species with higher interaction rates were the Critically Endangered waved albatross (18 birds), Vulnerable White-chinned petrel (18 birds) and Near Threatened guanay cormorants (15 birds). Other seabirds captured included Vulnerable Humboldt penguin (6 birds), Near threatened sooty shearwaters (6 birds) and Endangered black-browed albatrosses (3 birds). One individual of each of the following species was captured during the three years of monitoring: Blue-footed booby (*Sula nebouxii*), Peruvian booby (*Sula variegata*), and Inca tern (*Larosterna inca*). Additionally, species level identification for eight albatrosses and four petrels was not recorded and photographic records were not available for further identification.

Table 3. Summary of seabirds captures by species.

Species	# captured
Black-browed albatross	3
Blue-footed booby	1
Guanay cormorant	15
Humboldt Penguin	6
Inca tern	1
Peruvian booby	1
Pink-footed shearwater	3
Sooty shearwater	6
Waved albatross	18
White-chinned petrel	18
Unknown albatross	8
Unknown petrel	4
TOTAL	84

4.2.2.1 Longlines**:** A total of 2 black-browed albatrosses, 4 white-chinned petrels, and 1 unidentified petrel were reported as bycatch by longline vessels. Both albatrosses died after getting hooked in the beak. Both were captured by vessels from the port of Ilo. The animals were discarded. Interactions with white-chinned petrels and the unidentified petrel occurred in Salaverry and Paita, respectively. Three of the white-chinned petrels were hooked during the hauling of the gear and later released alive while the remaining white-chinned petrel was found hooked and dead and was discarded.

4.2.2.2 Mixed nets: One cormorant was reported caught in a mixed nets vessel. The animal became entangled during net retrieval and was after released alive.

4.2.2.3 Gillnets: Most (90%) of the seabird interactions observed occurred on gillnet vessels. One black-browed albatross, 1 blue-footed booby, 14 guanay cormorants, 6 Humboldt Penguins, 1 Peruvian booby, 6 pink-footed shearwater, 3 sooty shearwater, 18 waved albatrosses, 14 white-chinned petrel, 1 Inca tern, 8 unidentified albatrosses, and 3 unidentified petrels were captured.

Over half (55%) of the birds caught in gillnets were reported as drowned after becoming entangled. This includes 1 Peruvian booby, 13 guanay cormorants, 5 Humboldt penguins, 1 blue-footed booby, 8 shearwaters, 10 white-chinned petrels, 1 Inca tern, and 2 unidentified petrels. Most birds were discarded dead, but guanay cormorants and 4 penguins were retained by the crew for consumption. Almost all of the cormorants were brought to shore to be eaten.

Additionally, 1 black-browed albatross, 2 guanay cormorant, 1 Humboldt penguin, 1 shearwater, 1 waved albatross, and 4 white-chinned petrel were reported as entangled but alive. In most cases, the entanglement occurred during the net haul. All of the birds were released alive except the black-browed albatross which was killed and eaten by the crew.

Finally, 29 birds (35%) were intentionally captured with a baited hook during gillnet vessels operation.

4.2.2.4 Trammel nets: No seabirds were observed interacting with trammel nets.

4.2.3 Seabird interactions by port: Almost all (98%) seabird interactions occurred in northern Peru with the port of Salaverry having the highest number of observed interactions (Table 4). Although Ilo was the port with the most trips monitored (a total

of 90 trips) exclusively in longline vessels, only 2 seabird bycatch events were reported in three years of monitoring.

Table 4. Seabird captures by port.

Species	Paita	Supe	San José	Salaverry	Ilo
Black-browed albatross				1	2
Blue-footed booby				1	
Guanay cormorant			1	14	
Humboldt Penguin		1	2	3	
Inca tern				1	
Peruvian booby				1	
Pink-footed shearwater				3	
Sooty shearwater		1		5	
Waved albatross				18	
White-chinned petrel				18	
Unidentified albatross				8	
Unidentified petrel	1			3	
TOTAL	1	2	3	76	2

4.2.4 Bycatch vs. targeted catch:

4.2.4.1 Targeted catch: 35% of the birds (29 animals) with reported interactions with fisheries were baited. Over half of the birds (17) were waved albatrosses. Twenty five of 29 (86%) were albatrosses. Only two waved albatrosses were released alive after being purposely caught. Reasons for doing this are unknown but both birds carried bands that were kept by the crew of the boat. One of the birds was left with a plastic band only. All the other waved albatrosses were consumed either in the boat or on land.

Targeted take of other birds included 8 unidentified albatrosses and 3 white-chinned petrels. All the targeted captures took place in Salaverry. These captures occurred in 8 gillnet trips and baited hooks were used to lure the birds. Dolphin meat or shark liver were used as bait.

4.2.4.2 Bycatch: 63% of birds (53 animals) were incidentally caught. Bycatch was reported on 6 longline and 17 gillnet trips. The majority of the birds incidentally caught were white-chinned petrels (15) and cormorants (15), followed by sooty shearwaters (6) and penguins (5). Three black-browed albatrosses were also caught – one by a gillnet vessel in Salaverry and two by longline vessels in Ilo. The two Ilo captures were recovered dead and discarded. The Salaverry capture was recovered alive but killed and eaten by the vessel crew. Also of note is the first observed bycatch of a waved albatross. This occurred in Salaverry where the animal was entangled in a gillnet. It was recovered alive and released.

Most white-chinned petrels were entangled in gillnets, with only 4 hooked on longlines. The majority were recovered dead (mainly in gillnets) and discarded after hauling. All white-chinned petrels were caught in Salaverry.

All cormorants were caught in gillnets and almost all were recovered dead. Cormorants were typically retained and brought to shore for human consumption.

All observed penguin bycatch occurred in northern Peru in gillnets (Salaverry, Supe and San Jose). The majority of animals, while recovered dead were retained to be eaten. One penguin was caught alive and was brought to port (in Salaverry) by the captain of the boat. The fate of the animal is unknown.

4.2.5 Discarded vs. retained catch: Twenty seven percent of the birds caught were discarded, while 42% of birds were retained for human consumption. Discarded birds, all of which were recovered dead, included 1 Peruvian booby, 2 pink-footed shearwaters, 6 sooty shearwaters, 11 white-chinned petrel, 1 inca tern and 2 black-browed albatrosses. Consumption of seabirds was observed in the northern Peru ports Salaverry, Supe and San Jose. Of the 35 birds retained for consumption, 17 were recovered dead and 18 were recovered alive. Almost all of the live birds (14 waved albatrosses and 3 white-chinned petrels) that were retained for consumption had been purposely caught. One live black-browed albatross was incidentally captured in a gillnet. Fishermen consumed in their boats 1 black-browed albatross, 4 penguins, 1 cormorant, 1 white-chinned petrel and 10 waved albatrosses. Twelve cormorants, 4 waved albatrosses and 2 white-chinned petrels were taken back to port to eat. Another 10 birds captured (1 waved albatross, 8 unknown albatrosses and 1 unidentified petrel) were kept by fishermen but use was not reported.

4.2.6 Fishing effort and CPUE:

4.2.6.1 Longlines: Since May 2005 this project has observed 148 trips (1,047 sets; 1,046,558 hooks) in 8 ports. A total of seven seabirds were reported as bycatch on these 148 trips. The majority of longline trips and reported bycatch were from the ports of Ilo (90 trips; 638 sets; 468,018 hooks) and Salaverry (24 trips; 157 sets; 191,820 hooks).

Since the ports of Ilo and Salaverry have the greater observer effort as well as greater observed longline bycatch we prepared an overall bycatch CPUE estimate for these ports in terms of catch.set^{-1}. Ilo had an observed catch of 2 birds resulting in a bycatch CPUE estimate of 0.003±0.056 catch.set^{-1} (mean±SD; range: 0-1). Salaverry had an observed bycatch of 4 birds resulting in a bycatch CPUE estimate of 0.025±0.158 catch.set^{-1} (range: 0-1).

4.2.6.2 Gillnets: Since May 2005 this project has observed 94 trips (571 sets) in 4 ports. A total of 48 seabirds were reported as bycatch on these trips with another 29 targeted captures. The majority of gillnet trips, bycatch and targeted take were from the port of Salaverry (45 trips; 407 sets).

Since the port of Salaverry had the greater observer effort as well as greater observed gillnet bycatch and targeted take we prepared an overall bycatch CPUE estimate for this ports in terms of catch.set^{-1} and catch.trip^{-1}. Salaverry had an observed bycatch of 45 birds resulting in a bycatch CPUE estimate of 0.111±0.743 catch.set^{-1} (range: 0-12) or 0.818±2.35 catch.trip^{-1} (range: 0-12).

Targeted take and total seabird take (bycatch and targeted take combined) was also calculated for Salaverry gillnet vessels. This is only estimated as catch.trip^{-1} since targeted takes occurs independent of fishing effort. Twenty-nine seabirds were targeted for capture by Salaverry vessels resulting in a targeted take CPUE estimate of 0.527±1.86 catch.trip^{-1} (range: 0-10). The overall seabird catch rate by Salaverry gillnet vessels (combining bycatch and targeted take) was 1.34±3.66 catch.trip^{-1} (range: 0-22).

4.2.6.3 Salaverry catch estimate: Based upon daily shore based monitoring of fishing effort in Salaverry we calculated that there were an average of 518.2±90.0 gillnet trips (range: 411 to 620 trips/year) and 300.7±25.2 longline trips (range: 272 to 341 trips/year) per annum, for the years 2002 to 2007 (Table 5).

Based upon the catch rates derived in this study and the data on Salaverry fishing effort from 2002 to 2007, we are able to estimate the number of seabirds captured by the

gillnet fleet. To derive these values we applied the CPUE rates calculated in this study (from section 4.2.6.2) to the estimated number of gillnet sets for the years 2002 to 2007. Number of sets was estimated by multiplying the known number of trips annually by the average number of sets per trip as determined by this study (7.4 sets per trip for gillnet vessels).[2] For the years 2002 to 2007 the estimated annual number of seabirds bycaught and targeted by gillnet vessels in the port of Salaverry was 426 (95% CI 147-704)) and 273 (95% CI 12-534), respectively (Table 5).

Table 5. Estimated annual catch of small cetaceans by gillnet vessels for the port of Salaverry for the years 2002-2007, mean (CI).

Year	# trips	Estimated # sets	Estimated bycatch	Estimated targeted	Estimated total catch
2002	411	3,054	338 (117-559)	217 (10-424)	553 (146-960)
2003	620	4,607	509 (176-843)	327 (14-639)	834 (220-1,448)
2004	421	3,128	346 (119-572)	222 (10-434)	566 (150-983)
2005	572	4.250	470 (162-778)	302 (13-590)	770 (203-1,336)
2006	593	4,406	487 (168-806)	313 (14-612)	798 (211-1,385)
2007	492	3,656	404 (140-669)	259 (11-507)	662 (175-1,149)
Average	518	3,850	426 (147-704)	273 (12-534)	697 (184-1,210)

4.2.7 Band returns: To date we have collected information on 128 band return records from sources located along the Peru coast. The band returns date back to the late 1990s. These returns have come from 9 different ports and consist of records of waved albatrosses, a northern Buller's albatross, Humboldt penguins, a northern giant petrel, royal terns, laughing gulls, a Chatham albatross, and other unidentified species. One hundred and seven of these band returns are of waved albatrosses, the majority of which come from the port of Salaverry.

For January 2007 to August 2008 we received information on seven banded animals. These consist of 6 waved albatrosses and 1 northern Buller's albatross. Four of the bands were reported from the port of Salaverry, 2 from San Jose, and 1 from Callao. Three of the captured waved albatrosses from Salaverry were reportedly taken using hook and line for the purpose of consumption. One waved albatross band from San Jose was reported by the fisherman as gillnet bycatch while the other was found dead on a beach. Band returns during the project were much lower than previous years. Possible reasons for this are addressed in the discussion.

The band return of the northern Buller's albatross was also of particular interest. This animal was reported as longline bycatch by a fisherman from the port of Callao. He indicated that the animal drowned. This band return was communicated to New Zealand officials who indicated that this is an unusual return since this species is a very rare bycatch species. They also noted that this animal was possibly 40 years old or older.

4.3 Fishing gear experiments

TDRs were deployed in a total of 20 sets from the two ports. During those sets, 56 TDRs were deployed. Of those 56, data was successfully recovered from 49 units. Given the wide variation in the depths reached by the TDRs we prepared several measurements as a means to compare results. First we determined the average depths reached by each TDR and calculated the sink rate to that depth. Second, in an attempt to standardize across TDRs we calculated the time to reach 5m depth and the sink rate to 5m.

Two TDRs were deployed on a Salaverry longline vessel fishing for sharks (Table 6). The two TDRs were deployed on 2 sets. Total branchline length was 3.5 fathoms (6.4

[2] A similar estimation is possible for the longline fleet but was not calculated given the low observed bycatch and smaller total observer effort.

meters)[3]. Each branchline had a 38g weight between the branchline and leader. Gear was set between 6:30 and 7:30 in the morning and retrieved between 10:00PM and 12:30AM (Table 7).

Average depth reached by the TDRs was 4.5 m and the maximum depth was 11.5m (Tables 7 and 8, Figure 2). Average sink rate to average depths ranged from 0.041 m/s to 0.269 m/s. Average time to 5m was 81.3 seconds (range: 53-113 seconds) and average sink rate to 5m was 0.068 m/s (range: 0.044-0.094 m/s). These times are only approximate because TDRs were set to record upon water entry. Average water temperature was 17.88 ^{o}C.

Three TDRs were deployed on 10 sets of a longline trip targeting sharks from the port of Ilo (Tables 6, 7, 8 and Figure 3). Gear was typically set in the mid- to late morning and retrieved around sunrise the following day. Branchline lengths were longer than those of Salaverry, ranging from approximately 12m to 14m.

The three branchlines on which the TDRs were placed were each configured slightly differently and are therefore considered separately. Average depths ranged from 9.9 to 11.7 meters with a maximum depth of 19.5m. Average sink rates to each TDR's average depth ranged from 0.134 m/s to 0.190 m/s. Times to 5m ranged from 16.9 to 23.2 seconds and sink rates to 5m ranged from 0.233 to 0.315 m/s. Average water temperature was 16.6 ^{o}C.

In January 2008 three TDRs were deployed on 6 sets for mahi mahi on a vessel out of Ilo (Tables 6; Figure 3). Mahi mahi sets are typically much shorter than shark sets, with multiple sets occurring daily (Table 7). Sets monitored occurred in the morning or afternoon and lasted between 1 and 4 hours. Branchline lengths were approximately 5.5 m and weights were not used.

Average TDR depths ranged from 4.4 to 5.1 m with a maximum depth of 9.5 m (Table 8). Average times to average depths ranged from 31.3 to 35.0 seconds and sink rates to average depths ranged from 0.16 to 0.186 m/s. Average times to 5m ranged from 31.0 to 48.5 seconds and sink rates to 5m ranged from 0.19 to 0.123 m/s. Average water temperature was 24.34 ^{o}C.

In February 2008 three TDRs were deployed on 2 sets, one each for mahi mahi and sharks, from Salaverry (Table 6). The shark gear was cut and never recovered. The mahi mahi gear was also cut but pieces were recovered the next day, including 2 of 3 TDRs. Gear design for the mahi mahi and shark sets was the same, although leader length for the mahi mahi set was 36 cm while 87 cm for the shark set. Average TDR depth for the mahi mahi sets was 6.8 m with a maximum of 18.5 m, although these times may not be representative of typical sets given the cut of the mainline (Tables 7 and 8, Figure 2). The average time to 5m was 145 seconds and the average sink rate to 5m was 0.04 m/s. Average water temperature was 24.69 ^{o}C.

4.4 Beach walks

A total of 12 beach walks were conducted from April 2007 to July 2008 in southern Peru, 9 at Ite beach, 2 at Enersur beach and 1 at Bombom beach. Among the species identified were albatrosses, boobies, giant petrels, guanay cormorants, red legged-cormorants, cormorant spp., gulls, Humboldt penguins, pelicans, shearwaters, small petrels and vulnerable white chinned petrels (Table 6). Preliminary results show that most of the beached birds surveyed were boobies (45%) and cormorants (46%) followed by pelicans (4%) and small petrels (2.5%). During at least three of the Ite surveys,

[3] Peruvian fishermen often refer to gear measurements in terms of "brazadas" which loosely translates into fathoms. 1 fathom = 1.8288 meters.

large numbers of boobies and cormorants were encountered freshly dead and purse seine fishing vessels were noted fishing close to shore (regulations forbid purse seine vessels from fishing within 5km of shore). On two occasions, guanay cormorants were found entangled in a fishing line.

Table 6. Number of seabirds surveyed per beach.

Species	Ite beach	Enersur beach	Bombom beach
Albatrosses	2	3	
Boobies	1,407	345	63
Guanay cormorants	1,047	6	
Red-legged cormorant	6		
Cormorant spp.	757	48	9
Giant Petrels	3	1	
White-chinned petrels	8	1	
Small petrels	87	8	5
Humboldt Penguins	28	7	
Pelicans	103	66	11
Gulls	2		
Shearwaters	13		

5. DISCUSSION

5.1 Outreach and education

Educational initiatives continue to form a core component of this and all Pro Delphinus projects. In the past year we have had the opportunity to visit many fishing communities and discuss seabird interactions with fishermen, boat owners and local officials. This has given us new insights into the scope of these interactions and potential ways forward. Fishermen have told us of the past use of albatross feathers for the making of lures. They have also discussed the consumption of seabirds and the species they see at sea. We believe this work continues to raise awareness among fishermen and their communities and builds partnerships which can help facilitate future initiatives.

We are particularly pleased with the efforts of fishing captain Chaval and his success in reaching out to his fellow fishermen during our conservation workshops. His participation in our seabird program has been very helpful. He was key team member of our educational work and his insights and rapport with his fellow fishermen helped in transmitting our message to them. Chaval showed great interest in taking part of other activities of our seabird project such as TDRs deployment and beach walks. In fact, he took the initiative to identify new beaches in which bird surveys could take place. Having been elected as our fishermen ambassador has been rewarding for Chaval as well. In order to continue with his efforts to conserve marine endangered animals, he has been selected to attend a training workshop in Mexico in October 2008. There he will acquire additional knowledge and tools that will help him conduct a conservation project and inspire conservation in his community.

We have also focused much effort on promoting ocean and seabird awareness by working with elementary, high-school, and university students. This work has come in various forms, such as the holding of a university credit course on seabirds at the Universidad de Trujillo, preparing World Ocean Day celebrations at local elementary schools and holding regular classes on marine conservation with children at grade

schools in southern Peru. Again the long term goal here is to raise local awareness and involvement in these issues.

Perhaps the most visible progress this past year can be seen with the attention now being focused on the waved albatross. We were pleased to participate in the various meetings held recently and hope that the attention will lead to greater cooperation, availability of information, and resources for carrying out research and conservation projects at local, national and international levels with waved albatrosses specifically and seabird-fishery interactions generally.

5.2 Seabird-fishery interactions

5.2.1 Fisheries bycatch: Results from this year's project generally reinforce findings from previous years. Seabird bycatch was documented in both artisanal longline and gillnet fisheries. The observed longline bycatch CPUEs of 0.003±0.056 catch.set^{-1} in Ilo and 0.025±0.158 catch.set^{-1} in Salaverry are relatively low in comparison with other longline fleets. We note, however, that this fleet is large and expanding so seabird bycatch may not be insignificant. Unpublished data from IMARPE states that in 2002 a total of 11,316 longline trips were conducted by Peru's artisanal fleet (ca. 90,528 sets/year). It is also noteworthy that these seabird interactions occurred at two separate ports spanning almost the entire length of Peru's coast (a third bycatch event was reported by a fisherman in the port of Callao). This suggests that seabird bycatch may be occurring throughout the country although the species affected in each port or region may vary given species' different distributions.

Gillnet bycatch was higher than longlines and consisted of more and different seabird species – many of which have declining or threatened populations. Onboard observers recorded the capture of cormorants, Humboldt penguins, white-chinned petrels, black-browed and waved albatrosses, pink-footed shearwaters, sooty shearwaters, blue-footed boobies, Inca terns, and other petrel or shearwater species. The most affected were cormorant species which composed 30% of the bycatch. Taken together, the four most commonly bycaught species - cormorants, white chinned petrels, Humboldt penguins and sooty shearwaters – made up 79% of all gillnet interactions. The estimated bycatch CPUE for the surface drift gillnet fleet (observed out of the port of Salaverry) was 0.111±0.743 catch.set^{-1} or 0.818±2.35 catch.trip^{-1} – that is, about 1 seabird bycatch event per trip. These rates are considerably higher than the CPUE for longline vessels and raise concern given the size of the fleet (an estimated 63,000 gillnet trips were reported for the year 1999; Estrella *et al*. 1999, 2000). Our estimate of captures for the port of Salaverry alone was 426 bycaught and 273 targeted by gillnet vessels each year (Table 5). It is likely, therefore, that seabird bycatch by surface gillnet vessels in Peru is on the order of thousands of animals.

The observed bycatch of a waved albatross (see cover photo) is also notable. While previous information from band returns and discussions with fishermen suggested that this species was bycaught this is the first documented occurrence. In this particular event the animal became entangled in a gillnet while trying to eat a piece of bait. While this animal was released alive, given the documented targeting of waved albatrosses for human consumption, other bycaught animals may not share the same fate. Confirmation that waved albatrosses are bycaught in the gillnet fishery reinforces the need for effective conservation measures for this critically endangered species that address incidental as well as targeted take. The recovery of a waved albatross band from a fisherman in San Jose (who reported the animal as bycaught in a gillnet) further suggests that waved albatrosses are interacting and being bycaught by fisheries regionally. Conservation measures and activities must therefore also be designed at the appropriate scale and address bycatch as well as targeted take.

The addition of observers to the port of San Jose has provided us information for several other fisheries (bottom set nets and trammel nets) and another portion on the country (northern Peru). The bycatch in this fishery of 2 Humboldt penguins reinforces the fact that gillnet bycatch is occurring at various ports along the coast. While bottom nets may be less of a risk for seabirds generally, Humboldt penguins (as well as marine mammals and sea turtles) may still be at risk from these nets since any entangled animals will likely drown (although no seabird bycatch has yet been observed in these nets).

It is also important to reiterate the distinction between discarded and retained bycatch. Most of the penguins, cormorants, and white-chinned petrels entangled were retained for consumption either by the boat crew or brought to shore for consumption at home or sale in the market. In the case of the black-browed albatross, this animal was entangled but brought aboard alive where it was then killed and eaten. The fact that these seabird captures are not necessarily undesirable to the crew should be taken into account when developing educational campaigns or proposing the use of bycatch mitigation measures. The interaction of black-browed albatrosses and white-chinned petrels with both the longline and gillnet fleets also indicates that these two species are at increased risk.

One should also remember that, while large, Peru's artisanal fleet is but one of the fleets operating in Peru's waters. As discussions at the ACAP Waved Albatross Action Plan meeting made clear, there are also industrial dermersal longliners, industrial purse seiners for anchovy, and industrial purse seiners for tuna operating within or just outside Peruvian waters. There is little or no information available on seabird interactions with these fleets and they do not actively employ seabird bycatch mitigation measures (E. Goya pers com).

5.2.2 Targeted take: The targeted take of seabirds further reinforces the challenge of reducing seabird mortalities in the fishery. This practice, documented by onboard observers in the port of Salaverry, mainly targeted waved albatrosses. We estimated an average annual targeted take of 273 animals for the port of Salaverry, the vast majority of which would be waved albatrosses. Discussions with fishermen suggested that this practice is related to two factors: (1) low capture rates of target fish species (particularly during the austral winter) and (2) the limited food taken to sea by boat crews during extended fishing trips. Targeted take was the primary threat to waved albatrosses identified during the study although band returns provided by fishermen and one documented bycatch also indicate that some waved albatrosses are taken as bycatch in both gillnet and longline fisheries. Recent information suggests that bycatch of waved albatrosses may also be occurring in Ecuador (May 2008 note at http://www.abcbirds.org/aboutabc/chron.html, http://www.equilibrioazul.org/spanish/proyectos_avesmarinas.html).

The change in CITES status of the waved albatross to Critically Endangered and the publication of the 2006 Awkerman *et al*. paper have served to draw attention to the waved albatross and to seabird-fishery interactions in Peru and Ecuador generally. The ACAP Waved Albatross Action Plan meeting in Lima was particularly helpful in drawing together experts and highlighting what we know and where further research and conservation efforts are needed. For example, it appears that targeted take of waved albatrosses may also occur out of the port of Chimbote. As a result of the meeting, it became clear that more research is necessary to document the frequency and extent of targeted take. The limited information available to local authorities and fishermen along the central and northern coast further reinforces this situation and emphasizes the need for continued educational campaigns.

To form a more complete understanding of seabird-fishery interactions generally our results could be compared with data on seabird distributions and at-sea surveys conducted by IMARPE. This data is not yet publicly available.

The potential results of targeted take and bycatch of a long lived, late maturing and slow reproductive species like the waved albatrosses could be devastating. Additional, new sources of mortality can push populations into decline – as has been suggested for the waved albatross (Awkerman *et al*. 2006). Anderson *et al*. (2008) confirmed the 2006 findings and notes a continuing reduction in breeding population size. Awkerman *et al*. (2007) noted that the male bias apparent from band returns, and the observed female bias at the nesting grounds (which directly affect fecundity and intrinsic growth rates) could be responsible for the observed population declines.

5.2.3 Band returns: The number of returns has declined significantly from previous years. This may suggest that fishermen are now more aware of the issue and that seabird interactions have declined. However the decline in band returns may also be a side-effect of our educational work in that fishermen may be more unwilling to share band information now that they know that some of these species have protected status. In the particular case of Salaverry, fishermen have become more guarded in their sharing of information and more likely to request compensation for band information. This decline may also be a result of fishermen in Salaverry feeling increased pressure from their association headquarters, authorities, or fishery agents visiting the port.

It is interesting to note that band returns in Salaverry only occurred through May of 2007 since meetings were held in June 2007 to discuss the conservation status and bycatch of waved albatrosses. These meetings were attended by many stakeholders including fishermen, NGOs, IATTC and government agencies. We believe this reduction in participation by fishermen may be related to the holding of this meeting or subsequent visits by some meeting attendees to the port of Salaverry that have encouraged fishermen to be less participative and more cautious with band returns.

On the other hand, the voluntary return of a seabird bands from Callao and San Jose were encouraging and showed our program's success in raising awareness of this issue along the Peru coast. The Callao band return was particularly important since it was of a northern Buller's albatross which is a considered a rare bycatch species. And as stated previously, the waved albatross band return from San Jose was also important because it reaffirms that fishery interactions are not limited to Salaverry and are not limited to targeted take.

5.3 Gear experiments

The objective in deploying TDRs on longline vessels was to improve our understanding of longline gear design and performance characteristics such as sink rate and soak depth. Vessels typically set their gear on a westerly heading and at a speed of 3 to 5 knots. Gear designs differed markedly among the observed trips and make any generalization regarding sink rates or fishing depth difficult. In most cases, branchlines appeared to sink immediately and reach their average depth within 30 to 90 seconds and with sink rates of from 0.134 to 0.190 m/s. The longer branchlines set in Ilo for sharks took the longest to reach their average depths of approximately 10m.

It is important to note that the maximum average depth reached by any one instrument was 14 m, with the majority being at less than 10m. Mahi mahi sets in particular employ short branchlines and often do not have weights. One fishing captain noted that he never uses weights for mahi mahi sets because the fish are at the surface and the weight of the bait is sufficient for the branchlines. Given that various species of albatrosses and petrels are thought to be able to dive to depths of 5m (black browed albatrosses for example) or as much as 20m (sooty shearwaters) this suggests that Peru's artisanal longlines for sharks and mahi mahi are constantly within the diving range of many of these species. The fact that our onboard observer work has documented only rare instances of longline seabird bycatch may suggest that seabird density, or presence around fishing vessels in the area is low and resulting interactions

limited. How this situation applies to the Critically Endangered Waved albatross which forages intensively off the northern and central Peru coast (and within areas used by longline and gillnet vessels) requires further investigation.

Results from this project also showed that branchlines maintained fairly constant, shallow depth profiles. These profiles were most clearly disrupted only with fish captures. The shark and mahi mahi captures documented typically showed the animals swimming actively around the branchlines average depth and to the surface. On one occasion, however, the TDR reached a depth of 53m after hooking a jumbo squid.

Results also suggest, however, that fairly inexpensive measures could be taken to further reduce seabird interactions. The use of larger (or any) weights on branchlines could increase sink rate, take hooks deeper, and take them more out of the reach of seabirds. The integration of floats into the mainline, typically 1 float on every 2nd branchline, seems capable of maintaining the mainline at the ocean surface.

Recently some vessel owners have indicated that they may reconfigure their longline vessels for mid-water mahi mahi for the next season which will begin in the austral spring or summer of 2008. This shift could be a benefit to seabird species although its possible impacts on other protected species, like sea turtles and marine mammals, need to be considered.

5.4 Recommendations

Below is a summary of recommendations for advancing seabird conservation in Peru. Some of these are similar to recommendations presented at the Action Plan for the Waved Albatross meeting. These have been developed as a result of this project and in consideration of the recent ACAP and Birdlife meetings.

1. Maintain and expand the onboard observer program for both artisanal longline and gillnet vessels to monitor fishing effort and interactions with protected species. Observer effort should be increased in sampled ports and expanded to other ports along the coast where no effort currently exists.
    a. Particular attention should be paid to the central and northern coast given the potential for interactions with waved albatrosses and the prevalence of the use of gillnet fisheries.
2. If possible, observer effort should be coordinated by IMARPE and involve participating NGOs to develop a consistent data collection format and effective division of labor.
3. Make use of artisanal fishing vessels as research platforms to gather information on seabirds such as waved albatross foraging, boat approach behavior, etc.
4. Findings from this and other studies should be compared with IMARPE research cruise data on seabird abundance and distribution.
5. Data on seabird interactions with commerical and industrial fleets operating in Peru's waters or the high seas of the region need to be collected in order to develop of more complete understanding of seabird-fishey interactions, the scope of the issue and the species at risk.
6. Emphasis should be placed on identifying seabird bycatch mitigation measures for surface drift gillnets, given the high observed bycatch rates, although available measures for the other fishing techniques should also be explored.
7. The continuation of educational work at fishing ports is critical in order to raise awareness of seabird conservation issues and lay the groundwork for future initiatives.
    a. Workshops and educational materials should continue to discourage the consumption of protected seabird species and reiterate that there is no reward for the collection of seabird bands or transmitters.

    b. Workshops should be held before the beginning of the fishing season in areas known to have seabird interactions.
8. The targeted take for human consumption of waved albatrosses and other species needs to be explored further in order to gauge the frequency and extent of the practice.
    a. a. The use of trained anthropologists, sociologists or other relavant experts should be considered as a means of better understanding the issue and developing mitigation measures.Potential mitigation measures could address the lack of food resources available to fishermen on long trips.

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Figure 1. Locations of all monitored fishing sets by vessel type, May 2005-March 2008.

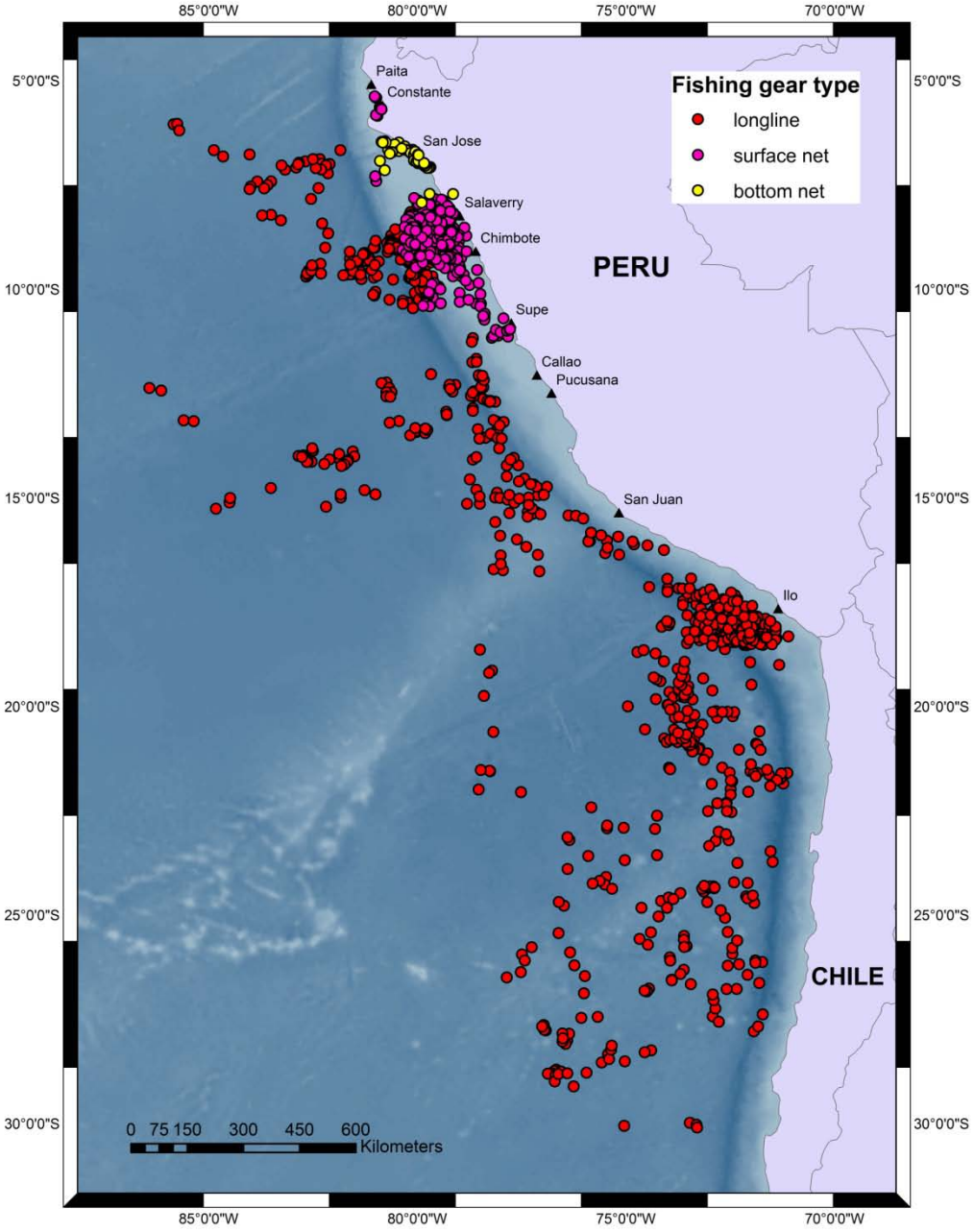


Figure 2. Salaverry trials for (a) sharks and (b) mahi mahi. Lines represent TDR times to average depths.

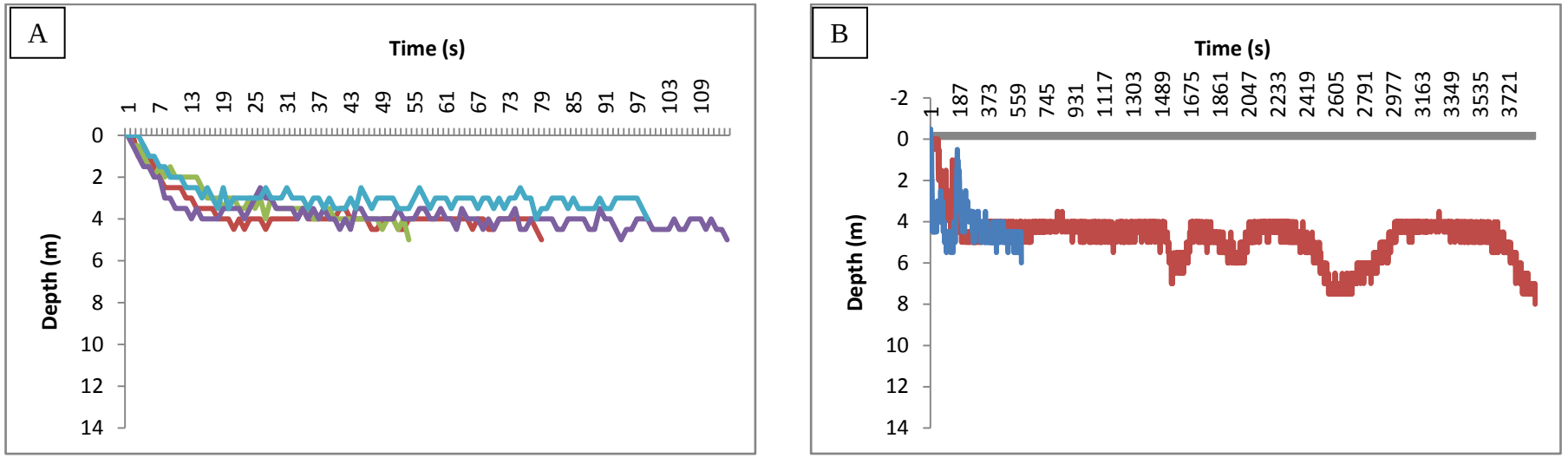


Figure 3. Ilo trials for (a) sharks and (b) mahi mahi. TDR times to average depth.

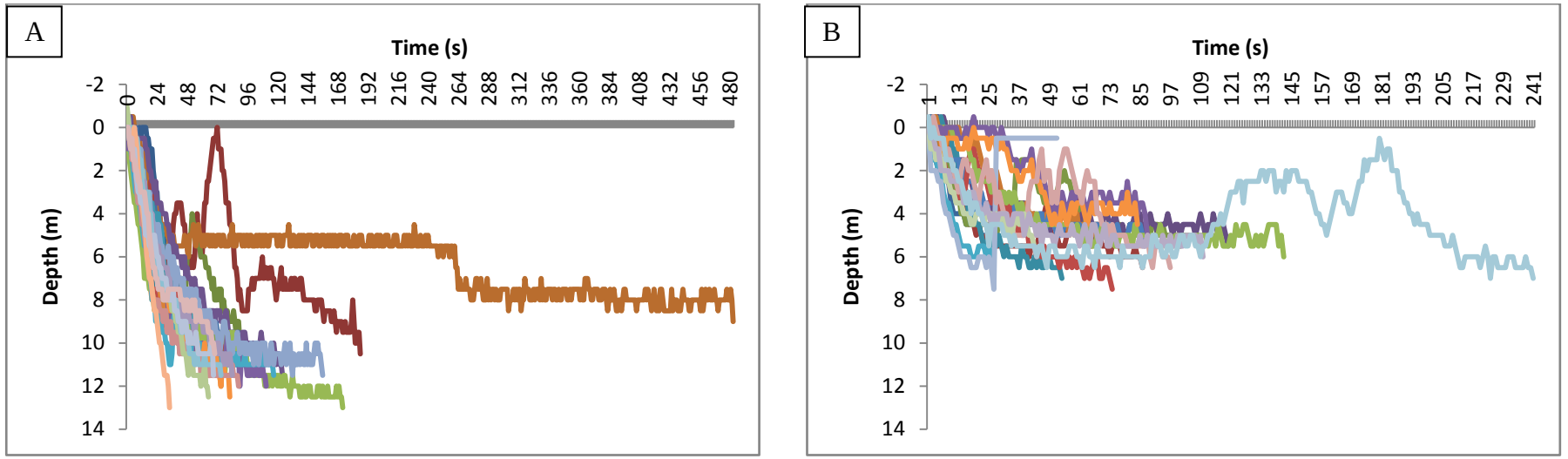


Table 6. Trip and set summary for TDR deployment in Salaverry and Ilo, Peru.

Trip	Port	Set	Date	Target	Set location	Prop rotation	# hooks	Dist b/t Hooks (fathoms)	Gear Length (km)	Leader Material	Weight used (g)	Beaufort scale	Set speed (knots)	Set bearing
1	Salaverry	1	25-Jul-07	sharks	-	-	1200	8	17.56	Cable	37.7	-	3.3-3.5	-
1	Salaverry	2	27-Jul-07	sharks	-	-	1200	8	17.56	Cable	37.7	-	3.3-3.5	-
2	Ilo	1	14-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	5	5	300
2	Ilo	2	15-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	6	5.3	270
2	Ilo	3	16-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	5	5.5	310
2	Ilo	4	17-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	4	5.5	330
2	Ilo	5	18-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	2	5.8	300
2	Ilo	6	20-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	2	5.4	330
2	Ilo	7	21-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	1	5.6	300
2	Ilo	8	22-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	1	5.6	330
2	Ilo	9	23-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	2	5.5	330
2	Ilo	10	24-Oct-07	sharks	port	clockwise	450	15-18	12.34	Cable	40-45	1	5.6	330
3	Ilo	1	13-Jan-08	mahi	port	clockwise	450	10	8.23	Mono	na	4	3	350
3	Ilo	2	13-Jan-08	mahi	port	clockwise	450	10	8.23	Mono	na	5	3	320
3	Ilo	3	14-Jan-08	mahi	port	clockwise	450	10	8.23	Mono	na	5	3	330
3	Ilo	4	15-Jan-08	Mahi	port	clockwise	450	10	8.23	Mono	na	4	4	330
3	Ilo	6	16-Jan-08	Mahi	port	clockwise	450	10	8.23	Mono	na	3	3	320
3	Ilo	8	17-Jan-08	Mahi	port	clockwise	450	10	8.23	Mono	na	3	3	330
4	Salaverry	1	20-Feb-08	Mahi	starboard	clockwise	950	10	17.37	Mono	40	4	~7	e→w
4	Salaverry	2	20-Feb-08	sharks	starboard	clockwise	180	10	3.29	Cable	40	5	~7	e→w

Table 7. Summary of TDR data from all deployments in Salaverry and Ilo, Peru.

							All Data					Pre-Capture								
				set	recover		depth (m)			Temp (°C)		depth (m)			Temp (°C)		Time to	Sink rate	Time to	Sink rate
Port	TDR	Set	Date	time	time	capture?	avg.	max	sd	avg.	sd	avg.	max	sd	avg.	sd	avg (s)	to avg. (m/s)	5m (s)	To 5m (m/s)
Salaverry	6	1	25-Jul-07	7:48:54	21:59:40	yes	1.7	6.0	1.7	17.94	0.02	3.5	6.0	1.8	17.90	0.02	13	0.269	78	0.064
	17	1		7:51:52	21:57:44	no	5.2	11.5	0.5	17.95	0.04	-	-	-	-	-	26	0.154	53	0.094
	6	2	27-Jul-07	6:26:58	0:31:51	no	4.4	7.0	0.4	17.80	0.08	-	-	-	-	-	40	0.113	113	0.044
	17	2		6:30:04	0:28:51	no	4.0	5.5	0.4	17.85	0.09	-	-	-	-	-	98	0.041	na	na
Ilo	13	1	14-Oct-07	11:20:31	LOST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	1		11:12:55	6:16:59	no	7.6	12.5	1.0	16.02	0.06	-	-	-	-	-	38	0.197	28	0.179
	15	1		11:04:32	6:30:16	no	10.7	13.0	1.0	16.07	0.06	-	-	-	-	-	186	0.056	15	0.333
	7	2	15-Oct-07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	2		12:32:40	6:13:53	no	6.8	12.5	0.9	16.11	0.07	-	-	-	-	-	37	0.189	22	0.227
	15	2		12:27:39	6:24:09	no	9.2	12.0	1.2	16.16	0.06	-	-	-	-	-	43	0.209	19	0.263
	7	3	16-Oct-07	14:29:18	6:17:23	no	10.9	13.0	1.1	16.50	0.04	-	-	-	-	-	74	0.149	15	0.333
	14	3		14:20:29	6:29:17	no	8.5	11.0	0.7	16.38	0.06	-	-	-	-	-	304	0.028	32	0.156
	15	3		14:15:18	6:39:11	no	10.6	12.5	0.7	16.39	0.04	-	-	-	-	-	88	0.119	26	0.192
	7	4	17-Oct-07	12:27:34	5:55:23	no	11.5	13.0	0.8	16.57	0.03	-	-	-	-	-	78	0.147	26	0.192
	14	4		12:20:10	6:10:48	no	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	4		12:15:02	6:24:34	no	10.4	13.0	0.7	16.46	0.04	-	-	-	-	-	90	0.117	19	0.263
	7	5	18-Oct-07	13:25:52	6:25:15	no	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	5		13:19:16	6:37:21	no	11.2	15.0	0.6	16.34	0.03	-	-	-	-	-	103	0.107	34	0.147
	15	5		13:14:33	6:47:25	yes	11.3	12.5	0.6	16.39	0.02	-	-	-	-	-	99	0.116	28	0.179
	7	6	20-Oct-07	8:25:42	6:10:19	no	11.7	14.0	1.0	16.72	0.12	-	-	-	-	-	65	0.177	15	0.333
	14	6		8:17:45	6:23:35	yes	8.6	18.5	3.2	16.67	0.16	10.2	14.0	0.9	16.57	0.05	50	0.200	17	0.294
	15	6		8:11:25	6:34:49	yes	10.2	16.0	2.5	16.60	0.16	10.8	13.0	0.6	16.58	0.07	59	0.186	15	0.345
	7	7	21-Oct-07	12:02:05	5:30:13	yes	14.6	53.0	7.1	16.64	0.65	12.2	13.0	0.4	16.84	0.02	110	0.109	11	0.455
	14	7		11:53:01	5:41:58	no	11.8	14.5	0.5	16.68	0.03	-	-	-	-	-	111	0.108	16	0.313
	15	7		11:48:10	5:49:44	yes	8.4	17.5	3.7	16.85	0.24	-	-	-	-	-	117	0.098	13	0.385
	7	8	22-Oct-07	10:56:32	5:39:08	no	12.2	18.0	0.5	16.92	0.04	-	-	-	-	-	75	0.160	18	0.278
	14	8		10:49:58	5:49:24	no	11.0	13.5	0.6	16.76	0.05	-	-	-	-	-	101	0.109	24	0.208
	15	8		10:44:53	5:56:25	no	11.8	18.5	0.6	16.81	0.07	-	-	-	-	-	89	0.135	14	0.357
	7	9	23-Oct-07	10:06:06	5:52:13	no	12.0	19.5	0.6	17.00	0.07	-	-	-	-	-	59	0.203	18	0.278

	14	9		9:59:31	6:04:23	no	11.5	15.5	0.9	16.84	0.06	-	-	-	-	-	84	0.137	21	0.238
	15	9		9:55:03	6:12:05	no	11.4	15.0	0.5	16.92	0.05	-	-	-	-	-	75	0.153	20	0.250
	7	10	24-Oct-07	10:20:45	23:12:09	no	11.4	13.5	0.1	17.04	0.12	-	-	-	-	-	30	0.383	15	0.333
	14	10		10:14:23	23:26:23	no	10.2	12.5	0.9	16.89	0.14	-	-	-	-	-	49	0.204	15	0.333
	15	10		10:09:55	23:35:39	no	9.8	13.5	0.7	16.93	0.12	-	-	-	-	-	68	0.147	18	0.278
Ilo	6	1	13-Jan-08	8:39:05	12:10:56	no	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	1		8:42:28	12:15:52	no	4.7	6.0	0.5	24.02	0.09	-	-	-	-	-	15	0.300	21	0.238
	7	1		8:46:21	12:10:57	no	5.9	7.5	0.5	24.12	0.06	-	-	-	-	-	40	0.150	21	0.238
	15	2	13-Jan-08	18:03:56	19:35:42	no	4.9	8.0	0.7	24.35	0.09	-	-	-	-	-	27	0.185	27	0.185
	14	2		18:06:45	19:30:40	no	4.5	5.5	0.7	24.32	0.03	-	-	-	-	-	30	0.150	48	0.104
	7	2		18:09:10	19:20:38	yes	6.1	9.5	1.3	24.39	0.20	6.3	9.5	0.9	24.42	0.77	36	0.181	21	0.238
	15	3	14-Jan-08	9:52:39	13:11:38	no	4.2	6.0	0.5	24.29	0.08	-	-	-	-	-	32	0.125	43	0.116
	14	3		9:54:56	13:07:33	no	4.1	5.5	0.5	24.24	0.07	-	-	-	-	-	19	0.211	46	0.109
	7	3		9:57:18	not recorded	no	6.3	8.0	0.6	24.31	0.06	-	-	-	-	-	52	0.125	35	0.143
	15	4	15-Jan-08	10:22:06	12:48:30	no	3.1	6.0	1.4	24.49	0.12	-	-	-	-	-	25	0.120	58	0.086
	14	4		10:24:39	12:44:38	no	4.3	6.0	0.6	24.42	0.02	-	-	-	-	-	68	0.066	87	0.057
	7	4		10:28:34	12:42:01	no	5.3	7.0	0.6	24.57	0.11	-	-	-	-	-	13	0.423	12	0.417
	15	6	16-Jan-08	11:24:16	13:53:43	yes	4.8	12.0	1.5	24.27	0.86	4.5	6.0	0.4	24.23	0.03	25	0.180	36	0.139
	14	6		11:26:15	13:50:54	no	3.8	5.5	0.5	24.24	0.04	-	-	-	-	-	40	0.100	51	0.098
	7	6		11:28:21	13:46:03	no	5.2	7.0	0.4	24.37	0.04	-	-	-	-	-	34	0.147	34	0.147
	15	8	17-Jan-08	10:27:22	13:56:57	no	4.5	5.5	0.4	24.50	0.04	-	-	-	-	-	17	0.265	31	0.161
	14	8		10:29:00	13:48:58	no	4.8	6.0	0.5	24.44	0.06	-	-	-	-	-	38	0.132	38	0.132
	7	8		10:30:44	13:46:04	no	6.1	7.5	0.7	24.58	0.05	-	-	-	-	-	43	0.140	23	0.217
Salaverry	14	1	20-Feb-08	9:09:12	20:44:47	no	5.8	18.5	1.3	24.67	0.21	5.1	9.0	0.8	24.55	0.18	103	0.053	90	0.056
	15	1		9:01:30	7:59:24	no	7.9	12.5	2.0	24.70	0.19	-	-	-	-	-	3891	0.002	200	0.025
	17	1		8:36:50	LOST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salaverry	1	2	20-Feb-08	16:14:51	LOST	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 8. Summary table of TDR deployments by trip and branchline configuration.

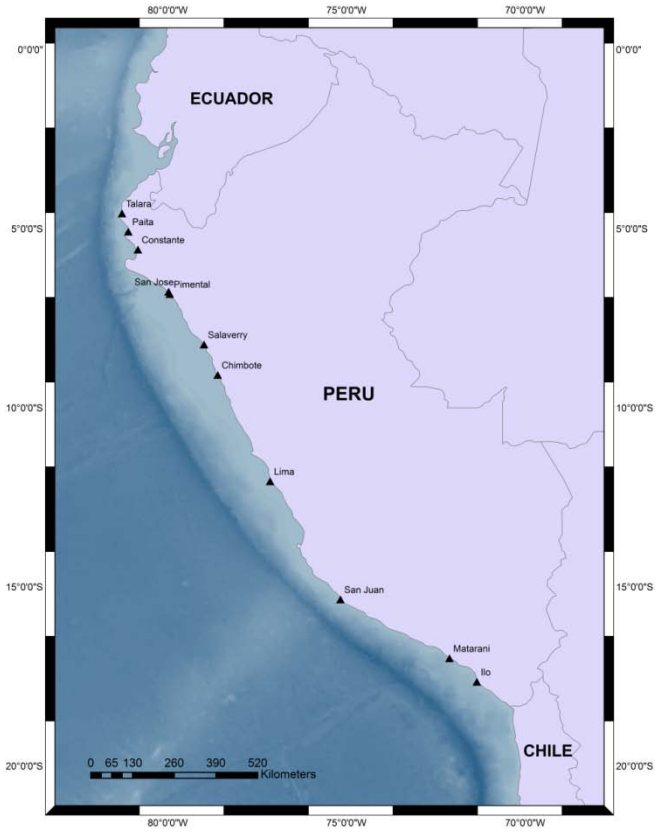
Port	Target species	TDR or Branchline	Branchline Weight (g)	Total branchline length (m)	Driza[1] Length (m)	Tanza[2] Length (m)	Leader Length (cm)	TDR dist. from hook (cm)	Branchline float?	Beaufort scale	Set speed (knots)	depth (m) avg.	depth (m) max	Temp avg. (°C)	Avg time To avg depth (s)	Avg sink rate to avg depth (m/s)	Average Time to 5 m (s)	Average 5 m sink rate (m/s)
Salaverry	Sharks	All	37.7	6.4	2 bz	na	1.5 bz	20.0	-	-	3.3 to 3.5	4.3	11.5	17.88	44.3	0.144	81.3	0.068
Ilo	Sharks	7 (with float)	40 to 45	14.3	13.60	na	70.0	30.0	yes	6	5.3	11.7	19.5	16.80	70.1	0.190	16.9	0.315
		15 (with float)	40 to 45	12.7	5.60	6.41	70.0	30.0	yes	6	5.3	10.4	17.5	16.56	91.4	0.134	18.7	0.284
		14 (no float)	40 to 45	12.5	5.82	5.95	70.0	30.0	no	6	5.3	9.9	15	16.51	97.4	0.142	23.2	0.233
Ilo	Mahi mahi	No float	none	5.5	na	2 bz	1 bz	20.0	no	4	3	5.1	9.5	24.39	31.3	0.186	31.0	0.190
		With float	none	5.5	na	2 bz	1 bz	20.0	yes	4	3	4.4	6	24.28	35.0	0.160	48.5	0.123
Salaverry	Mahi mahi	All	40	3.6	na	3.25	36.0	28.5	no	4	~7	6.8	18.5	24.69	1997.0	0.028	145.0	0.040
Salaverry	Sharks	All	40	4.1	na	3.25	87.0	79.5	no	5	~7	-	-	-	-	-	-	-

[1] Driza = Multifilament black nylon cordage

[2] Tanza = Nylon monofilament

APPENDIX 1:

Summary of Seabird Conservation Talks & Workshops



Audience	Port location	Date	Participants
Fishermen	Paita	May 2007	12
	Talara	May 2007	14
	San Jose	May 2007	6
	Pimentel	May 2007	10
	Salaverry	May 2007	24
		May 2007	5
	Chimbote	May 2007	5
	San Juan	May 2007	11
		May 2007	9
	Matarani	May 2007	33
	Ilo	Jun 2007	27
		Aug 2007	19
		Dec 2007	12
Local officials	DICAPI-Paita	May 2007	6
	DICAPI-Talara	May 2007	5
	DICAPI-Pimentel	May 2007	4
	DICAPI-Salaverry	May 2007	8
	DICAPI-Chimbote	May 2007	13
	DICAPI-San Juan	May 2007	5
	DICAPI-Matarani	May 2007	12
	DICAPI-Ilo	May 2007	22
University & elementary schools	Universidad Cayetano Heredia, Lima	Apr 2007	30
	Jorge Basadre School, Ilo	Jun 2007	~30
	Daniel Becerra School, Ilo	Aug 2007	~30
		Apr 2008	~30
	Villa Maria School, Lima	Sep 2007	60
	Constante School, Piura	Dec 2007	23
		Apr 2008	16

APPENDIX 2: Educational Materials

Figure 1. Guide to the safe rescue, handling and release of seabirds.

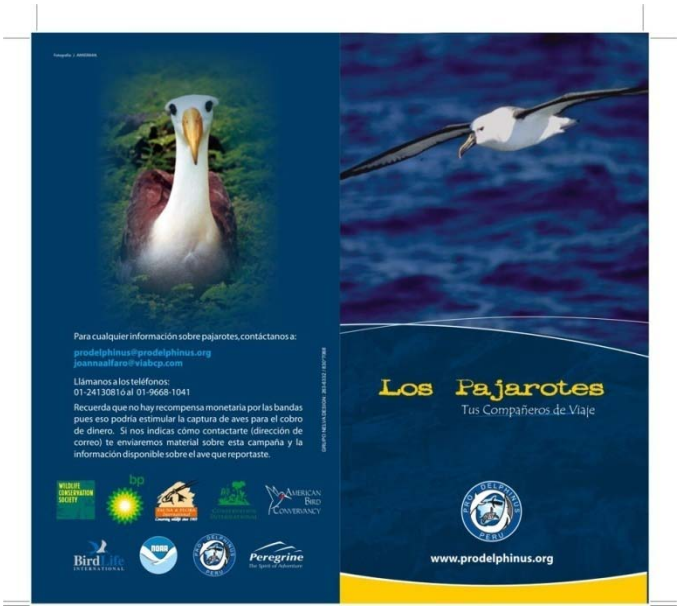


Figure 2. Updated brochure on seabird biology and identification.

Figure 3. Small informational sticker with information on albatrosses.

Figure 4. Wallet-size 2008 calendars.

Figure 5. Penguin conservation sticker.

Figure 6. Penguin conservation and biology brochure.

Figure 7. T-shirt design #1.

Figure 8. T-shirt design #2.

Figure 9. Example pages from the seabird comic produced during the project.

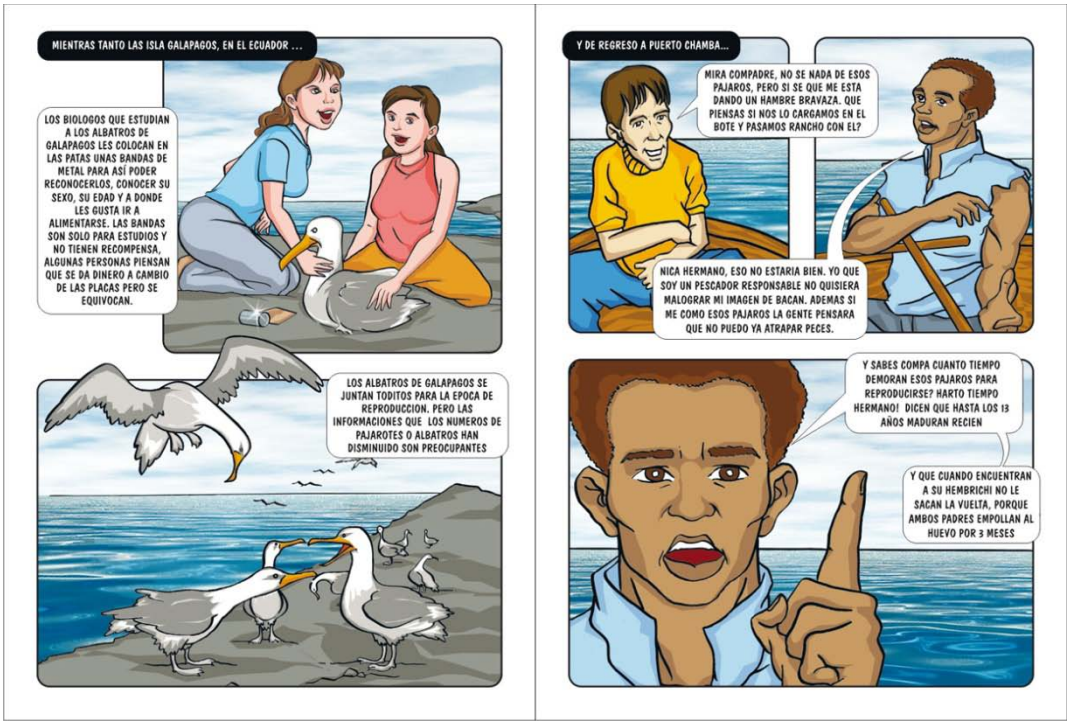


Figure 10. More example pages of the seabird comic distributed in Salaverry.

APPENDIX 3: Webpage Note

1. From Conservación Internacional Perú
   Contact: Nina Pardo
   In: Boletín informativo CI-nforma; Mayo 2007
   Posted: 22 May 2007

Ambientes marinos y costeros

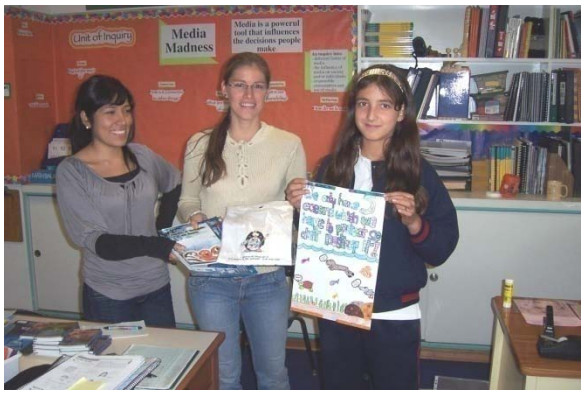
Albatros liberado luego de captura incidental durante faena de pesca
© Pro Delphinus

Con la finalidad de empezar a llenar el vacío informativo sobre pesca incidental de aves marinas en la costa oeste de Sudamérica, la ONG Pro Delphinus inició el **"Proyecto Aves Marinas"** en el 2004. En el 2005, con financiamiento obtenido del Programa de Conservación de British Petroleum (BPCP) en alianza con Conservación Internacional, además de otras entidades, se inició la evaluación de pesca incidental en varios puertos de la costa peruana implementando para esto un programa de observadores a bordo. Como parte del proyecto además se llevan a cabo charlas y talleres de conservación de aves marinas en peligro como albatros, petreles y pingüinos por mencionar algunos. Resultados iniciales nos indican que la principal amenaza para las aves marinas se encuentra en las redes de pesca y en el uso de las aves para consumo humano. En el 2007, Pro Delphinus obtuvo financiamiento por parte del BPCP para continuar con la evaluación de pesca incidental de aves marinas a través de investigación y programa de educación a comunidades costeras.

APPENDIX 4: Project Photos

Waved albatrosses approaching a gillnet vessel to feed on discarded offal.

A gillnet entangled black-browed albatross killed for human consumption.



Celebrating World Ocean Day 2007 with students of the Roosevelt School, Lima. (posted on the World Ocean Network website.)

Attendees (men and women) to an Ilo seabird workshop.

Longline boat captain “Chaval” (on right) from Ilo, assisting Pro Delphinus with talks at port communities.

Chaval in action giving a presentation to local officials in the port of Salaverry.

Matarani Capitania during a talk on national seabird legislation.

Atico and Mollendo fishermen after talks on seabird conservation.

Crew members of Ilo longline vessel captained by Chaval (right), and showing off their project t-shirts.

Goat hair fishing lures used by longline vessels from the port of Ilo.

Two murals produced in the port of Ilo asking for the help of fishermen to not Discard their refuse while at sea and to not consume turtle and seabird meat.

Fishermen and local officials presented with copies of the “Vivan los pajarotes” comic book.


Chaval checking a seabird carcass during a survey walk at Ite beach.


Chaval with a seabird carcass entangled in a fishing net recovered during a beach survey.