Agreement on the Conservation of Albatrosses and Petrels

Third Meeting of Advisory Committee

Valdivia, Chile, 19 - 22 June 2007

Report of the Waved Albatross Workshop

Author: Secretariat

Report of the Waved Albatross Workshop
5 – 6 June 2007, Lima, Peru

In response to reports of a rapid decline in the population abundance of the waved albatross the Agreement on the Conservation of Albatrosses and Petrels (the Agreement), in conjunction with the Governments of Ecuador and Peru, convened a workshop tasked with the development of an action plan to address this decline and with the objective of returning this species to a favourable conservation status.

Representatives from the Agreement, the governments of Ecuador and Peru, the Peruvian fishing industry, scientific community and inter and non-governmental organisations met to review available information on this decline and identify actions that could be taken. A list of participants is provided at Appendix A.

Discussions at the workshop focussed on draft action plans which had been developed by the Ecuadorian Government and the Agreement. The draft plan developed by the Agreement was prepared by Dr Jaime Jahncke from PRBO Conservation Science.

The draft ACAP Action Plan reviewed the biology and threats, and made some suggestions for future actions. The draft ACAP Action Plan, which was presented at the workshop, is attached (Appendix B). The Ecuadorian Action Plan focused on actions within Ecuador to address the decline in the waved albatross population. The Ecuadorian Action Plan is attached (Appendix C).

The meeting was opening by Minister Doris Sotomeyer who highlighted the importance of this issue, emphasised the urgency of the need to take action and thanked participants for making their time available to attend the workshop.

The first day focussed on biology and threats to the species, identifying obvious gaps in knowledge and errors of omission and commission. Discussion focussed in particular on estimation of adult survival and conflicts within literature, the impact of feral goats, the role they may have played in modifying habitat and the quality of fishing data, and the veracity of reports of intentional take.

A small working group was formed to discuss technical biological issues relating to demographic analysis and modelling. This group agreed that although data quality on population size was relatively poor, data on adult survival in particular was of high quality and provided clear evidence of a reduction of this parameter that warranted concern. It was agreed that continued efforts should be put toward estimation of annual survival, and refining methodologies to improve estimation of population size.

The second day focussed on management actions within the draft plans, looking to refine these as appropriate and to identify Parties able to carry these forward. There was considerable discussion on how to manage and reduce both incidental and intentional take of waved albatrosses. The meeting identified a key information gap in relation to fisheries off mainland Ecuador and the Government of Ecuador undertook to address this concern.

A number of areas were identified as requiring further information or amendment. These are to be incorporated into a revised draft that collates information provided by all those present at the workshop as well as additional stakeholders. This should ensure that when finalised it will contain the most current information available.

The governments of Ecuador and Peru, together with ACAP, are intending to consult shortly over priorities within the plan and sources of funding to ensure its effective implementation.

Minister Sotomeyer, in closing the meeting, thanked all participants for their openness in sharing information to address the conservation of waved albatross. On behalf of ACAP, Mark Tasker thanked in particular the governments of Peru and Ecuador for working closely to coordinate the workshop. He also thanked Peru's Ministry of Foreign Affairs for their hospitality and provision of excellent facilities for the meeting, and Dr Elisa Goya for chairing the meeting.

Participant List

Nº	FIUPAP (Federación de Integración y Unificación de los Pescadores Artesanales del Perú)
1	José Cachique
2	Justo Fuentes
3	Juan Orbezo
4	Ramón Agama
5	César Zumaeta
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7	Guillermo Alburqueque Laopouble
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Nº	Ministerio de Relaciones Exteriores del Perú
17	Ministra Doris Sotomayor
18	Ministra Consejera Liliana Gómez
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28	Ing. César Cervantes Gálvez

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49	Hernan Vargas
50	Liliana Ayala

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56	Nina Pardo
57	Shaleyla Kelez

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58	Gabriela Cruz

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59	Biologa Daniela Lainez
60	Carlos Zavalaga

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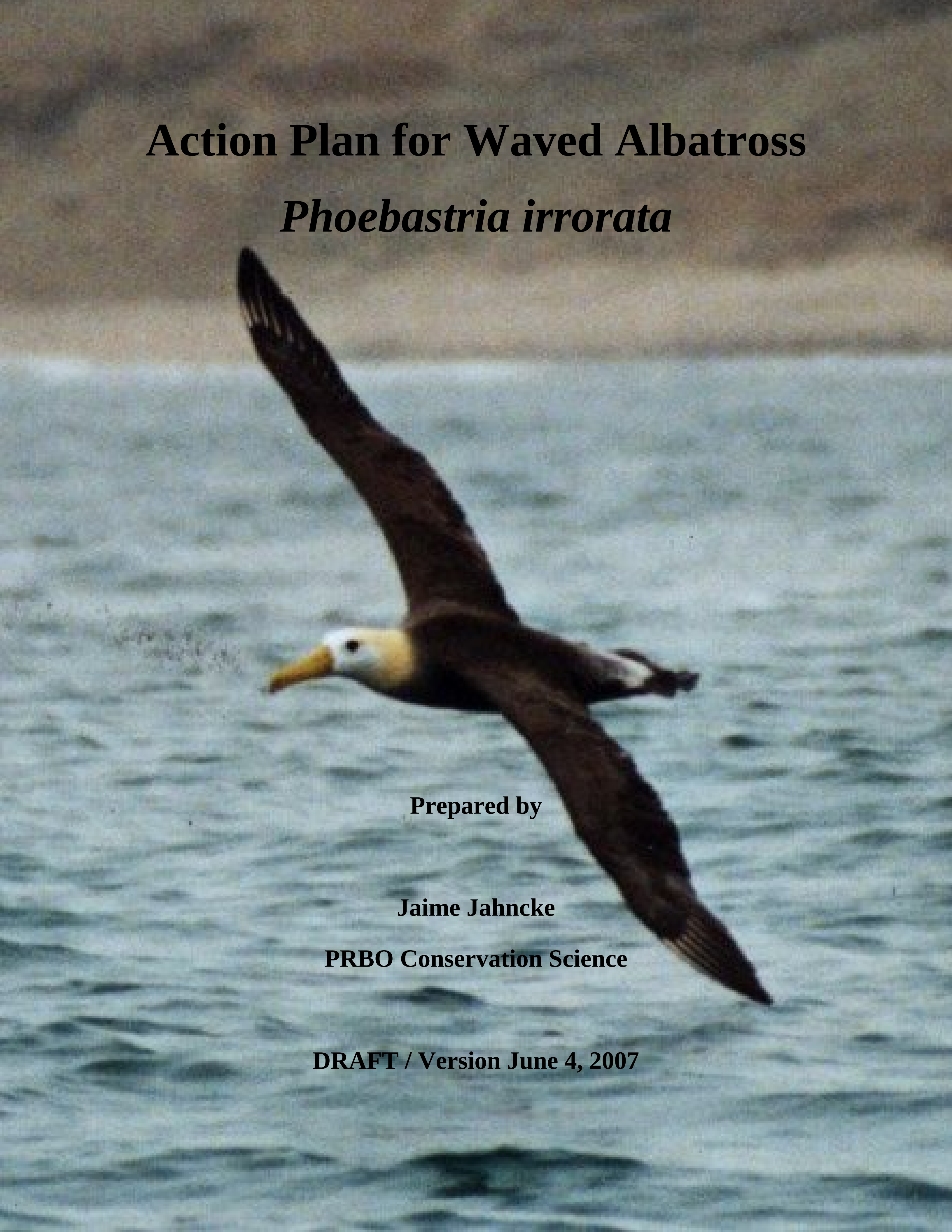

Action Plan for Waved Albatross

Phoebastria irrorata

Prepared by

Jaime Jahncke

PRBO Conservation Science

DRAFT / Version June 4, 2007

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1 Introduction

The waved albatross *Phoebastria irrorata* is a tropical seabird that breeds almost exclusively on Española Island in the Galapagos Archipelago (Tickell 2000, Anderson et al. 2002). Its distribution is restricted to the eastern Pacific Ocean between the Galapagos Archipelago and the adjacent mainland of South America from central Ecuador to southern Peru (Anderson et al. 1998, 2003, Tickell 2000, Fernández et al. 2001). A major reduction in population size and adult survival has occurred in recent years and appears to be associated with increased mortality from incidental catch in fisheries and intentional catch for human consumption (Anderson et al. 2002, Awkerman et al. 2006). This evidence suggests a high risk of extinction and has led to its recategorization from Vulnerable to Critically Endangered by the IUCN Red List (Birdlife 2007).

The purpose of the Action Plan for Waved Albatrosses developed by the Agreement for the Conservation of Albatrosses and Petrels (ACAP) is to provide managers, scientists and stakeholders with a brief summary of the biology, status, threats, and actions necessary to improve the conservation status of the waved albatross. The goal is to increase public awareness of the urgent conservation needs of waved albatrosses and to promote specific management, research and education actions that will minimize human impact, prevent further population declines, and secure the future of this species. The geographical scope of this plan includes the Galapagos Archipelago where most nesting grounds are located, the coastal waters of Ecuador and Peru where most feeding activity occurs, and the eastern Pacific Ocean including Panama, Colombia and the north of Chile where birds may occasionally disperse.

2 Biology

2.1 General description

The waved albatross is a medium-sized albatross with white head, yellow crown and nape, whitish breast, barred brown upper body, upper wing and flanks, and slightly lighter color underparts (Murphy 1936). The bill is yellow, the eyes are dark brown with prominent orbital ridges, and the feet are bluish, projecting beyond the tail when in flight (Murphy 1936). Juveniles look like the adults but have a whiter head (Murphy 1936). Birds can be sexed by size and general appearance; males are conspicuously larger than females with wing spans of about 2.23 meters, larger bills and prominent orbital ridges (Harris 1973). Bills longer than 149 mm indicate males, bills shorter than 146 mm indicate females, but there is uncertainty in between these values (Jiménez-Uzcátegui and Wiedenfeld 2003).

2.2 Distribution

The waved albatross breeds almost exclusively on Española Island (1°22'S, 89°40'W) in the Galapagos Archipelago, but occasionally some birds breed on La Plata Island (1°17'S, 81°3'W) off the central coast of Ecuador (Tickell 2000, Anderson et al. 2002) (Fig. 1). Waved albatrosses are restricted to the eastern Pacific Ocean, birds range over a relatively small area delimited by the Galapagos Islands, the central Ecuadorian coast and the southern Peruvian coast (Pitman 1986, Tickell 1996, 2000, Anderson et al. 1998, 2003, Fernández et al. 2001, Awkerman et al. 2005a). Recent studies have shown that waved albatrosses travel from their nesting sites on Española Island to the Peruvian upwelling region to forage during the incubation and chick-rearing periods, and are thought to spend the non-breeding season in the same area (Anderson et al. 1998, Fernández et al. 2001). They are rarely seen north of the equator (Fig. 2), although a few birds have been recorded off the coasts of Colombia and Panama (Hilty and Brown 1996, Tickell 2000, Ballance and Pitman unpub. data). There have been sightings of birds west of Fernandina and Isabela Islands (Merlen 1996, H. Vargas pers. comm.); however, no waved albatrosses appear to wander west of these areas into the tropical Pacific Ocean (Ballance and Pitman unpub. data, Tickell 2000).

2.3 Population

2.3.1 Española Island (> 99.9% of the population)

The first complete censuses were conducted by Harris (1973) in 1970 and 1971. He visited all nesting areas and counted eggs (or chicks in one area) as proxy for the breeding population size. Harris monitored egg loss and egg laying and used these data to adjust each day's count for eggs that were already lost (and missed) and eggs that would be laid after the count. Harris estimated a total of 10,600 breeding pairs in 1970 and at least 12,000 breeding pairs in 1971 (Harris 1973).

The second census was conducted by Douglas (1998) in 1994. He and his colleagues visited all nesting areas identified by Harris (1973). Two nesting areas had disappeared since 1971 due to dense vegetation growth. Douglas used four methods to estimate breeding population size. Method two was directly comparable to Harris' (1973) and indicated at least 18,254 breeding pairs in 1994 (Douglas 1998).

The third census was carried out by Anderson et al. (2002) in 2001. They visited all previously identified nesting areas except for those that disappeared between 1970 and 1994 (Harris 1973, Douglas 1998), and the central colony, which had become difficult to access. They adjusted each day's count for eggs lost and eggs that would be laid as previously done. Additionally, they used new methods to estimate the size of the non-breeding population present on the Island and the size of the breeding population alive but absent from the island. Anderson et al. (2002) estimated a total

19,214 breeding adults (i.e. 9,607 breeding pairs) on the island in 2001. Additionally and for the first time, they estimated 5,495 breeding adults not nesting in 2001 and 7,109 non-breeders present on the island (Anderson et al. 2002).

Initially, Anderson et al. (2002) speculated that the increase in the number of breeders from 1970/71 to 1994 was due to the return of all potential breeders to the colony after a two year breeding interruption due to the extended 1991/94 El Niño-Southern Oscillation (ENSO) (Anderson et al. 2002). Waved albatrosses were known to arrive late to the colony or defer breeding during warm ENSO years as observed in 1982/83 (Rechten 1986). The 1970 and 2001 counts were thought to provide the best indication of long-term population trends, which indicated a numerical stability and no overall decline over a 31 year period (Anderson et al. 2002). The above possibility was later rejected after new data showed that the number of eggs laid after the 2002/03 warm ENSO event was similar to that before the ENSO. Thus, the 1994 population count using eggs laid to estimate the size of the breeding component of the population is less likely to be inflated than was speculated by Anderson et al. (2002). This new perspective suggested that a substantial change in population size may have occurred between 1994 and 2001 (Awkerman et al. 2006). ENSO effects on the ecosystem vary from event to event, and this may explain differences in attendance between the strong 1982/83 and the weak 2002/03 warm ENSO events.

2.3.2 La Plata Island (< 0.1% of the population)

Population counts during the incubation period showed five adults in 1975 (Owre 1976), eight in 1981, one breeding pair in 1988 (Ortiz-Crespo and Agnew 1992), four in 1991 (Curry 1993), and three in 2001 (Anderson et al. 2002). Counts after hatching showed two adults in 1985 (Nowak 1987), 30 in 1981 (Hurtado 1981, cited in Ortiz-Crespo and Agnew 1992), and 22 in 1990, plus six chicks (Ortiz-Crespo and Agnew 1992).

2.4 Nesting habitat

Waved albatrosses nest along the southern coastline of Española Island which is exposed to the southeasterly trade winds. No albatrosses nest on the north side (Douglas 1998). Dense scrub (*Acacia*, *Prosopis, Cordia and Parkinsonia*) covers the island, except for a few open areas which approximately delimit the location of the colonies (Harris 1973, Douglas 1998). Española had a large land tortoise population that was depleted by human consumption during the 17th to 19th centuries. The land tortoises were the only endemic herbivore on the Island. In the 1970s only 9 individuals were found on the Island, which were removed and used for captive breeding at the Charles Darwin Foundation (F. Cruz pers. comm.). Feral goats *Capra hircus* inhabited the island for about 80 years and may have created additional clearings, benefiting the albatross population. Birds also colonized the airport landing strip which was cleared at the US radar site in the eastern part of the island during World War II and later abandoned (Anderson et al. 2002). Goats were eradicated by the Galapagos National Park Service by 1978, and the vegetation across the island closed in thereafter (Douglas 1998). Two hillside inland colonies disappeared entirely by 1994 due to dense vegetation growth (Douglas 1998). Overall declines in population at other inland areas have also been attributed to habitat loss due to regrowth of vegetation (Anderson et al. 2002). The colony associated with the former landing strip has been shrinking, as the runway was overgrown by vegetation in 2001 (Anderson et al. 2002). It appears that the population in 1970 may have been inflated compared to that before the clearing by the goats (Harris 1973).

2.5 Breeding

Waved albatrosses on Española Island breed from April to December (Harris 1973). They are considered annual breeders, even though some pairs defer breeding (Rechten 1986). Pairs are monogamous and return to breed within 10 meters of their previous breeding location (Harris 1973). Early breeders arrive in late March and begin laying eggs between mid-April and late June. Males arrive earlier than females, and older more experienced birds arrive earlier than younger birds. They lay a single egg of 285 grams (Castro and Phillips 1996), on flat ground which is often moved up to 40 meters within a few days. Incubation takes two months and both adults share incubation shifts that may span 20 days in recently laid eggs to four days as hatching time approaches. Hatching success is low, ranging from 10% to 56% in 1970 and 1971; over 80% of the failures were related to egg movement. Chick-rearing takes 5.5 months and both adults share duties as chicks need to be brooded and guarded for several weeks. Nesting success varies between areas and years, ranging from 9% to 80% in 1970 and 1971; most young die within a month of hatching. Average breeding success was 25.4% in 1970 and 1971. Most birds leave the island between January and March. The majority of birds breed for the first time in their fifth and sixth years of age (Harris 1969, 1973). The oldest known waved albatross was about 38 years old in 1994 (Douglas and Fernández 1997), the second oldest record was 34 years old in 2006 (Jiménez-Uzcátegui 2006a).

2.6 Survival

The survival of adults from 1961, 1962 and 1964 to 1970 averaged 95% (range: 94.6% – 95.9%) per year over the study areas (Harris 1973). These were underestimates as some adults may have been alive but not caught. Annual survival of adults marked in 1970 and resighted in 1971 was 96.9%. Survival of young from banding in 1961, 1962, 1964 and 1966 to 1970 was also high and averaged 93.4% per year (range: 92.1% – 94.0%) (Harris 1973).

The first attempt by Anderson et al. (2004) to estimate adult survival yielded a value of 95% for all years from 1999 to 2002, followed by a decrease to approximately 86% over the period 2002/03 which correspond to a warm ENSO event. These preliminary results suggested no decrease in survival relative to Harris' (1973) estimates during the 1960s except during warm ENSO years. Awkerman et al. (2005b) also reported that adult survivorship of waved albatrosses from 1999-2002 were close to Harris' estimates of 95% and had remained unchanged since the 1960s. These preliminary reports have created confusion among researchers as annual survival estimates are greater than those reported by Awkerman et al. (2006) using similar methods. The reasons for discrepancy have not clearly been stated in the recent manuscript.

Awkerman et al. (2006) estimated adult survival as 92.5% for most years from 1999 to 2005. Their survival estimates were 2-3% lower than Harris' (1973) during non-ENSO years and about 10% lower in the 2002/03 warm ENSO. The matrix population model used generous estimates of juvenile and inexperienced breeder survival, most likely the actual rates are lower as acknowledged by the authors. Typically, matrix models of monogamous species only consider females, when sex ratios are near 1:1, but this was not expressly stated in the paper. Assuming this model was supposed to consider only females, the fecundity of experienced breeders can not exceed 0.5 female eggs produced per female per year; however, the authors used a value of 0.88 from an unidentified source. If this value is total fecundity, it needs to be halved to remove the males (N. Nur pers. comm.). In current form, the population matrix does not indicate that experienced breeders must die at age 50 (N. Nur pers comm.). Additionally, the model only incorporates mild effects of warm ENSO every five or six years, more realistic effects would include some very unproductive years that further reduce survival and reproduction (D. Lee pers. comm.). A complete matrix with more realistic parameter estimates result in a finite rate of population growth (lambda) lower than one, indicating a declining population (D. Lee pers. comm.).

Elasticity indicated that changes in adult survival had the largest effect on population growth rate, as is to be expected in a long-lived species with delayed reproduction and low fecundity. In light of this, the minimum 1% estimated adult mortality attributed to incidental and intentional capture of birds in artisanal fisheries off Peru is a significant impact on the population. Given the limited band-recovery search area and imperfect band recovery rates, the actual rate of direct fisheries-related mortality is probably higher than 1%. There is no estimate of reduction in survival due to tuna fisheries, which overlap with waved albatross distribution and may further threaten the population (IATTC 2006). The effect of warm ENSO conditions on adult survival was greater than expected and may reflect natural mortality and/or increased attention from fishermen. The evidence of higher mortality of males lacks statistical support but agrees with recovered bands showing that males were caught more frequently than females. Any reduction in human-related mortality of adult birds would be beneficial to the species.

2.7 Diet and foraging

Murphy (1936) thought that waved albatrosses off the coast of Peru fed on shoaling fish such as sardines *Sardinops sagax* and anchovies *Engraulis ringens*, but no studies have been conducted in the region and little is known about the diet of adult and sub-adult waved albatrosses either there or around the Galapagos Islands (Anderson and Cruz 1998, Cherel and Klages 1998). The bulk of the food fed to waved albatross chicks on Española Island was composed of squid (53%), fish (41%), and pelagic crustaceans (46%) (Harris 1973). Most of the squid (80%) was from two families, Histioteuthidae and Octopodoteuthidae, with individuals ranging in mass from five grams to 450 grams. The most common fish identified included flying fish Exocoetidae, Carangidae *Decapterus scombrinus*, and Clupeidae *Etrumeus acuminatus*, ranging in length from 30 mm (20 fish in a single regurgitation) to 340 mm. The euphausiids *Benthopausia* sp. and *Thysanopoda monocantha* were the most common crustaceans in the chick's diet.

The scavenging behavior of waved albatrosses was disregarded as a source of food due to scarcity of documented events and impression that birds do not follow ships (Harris 1973). Merlen (1996) documented several instances where waved albatrosses, ranging from eight to 389 birds, associated with other birds (frigatebirds *Fregata magnificens*, boobies *Sula sp*.) and dolphins (*Delphinus delphis*, *Tursiops truncatus*) feeding on fish. In each one of these instances, waved albatrosses were seen scavenging fish disgorged by boobies. We currently do not know how important these predator feeding aggregations are for the waved albatross.

Recent studies using satellite telemetry have shown that waved albatrosses forage in the Peruvian upwelling region during most of the year, except during the brooding period (Anderson et al. 1998, 2003, Fernández et al. 2001, Awkerman et al. 2005a). Albatrosses travel from their nesting grounds on Española Island to the continental shelf off Peru to forage during the incubation and chick-rearing periods, and are thought to spend the non-breeding season in the same area (Anderson et al. 1998, 2003, Fernández et al. 2000). Albatrosses remain within the Galapagos Islands, foraging in the central part of the archipelago, during the brooding period (Fernández et al. 2001, Anderson et al. 2003, Awkerman et al. 2005a). Non-breeding birds prospecting for mates and sites on Española Island remain within the Galapagos Islands during at least part of the breeding season (Anderson et al. 1998, Awkerman et al. 2005a).

At sea surveys conducted in late summer (March 27 – May 1) 1998 showed that during warm ENSO conditions waved albatrosses forage over localized upwelling cells on the continental shelf off Peru (Jahncke et al. unpub. results). Birds were distributed along the shelf edge in late winter (August 23 – September 17). More birds than expected by chance concentrated in areas where fish backscatter was registered by acoustic methods. Of the birds observed in late summer and late winter, 72% (of 3,853 birds) and 77% (of 989 birds) aggregated in areas where potential prey was available, respectively. The localized upwelling cells used by waved albatrosses in late summer 1998 (warm ENSO) contained half of the fish backscatter integrated in that cruise. Fish backscatter, as indicated by targeted samples, included epipelagic species such as Mackerel *Scomber japonicus* (Scombridae), Scad *Trachurus murphyi* (Carangidae), sardines *Sardinops sagax* (Clupeidae), and anchovies *Engraulis ringens* (Engraulidae). Most of the backscatter at the shelf edge in late winter corresponded to mesopelagic species *Vinciguerria lucetia*.

2.8 Climate variability and El Niño Southern Oscillation

Most information on the effects of climate variability on waved albatrosses, particularly El Niño Southern Oscillation (ENSO), is anecdotal. Warm ENSO may result in late arrival to breeding colonies and reduced attendance of breeding birds, particularly males (Rechten 1986). However, recent observations from one mildly warm ENSO event indicated that the number of clutches produced by the population after the event was similar to those of two years preceding the event (Awkerman et al. 2006). Variability in the timing and intensity of ENSO affects the ecosystem differently from event to event, and this may explain differences in attendance between the 1982/83 and 2002/03 ENSOs. Warm ENSO has been related to mass abandonment of eggs and low nesting success in waved albatrosses in 1965, 1967-69 and 1972 (Harris 1969, 1973). Mass desertions have been associated with increased abundance of mosquitoes *Aedes taeniorhynchus* which thrives in pools of water formed by heavy rains (Harris 1969, Anderson and Fortner 1988).

Prey abundance and availability within Galapagos and off Peru changes dramatically during ENSO years. For example, Peruvian anchovies migrate southwards or seek refuge in upwelling cells close to shore in search for optimal habitat conditions during warm ENSO years (REF), schools disperse further offshore during cold ENSO years (REF). We lack the specific prey information for waved albatrosses to assess these ecological effects. Preliminary information suggests that waved albatross distribution contracts during warm ENSO events and that birds forage in the vicinity of localized upwelling centers that serve as refugia for fish (Jahncke et al. unpub. results). Adult survival of waved albatrosses was greatly reduced during one warm ENSO suggesting greater natural mortality and/or increased attention from fishermen (Awkerman et al. 2006).

3 Conservation and legal status

The waved albatross has been recently reclassified from Vulnerable to Critically Endangered by the Birdlife Red List of Threatened Species (Birdlife 2007). The waved albatross was previously considered by IUCN as Vulnerable because the risk of chance events could potentially threaten the world population on Española Island and off Peru (IUCN 2006). In recent years, uplisting to Endangered was considered but conditioned to demonstrating that regrowth of vegetation had affected their breeding distribution (IUCN 2006). The uplisting to Critically Endangered came after recent evidence suggested a major reduction in population size and adult survival due to human induced mortality that could lead to extinction within a few decades (Anderson et al. 2002, Awkerman et al. 2006).

The waved albatross is currently included in the Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention). Appendix II includes migratory species of "unfavorable" conservation status that need or would significantly benefit from international agreement on their conservation and management. The Agreement on the Conservation of Albatrosses and Petrels (ACAP), drawn up in 2001, includes the waved albatross. Ecuador and Peru have both signed and ratified the ACAP.

Recent uplisting of waved albatrosses by Birdlife may result in their inclusion in the Appendix I of CMS which comprises migratory species threatened with extinction. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they breed, mitigating obstacles to migration and controlling other factors that might endanger them.

In Ecuador, the waved albatross is considered Endangered (Garnizo 2002) and benefits from complete protection. The main breeding colonies on Española Island are protected by the Galapagos National Park and the small colony on La Plata Island is protected by the Machalilla National Park. The Galapagos Marine Reserve offers additional protection by securing 138,000 km^2 of ocean around the islands where longline and driftnet fishing has been banned. The Ecuadorian Law and the Galapagos Special Law specifically mentions that all endemic and native species, including the waved albatross, are legally protected with penalties of up to 12 years of imprisonment (F. Cruz pers. comm.).

In Peru, the waved albatross is listed as Vulnerable in the Categorization of Threatened Wildlife Species (DS 034-204-AG). This legal measure is based on the IUCN Red List of Threatened Species and adopts their categories and classification criteria. This law prohibits hunting, capture, possession, transportation and exports of threatened wildlife for commercial purposes, but does not mention specific sanctions against people that infringe the law.

4 Current and potential threats

4.1 Introduced species

Española Island was populated by introduced feral goats *Capra hircus* that destroyed native flora for more than 80 years, changing the landscape of the island (Harris 1973, Anderson et al. 1998, Tickell 2000). Goats were eradicated by the Galapagos National Park Service by 1978 (Hamann 1984), and the vegetation across the island recovered since (Douglas 1998, Anderson et al. 2002). The cactus *Opuntia megasperma* once common on the islands was severely reduced by goats, and has not come back since the goats were eradicated (Browne et al. 2003). Goats created additional clearings in the vegetation that benefited the albatrosses; as a result population numbers in 1970 were probably higher relative to those before the clearings were created (Harris 1973). There are no introduced mammals or birds currently on the island, although there are introduced invertebrates and plants (Amador et al. 1996). Introduced mammals had dramatic effects on the landscape which affected the distribution and abundance of albatrosses on the island, particularly inland colonies. We do not know what effects introduced invertebrates and plants may have on the ecosystem.

4.2 Loss of habitat

Nesting habitat for waved albatross has been decreasing since goats were eradicated in 1978 (Douglas 1998, Anderson et al. 2002). Two hillside inland colonies disappeared by 1994 (Douglas 1998), and the population at other inland areas has declined due to vegetation growth (Anderson et al. 2002). There appears to be redistribution in population from inland to large open areas at the eastern, western, and southern parts of the island, although populations in these coastal areas appear well below their potential densities (Anderson and Cruz 1998).

4.3 Disease and parasites

Exposure to common infectious disease could have dramatic effects on the population of waved albatrosses. Serum from albatrosses was tested for several common avian pathogens and evidence of exposure to adenovirus group 1 and avian encephalomyelitis was found (Padilla et al. 2003). No birds showed clinical signs of disease, but surveillance for causes of mortality may elucidate the significance of these pathogens in the population (Padilla et al. 2003).

Increased abundance of parasites has devastating effects on the population of waved albatrosses during years with heavy rain fall. During warm ENSO years, the abundance of mosquitoes *Aedes taeniorhynchus* increases, producing distress in the birds and resulting in mass abandonment of eggs (Harris 1969, Anderson and Fortner 1988). Climate change models predict an increase in the occurrence of extreme ENSO events (IPCC 2001); frequent heavy rains may lead to greater presence of mosquitoes on the island and lower nesting success than currently observed.

4.4 Disturbance

The only potential source of disturbance to waved albatrosses is the presence of humans in Punta Suárez on the western side of Española Island. A trail of about three kilometers in length runs along the southern coast of the point, at times approaching close to albatross nests (Anderson and Cruz 1998). The path was designed to minimize disturbance and no obvious negative influence on the birds has been detected, albatrosses appear to be indifferent to the presence of well-regulated groups of tourists (Anderson and Cruz 1998). Anecdotal evidence indicates that the number of nests in the tourist area at Punta Suárez has decreased over the years (D. J. Anderson pers. comm.).

4.5 Pollution

There is no information on the effects of pollution on waved albatrosses in Galapagos and off Peru. Pollution is the presence of foreign substances in the environment at concentrations ‘enough to cause adverse effects on life’, while contamination only refers to their presence at concentrations ‘above natural levels’.

Chemicals associated with plastics (polychlorinated biphenyls, PCBs) and insecticides (chlorinated hydrocarbons, CHCs) degrade slowly and become concentrated in tissues of top predators. Seabirds that forage in coastal waters have higher levels of contaminants which affect their reproductive success and lead to population declines (Environment Australia 2001).

Albatrosses ingest large quantities of plastic and other marine debris which have a wide range of lethal effects. The debris can result in blockage or damage of the digestive system leading to starvation. Some plastics are sources of toxic pollutants which lowers the bird’s ability to reproduce (Environment Australia 2001). A study of plastic ingestion in the Española colony is currently underway (D. J. Anderson pers. comm.)

There is significant amount of national and international shipping traffic that passes thorough the Galapagos Islands, including freighters and tourist vessels, raising the possibility of contaminant spills near the breeding colonies (Anderson and Cruz 1998). In 2001 the fuel tanker Jessica grounded off on San Cristóbal Island, 54 km north of Española Island: no birds were affected because the spill occurred at the end of the breeding season (Anderson et al. 2003), but a high impact would have been expected if the spill occurred during the brooding season when birds forage north of Española and west of San Cristóbal.

4.6 Climate change

Climate change models predict increased frequency of extreme weather events with global warming (IPCC 2001). Heavier rains during warm ENSO may lead to increased mosquito abundance, mass egg abandonment and low nesting success more often than previously observed. Decreased upwelling during warm ENSO may result in prey redistributions including a southward shift in foraging areas or increased foraging near the coast. The frequent use of upwelling centers and fish refugia also exploited by artisanal fishermen during warm ENSO may increase the risk of human induced mortality on albatrosses further threatening their population.

4.7 Fisheries and fisheries interactions

4.7.1 Evidence for potential interactions

Fishing activities were not considered a risk to waved albatrosses because birds apparently lacked the ship-following behavior that leads to bycatch in longlines (Anderson et al. 1998). However, waved albatrosses scavenge dead fish when available and this behavior represents a threat in the presence of longline fisheries (Merlen 1996). A local artisanal fishery for bigeye tuna *Thunnus obesus* that operated in Galapagos apparently catches up to five albatrosses per boat per day using live sardines as bait (G. Merlen pers. comm. in Anderson et al. 2003). A longline fishery for blue shark *Prionace glauca*, mako shark *Isurus oxyrinchus*, and mahi mahi *Coryphaena hippurus* has been reportedly taking waved albatrosses off Peru (Jahncke et al. 2001, Mangel et al. 2006). The Inter-American Tropical Tuna Commission (IATTC) recognized that artisanal vessels could be a problem for waved albatrosses in their 2006 report (IATTC 2006).

Although waved albatrosses are distributed within the area delimited by Galapagos and the coasts off Ecuador and Peru, most of their foraging activity occurs over the continental shelf off northern Peru (Anderson et al. 1998, 2003, Fernández et al. 2001, Awkerman et al. 2005a). Longline and driftnet fishing are currently banned within the Galapagos Marine Reserve where chick-brooding and prospecting albatrosses are known to forage (Anderson et al. 1998, Awkerman et al. 2005a). Longline and driftnet fishing are common practices off Peru, for this reason we focus on fisheries and fisheries interactions with Peruvian fisheries, which currently represent the greatest threat to waved albatrosses.

4.7.2 Longlines

Longlines were once regarded as an environmentally friendly fishing method and were encouraged by authorities because they caused no damage to bottom habitats and discards of unwanted fish were low (Brothers et al. 1999). Longlines in Peru were encouraged in the late 1980s and 1990s as way to reduce dolphin mortality in gillnets from artisanal fishermen (Reyes 1993, Jahncke et al. 2001). However, longlines have become the primary factor in seabird mortality since the 1990s (Crowder and Myers 2001).

Demersal longline fishing takes place on the shelf and shelf-edge of most continents. It is regarded as artisanal if it takes place from a small (sometimes open) vessel or commercial (industrial) if it takes place from large deep-water vessels which process their catch aboard (Brothers et al. 1999). Pelagic longline fishing generally takes place in deep water off the continental shelf. Most pelagic longlining is commercial (industrial) and concentrates on tuna and billfish species and operates in tropical areas (Brothers et al. 1999).

4.7.2.1 Industrial demersal longlines

In Peru, demersal longline fishery at industrial scales represents 1% of the fleet with vessel storage greater than 30 m^3 (Goya and Cárdenas 2004). The industrial longline fishery off Peru targets Patagonian toothfish *Dissostichus eleginoides*. The fleet consisted of six vessels in 1996 and 1999, 13 in 2000, 11 in 2001 and 2002, and 13 vessels during 2003 (Goya and Cárdenas 2004). Catches are made between 800 and 2,250 m depth and there are latitudinal differences in fish abundance: yields are greater between 12°S and 18°S. Total effort of the fleet was 1,409,354 hooks from 1996 to 1999. Mean effort by month was 128,123 hooks, with minimum and maximum effort levels being recorded in March (35,550 hooks) and July (276,815 hooks) of each year, respectively. Annual catches from 1996 to 2002 had fluctuated according to effort levels from 369.91 metric tons (MT) in 1996 to 173,434 MT in 2000, with mean annual catches of 253.84 MT and a variation coefficient of 30% (Goya and Cárdenas 2004). There is no information on seabird bycatch in this fishery.

4.7.2.2 Industrial pelagic longlines

Peru has no industrial pelagic longline fishing fleet, but the law allows for annual permits to be issued to foreign fishing vessels. In 1993 and 1994, 4-6 Japanese pelagic longline vessels operated under permits in Peruvian waters, they targeted bigeye tuna. Their permits were not renewed because, among other things, they had high levels of bycatch on non-target fish species (i.e. sharks). Onboard government observers from Instituto del Mar del Perú (IMARPE) were present on all vessels to monitor the tuna catches (G. Cárdenas, pers. comm.). There was no information on seabird bycatch by the Japanese fleet. However, information provided in the IATTC reports point out an overlap of the distribution of the waved albatross and their longline fishing area (IATTC stock assessment group 2007).

4.7.2.3 Artisanal pelagic longlines

The artisanal pelagic fleet ranges in size from the small reed (totora) craft to the larger wooden hulled boats with diesel powered motors and a fish hold, some of them equipped with GPS and sonar fish spotters (Estrella et al. 2007). Although the maximum legal size for an artisanal boat is 32.6 cubic meters with a hold capacity of 30 MT of fish, 80.7% of the boats are less than five MT and only 5.8% are greater than 10 MT (Estrella et al. 2007).

In 1995-1996, approximately 28,000 artisanal fishermen and 6,250 fishing boats operated along the Peruvian coast. Longliners represented 3% of the fleet with a total of about 190 boats (Escudero 1997). Since 1995, these figures have increased and 37,700 fishermen and 9,650 fishing boats were estimated in 2004-2005, 9.8% of them correspond to longliners with an additional 9% that switch gears during the year (Estrella et al. 2007), this represents between 946 and 1,814 longliners, accounting for seasonal shifts in fishing gears. The number of longline boats increased considerably during warm ENSO years, as was the case in ENSO years 1997/98 (Goya and Cárdenas 2004). The 60% expansion of the fleet has been attributed to the exploitation of Humboldt squid *Dosidicus gigas* which is a relatively new species in Peruvian waters. The main fishing gear used by the artisanal fishermen is the long line, although hand jiggers (for squid), tangle nets, traps and a variety of designs of small nets are also used (Tilman 2006).

The most comprehensive description of longline fishing practices comes from 297 surveys conducted by Mangel and Alfaro-Shigueto (2005) in 19 fishing ports where longlines are used. They reported that the artisanal fleet in these areas target blue and mako sharks from March to November and mahi mahi during the remaining months. Fleet size increases during summer to take advantage of the profitable mahi mahi season. Trip length during the shark season is approximately 15 to 20 days while during the mahi mahi season it drops to 5 to 7 days. Boats travel as much as 250 miles from shore during winter, and move closer to shore during the summer. Boats typically set their gear in the morning and recover it in the early evening. Boats in the north of Peru use smaller J-shaped hooks to target mahi mahi while in the south they use larger hooks as they focus on shark fishing. The length of the mainline and the number of hooks varies by boat, but typically is 2-3 km long, contains an average of 800 hooks and is set at 18 meters depth. Fewer hooks are used for mahi mahi. Weighted branchlines are used in some ports and steel leaders are often used to reduce gear loss during shark season. Baits used include squid (45%), mackerel (21%) and sardines (17%); and many used fresh (35%), frozen (15%) or salted (50%).

Half of the fishermen interviewed reported seeing and hooking albatrosses or petrels while at sea. Most fishermen (79%) indicated that they rarely hooked seabirds during fishing operations, indicating that seabird bycatch is a relatively rare event. Most respondents indicated that more seabirds were caught during the summer (60%) than during the winter (30%). The majority (96%) said that interactions occurred during the day, and that birds are generally caught from their beak (76%), throat (13%) and wing (9%). Fishermen said that hooked seabirds were released alive (18%), discarded dead (59%), eaten (22%), or de-feathered for lures (1%). A rough estimate from these surveys suggested a bycatch rate of 0.20 to 0.61 seabirds/1000 hooks. These estimates represent rates of seabird bycatch as reported by fishermen and do not necessarily suggest actual mortality rates (Jahncke et al. 2001, Mangel and Alfaro-Shigueto 2005).

An onboard observer program carried out from May 2005 to April 2006 surveyed 51 artisanal longline fishing trips (a total of 354,222 hooks) in six fishing villages. They documented a single entanglement of a black-browed albatross *Thalassache melanophrys* caught by the beak after the longline was deployed while fishing for sharks in the port of Ilo (Mangel et al. 2006). This represents a bycatch rate of 0.003 birds/1000 hooks. Mangel et al. (2006) made an effort to estimate bycatch for the artisanal longline fleet. For this purpose they assumed information regarding average fishing practices collected at seven villages during a total of 173 fishing trips from 2003 to 2006 (6.5 sets/trip × 860 hooks/set) and combined this with IMARPE's estimate of 11,316 artisanal longline fishing trips along the coast in 2002. Assuming that fishing practices in 2002 were similar to 2003-2006, they estimated that approximately 190 albatrosses may have been caught in that year. Mangel and Alfaro-Shigueto (2005) report that most birds (26%) caught incidentally by artisanal longliners are waved albatrosses; this would represent a total of 49 waved albatrosses caught in 2002, this extrapolation needs to be taken carefully as it is based on bycatch of a totally different species. Further research is needed to come up with a more precise estimates of seabird mortality associated with longlining in this region. To date 43 metal bands from waved albatrosses have been recovered, 44% of these correspond to birds that reportedly died as bycatch during artisanal longline fishing operations (Jiménez-Uzcátegui et al. 2006b).

4.7.3 Other relevant fisheries

4.7.3.1 Industrial purse seiners targeting anchovy

The industrial purse seine fishing fleet comprises 609 steel-hulled vessels, averaging 287 m^3 of hold capacity, dedicated exclusively to the capture of anchovy and 600 wooden hulled vessels, with hold capacities ranging from 32 to 110 m^3, permitted to fish anchovy, horse mackerel, and sardine (Bouchon et al. 2007). Many birds, likely guano producing birds, were reportedly killed in purse seine nets set for anchovies during the height of the anchovy fishmeal industry in the 1960s (Jordan and Fuentes 1966), but this was never quantified (Duffy et al. 1984). The industrial purse seine fishery is closely monitored since the 1980s by onboard observers from IMARPE (Programa Bitácoras de Pesca) which, among other duties, record attraction and/or bycatch of sea birds, turtles, and mammals to the vessels. To date, no bycatch of albatrosses and petrels has been documented, and these species of birds are rarely attracted to the ships during normal fishing operations. Bycatch of guanay cormorants *Phalacrocorax bougainvilli*, Peruvian boobies *Sula variegata* and gulls has been noted but not properly quantified, although data sheets have been modified accordingly to better account for these interactions (E. Goya pers. comm.).

4.7.3.2 Industrial purse seiners targeting tuna

There are approximately 80 to 100 foreign tuna fishing boats operating under permit within Peruvian waters since 2003. Although most ships come from Ecuador, there are others that come from Colombia, Venezuela, Panama, and USA among others. Permits are given for specific periods of time, in this case for the length of the tuna season. Vessels with hold capacities less than 353 MT are monitored by onboard observers from Instituto del Mar del Perú (IMARPE). Vessels with greater hold capacities are monitored by observers from the IATTC (G. Cárdenas pers. comm.). Observers record fisheries related information including bycatch of non targeted species including seabirds. No albatross and petrel bycatch has been reported to date, although birds appear to be attracted to ships during fishing operations (E. Goya pers. comm.).

4.7.3.3 Artisanal gillnets

Gillnets are the most common fishing method used by the artisanal fishery in Peru. For example in 1999, 63,083 gillnet fishing trips were conducted during the year compared to only 1,968 longline fishing trips recorded during half of the year (Estrella et al. 2000). In 1995-1996, 40.2% of the artisanal fishing boats (n = 6,250) used gillnets (Escudero et al. 1996). These numbers have not changed significantly and 33% of the fishing boats (n = 9,650) used gillnets in 2004-2005 with an additional 9% that switch gears during the year (Estrella et al. 2007). These figures represent a total of 3,185 to 4,053 gillnetting boats, accounting for seasonal shifts in fishing gears.

Gillnets are known to cause mortality among diving animals; drift gillnets cause especially higher levels of mortality of sea birds, mammals and turtles (Harrison and Robins 1992). A total of 1,805 marine birds, mammals and turtles were brought to port and reported as drift gillnet bycatch to observers by fishers in Punta San Juan between November 1991 and June 1998. Drift gillnets with bycatch were reported on 77% of the 1,205 fishing trips, and accounted for 76% of the animals caught, while set gillnets accounted for 17% of the mortality (Majluf et al. 2002).

The most complete description of gillnet fishing practices comes from results from 426 surveys conducted by Mangel and Alfaro-Shigueto (2005). Their results show that 33 fishing ports indicated that gillnets were used year-round and targeted sharks (13%), croaker (10%), rays (9%), weakfish (8%), mullet (8%), drum (7%), smooth hound shark (6%), and Pacific creole fish (5%). Trips are generally short and average 3.5 days in summer and 4.4 days in winter. Fishing operations occur close to shore. Net length ranges from 0.4 to 2.6 km and mesh size varies according to target species. Nets can be set at the surface or at depth, during day or night, and half of the respondents set their gear two or more times a day.

More than 20% of the fishermen reported entangled seabirds at least every month. Most respondents (70%) stated that entanglements occurred during summer and 56% percent said that they occurred during daylight. Fishermen said that birds were released alive (9%), discarded dead (51%), eaten (30%), de-feathered for lures (1%), and sold (9%). Most common bycatch species groups were albatrosses and petrels (13.4%), cormorants (44%) and boobies (20.3%).

An onboard observer program surveyed 21 artisanal fishing trips (175 sets and 300-423 km of net) in Salaverry, northern Peru, from May 2005 to April 2006 and recorded entanglement of 13 guanay cormorants, two Humboldt penguins, one sooty shearwater *Puffinus griseus*, and two unidentified petrels (Mangel et al. 2006). This represents a mortality rate of 0.103 birds/set, or 0.060-0.043 birds/km of net. All birds drowned except one penguin which was brought to port alive. Cormorants were de-feathered and brought to shore for consumption. Mangel et al. (2006) used bird catch rates and fishing effort, ranging from 411 trips in 2002 to 572 in 2005, to estimate that 352 – 490 birds may have been caught in Salaverry each year, respectively. Approximately 6,498 animals may have been caught in Peru in 1999 assuming 63,083 fishing trips and one set/trip. Interesting to note that no albatross were captured with this gear; however, Majluf et al. (2002) did noted the take of albatrosses in San Juan without mentioning the specific species captured. Further research is needed to come up with a more realistic estimate of seabird mortality associated with gillnets in Peru. To date 43 metal bands from waved albatrosses have been recovered, 18% of these correspond to birds that reportedly died as bycatch during artisanal gillnet fishing operations (Jiménez-Uzcátegui et al. 2006b).

4.8 Human consumption

Mangel et al. (2006) documented intentional capture of waved albatrosses in Salaverry. Fishermen reportedly captured 12 albatrosses and one unidentified petrel with baited hooks, one of the albatrosses was released after the band was removed, the other birds were eaten by the crew, nine of the eaten albatrosses were captured in a single fishing trip out of 21 onboard surveys. Assuming a catch rate of 13 birds per 21 trips and a fishing effort ranging from 411 trips in 2002 to 572 in 2005, Mangel et al. (2006) estimated a direct take of birds of 254 – 354 birds, including 235 – 327 waved albatrosses per year.

Recovered bands provided further evidence suggesting that catch of albatrosses in Salaverry may be a major problem (Jimenez-Uzcategui et al. 2006). Waved albatrosses comprised 87% of 107 bands recovered from nine fishing villages by Mangel et al. (2006). Eighty-two percent of them were recovered from Salaverry. Although band returns were generally associated with a particular fishery, it does not mean that birds were necessarily caught as bycatch. Some birds are captured because they carry a conspicuous metal band or electronic device that may bring a monetary reward, but most appear to be intentionally caught using hook and line to be eaten aboard (Mangel et al. 2006). At least 38% of the 43 metal bands from waved albatrosses recovered correspond to birds that were intentionally captured using hook and line (Jiménez-Uzcátegui et al. 2006b).

5 Previous management actions

5.1 Animal eradication

Española Island was populated by introduced feral goats *Capra hircus* from at least 1897 to 1978 (Harris 1973, Anderson et al. 1998). Goat eradication was conducted by the Galapagos National Park Service which is part of the National Protected Area System, under the Ministry of Environment. The Management Plan for the Galapagos National Park mandates continuous monitoring of introduced species and has made control and eradication of introduced vertebrates a top priority (Amador et al. 1996). This action however, might have had negative effects on the population of waved albatrosses and apparently has led to disappearance of several sub colonies. Further work might be needed to balance the vegetation growth, and the lack of tortoises in natural numbers (the land tortoises were the only herbivore on the Island). The tortoise breeding program has been able to return to Española over 2000 tortoises in the last 30 years and they are naturally breeding on the Island, but many more years will be needed to have a stable and ecological sound population, which will play a key role in vegetation control (F. Cruz pers. comm.).

5.2 Seabird monitoring

At present, there is not a systematic program for seabird monitoring on the Galapagos Islands (F. Cruz pers. comm.). Several seabird populations including waved albatrosses, Galapagos petrels *Pterodroma phaeopygia*, Galapagos penguins *Spheniscus mendiculus*, flightless cormorants *Phalacrocorax harrisi*, lava gulls (*Larus fuliginosus*) are monitored regularly by staff of the Galapagos National Park and the Charles Darwin Research Station (F. Cruz pers. comm.). Waved albatross eggs and fledglings are counted annually in two standard plots (one at Punta Suárez and one at Punta Cevallos), and unmarked adults and fledglings in these plots are banded and injected with a PIT tag during the two annual visits. Band resights of adults are conducted during these visits, lasting 1-2 days per plot. Detailed breeding data have been collected by D. J. Anderson, K. P. Huyvaert, and colleagues in most years since 1999. In addition, they have conducted annual band resight surveys of XX-XX d that have led to the results reported in Awkerman et al. (2006). Cooperative plans involving these visiting scientists and the National Park Service and Charles Darwin Station are planned to enhance the quality of the monitoring effort. Colony-based data on population size collected to date are poor, in part because they lacked error estimates; alternative methods are expected to be implemented for the 2008 breeding season (D. J. Anderson pers. comm.).

5.3 Tourism restrictions

Tourism is by far the main economic activity in the Galapagos Islands. The number of visitors has doubled over the last 15 years and resulted in annual economic growth of 14% per year (F. Cruz pers. comm.). It started sometime in 1969 with tourists visiting a few areas with easy access. The first designated tourist areas were established by 1974-77 and currently there are only 53 sites that can be visited even though the Park comprises 97% of the land mass in Galapagos. Tourists are required to have a trained guide to visit most sites except for a few located near populated areas (Amador et al. 1996). Tourism on Española Island consists from 5 to 20 groups of tourists per day that visit Punta Suárez and Gardner Bay. The large number of ships that arrive per day currently represents a problem as it exceeds the load-capacity per day (Jiménez-Uzcátegui pers. observ.). A trail of about three kilometers in length runs along the southern coast of Punta Suárez and was designed to minimize disturbance to albatrosses within view (Anderson and Cruz 1998). There is anecdotal evidence that indicates that the number of nests in the tourist area at Punta Suárez has decreased over the years (D. J. Anderson pers. comm.).

5.4 Zoning and Marine Protected Areas

The main breeding colonies on Española Island are protected by the Galapagos National Park and the small colony on La Plata Island is protected by the Machalilla National Park. The Galapagos National Park comprises 97% of the total land mass and the marine component is 40 nm from the outer points around the islands, therefore it has a total of 138,000 km^2. At present, longline and driftnet fishing is banned within the Marine Reserve but illegal fishing boats from mainland Ecuador, Costa Rica and perhaps from other neighboring countries are ravishing the Galapagos waters (F. Cruz pers. comm.). The main foraging grounds of pre-breeding adults and breeding age adults skipping one or more breeding seasons occurs in the southeastern portion of the Galapagos Marine Reserve (Anderson et al. 2003). Foraging grounds of breeding adults during the chick-brooding season extend from west of Española to the eastern coast of Fernandina, north to waters north of San Cristóbal, and especially within 70 km of Española, all within the Galapagos Marine Reserve (Awkerman et al. 2005a).

6 Recommended action strategies

6.1 Management

6.1.1 Ensure the enforcement of the legal framework for the conservation of waved albatrosses and other threatened species. Currently both countries have listed their priority wildlife species based on endemism or threatened status criteria. Ecuador has clear legal measures to reinforce the law that appear to be lacking in Peru.

6.1.2 Guarantee continuous funding for the conservation of waved albatrosses and other threatened species of critical status. Countries will seek funding from national and international sources to support management, research, education and outreach oriented towards the conservation of waved albatrosses and other threatened species of critical status.

6.1.3 Develop and implement a strategy for addressing specific issues affecting the conservation of waved albatrosses. The development and implementation of the strategy should involve participation of government, managers, scientists and stakeholder groups to guarantee coordinated efforts towards success.

6.1.4 Ensure continued communication among parties involved in the conservation of waved albatrosses and other threatened species. Coordinate regular workshops where government, managers, scientist and stakeholders analyze the efficacy of current conservation measures on highly threatened species and redirect their focus on the most important threats agreed up on. Promote the transparency of the information obtained by the government officers, non-profit organizations, fishermen associations, and other agencies working in the subject.

6.1.5 Implement a vegetation control program on specific breeding sites on Española Island to improve reproductive success as well as diminishing the adult mortality. The Galapagos National Park and the Charles Darwin Foundation will need the funding support to start this program. This will be a long-term project due to the small numbers of tortoises on the Island.

6.1.6 Develop tools to address the work at fishing communities in economic alternatives, social aid, etc (i.e., long term educational programs, ecolabelling, trials on mitigation measures, local capacity building, others) rather than legislation measures that in reality would not have a greater impact in this conservation problem while at sea, and might be received by these communities as a repression to their work (see: Van Waerebeek et al., 1997).

6.1.7 Coordinate with the Regional Fisheries Management Organizations operating in the area (IATTC – resolution res C05-01 June 05-, Galapagos Agreement, etc), for further work to reduce seabird bycatch (overlap areas, improve/implement observer coverage, etc.)

6.2 Research

6.2.1 Undertake regular monitoring of the waved albatross population on Española Island. A monitoring program for this species should focus on population, adult survival, juvenile survival and reproductive performance at colonies. Index plots for long tem monitoring should be set in main breeding sites to assess changes in population and demography parameters over time. Complete censuses of the breeding population should be conducted at regular intervals, at least every 1-3 years while it is declining and every 5-10 years once it is considered stable. Banding and resighting efforts should continue in the main breeding sites, although because of intentional capture of banded birds by fisherman, bands may have to be dropped and the use of PIT tags encouraged.

6.2.2 Initiate diet studies of waved albatrosses in Galapagos and Peru. There is very little information on the prey used by albatrosses near their colonies and no information whatsoever exist on the types of prey used off Peru. Identifying the prey organisms that link waved albatrosses and the Peruvian upwelling region, and drive their distribution and abundance off Peru, should be a priority as this information will help to determine appropriate conservation strategies to reduce the interaction with fishermen. These studies currently conflict with reluctance of the Galapagos National Park Service to permit collection of regurgitation samples.

6.2.3 Continue studies on the foraging ecology of waved albatrosses. Studies using satellite telemetry have been useful in showing the general foraging location of the birds, but no knowledge have been gained on the physical and biological variables driving those distributions and abundance patterns. At sea cruises have been conducted by IMARPE but no products have been made available that help to understand which oceanographic or biological variables may be driving the distribution and abundance of birds off Peru. Efforts that integrate satellite telemetry and satellite oceanography, and the at-sea counts with the available oceanographic and biological data from cruises are needed. These efforts will shed light on the physical and biological characteristics of the habitats used by waved albatrosses which will be a key to determine the appropriate conservation strategies to reduce interaction between birds and fishermen.

6.2.4 Continue studies on artisanal fisheries, their seasonality, gear, effort, fishing methods and areas, targeted species, and bycatch including non targeted fish and wildlife. This information is important to estimate overlap between fishermen and wildlife use of marine habitats. Knowledge about areas of high use by fishermen and birds may require particular attention to determine conservation strategies that minimize the fishermen's impact on the albatross population. Observer programs provide the best information about artisanal fisheries but require a lot of time and effort to build the sample size. Questionnaire surveys in contrast provide extensive information on artisanal fisheries but may be subjective. Conducting questionnaires in parallel to an observer program will allow controlling for biased responses from fishermen and to better characterize artisanal fishing at villages along the coast.

6.2.5 Conduct a Population Viability Analysis of the waved albatross population on Española Island. This analysis would estimate species persistence and measure population trends under different scenarios of threats and demographic traits over the next 100 years. This modeling exercise will identify main threats and population factors which via management could increase population size. Frequency and intensity of warm ENSO events, mortality by persecution, and reduction of nesting areas by increased vegetation cover may be modeled as catastrophic events. This analysis and a workshop for discussion should be held sometime in the next two years or when participants feel comfortable about the availability of quality data to obtain reliable outputs.

6.2.6 Integrate studies of the socio economic and cultural background of the fishing communities, to help understand their perspective on marine and seabird conservation and how this approaches can be addressed to encourage seabird conservation.

6.2.7 Document possible impact of other fisheries on bycatch of the waved albatross (i.e, extended effort in Ecuador, longline tuna fisheries, demersal longline fisheries, etc.) and explore the use of mitigation measures applicable to some of these fisheries.

6.3 Outreach and education

6.3.1 Discourage direct capture of waved albatrosses and other wildlife by fishermen through long term education and outreach programs, as well as economic alternatives for the fisherman along the coast of Peru. Educate fishermen on the ecology of birds and marine wildlife. Make intensive outreach to make clear that bird metal and plastic bands, and electronic gear on birds have no refund value, that there are no rewards for sending these items back, and that there is a lot of effort, money, and information lost when bands are removed from a bird for no reason.

6.3.2 Raise awareness of mitigation measures available to reduce bycatch of seabirds and other wildlife in fisheries. Focus on longlines, but cover seabird mortality in other gears including driftnets. Ensure fishermen have access to inexpensive bycatch mitigation devices and train fishermen in safe release handling techniques.

6.3.3 Encourage fishermen's participation in the conservation of waved albatrosses and other wildlife. Make them participate in the research. Fishermen could report on areas where albatrosses were abundant and take notes on prey consumed if the opportunity arises. Make efforts to enlist the fishing industry and fishers cooperatives in conservation. Establish a 'sustainable fisheries' certification of ecosystem friendly fishing practices that can be used to access better markets for their products.

6.3.4 Waved albatrosses and other marine wildlife have the potential to attract tourists. Small scale marine tourism is a sustainable option for fishermen to make a profit with less detriment to the environment. Ecotourism is likely to have positive effects in the overall economy of the village increasing demand for services and opening new job possibilities.

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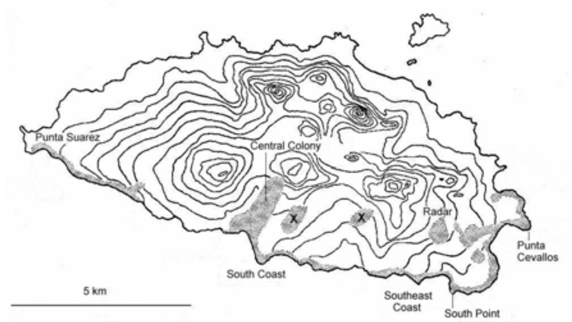
Figure 1A. Approximate distribution of waved albatross nesting areas on Isla Espanola, from Harris (1973). Areas that are apparently no longer used are marked with an "X". Figure 1B. Locations of waved albatrosses at sea during the breeding season, determined from bird-mounted Platform Transmitter Terminals (PTTs) in 1995, 1996, 2000, and 2001 and from Global Positioning System (GPS) units in 2003, 2004, and 2005 (Anderson et al. 1998, 2003, Fernández et al. 2001, Mouritsen et al. 2003, Awkerman et al. 2005, and Awkerman and Anderson unpub. data). The boundary of the Galapagos Marine Reserve is indicated, surrounding Galapagos (from Anderson et al. 2002).

A



B

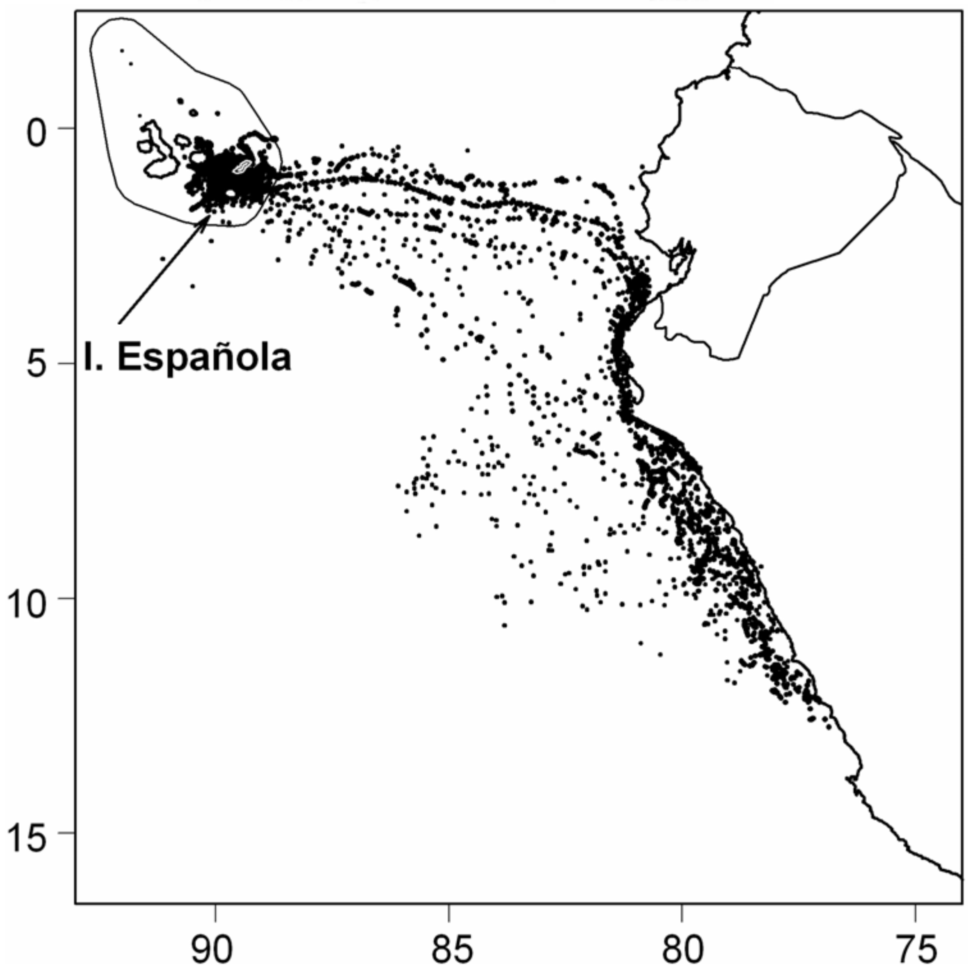
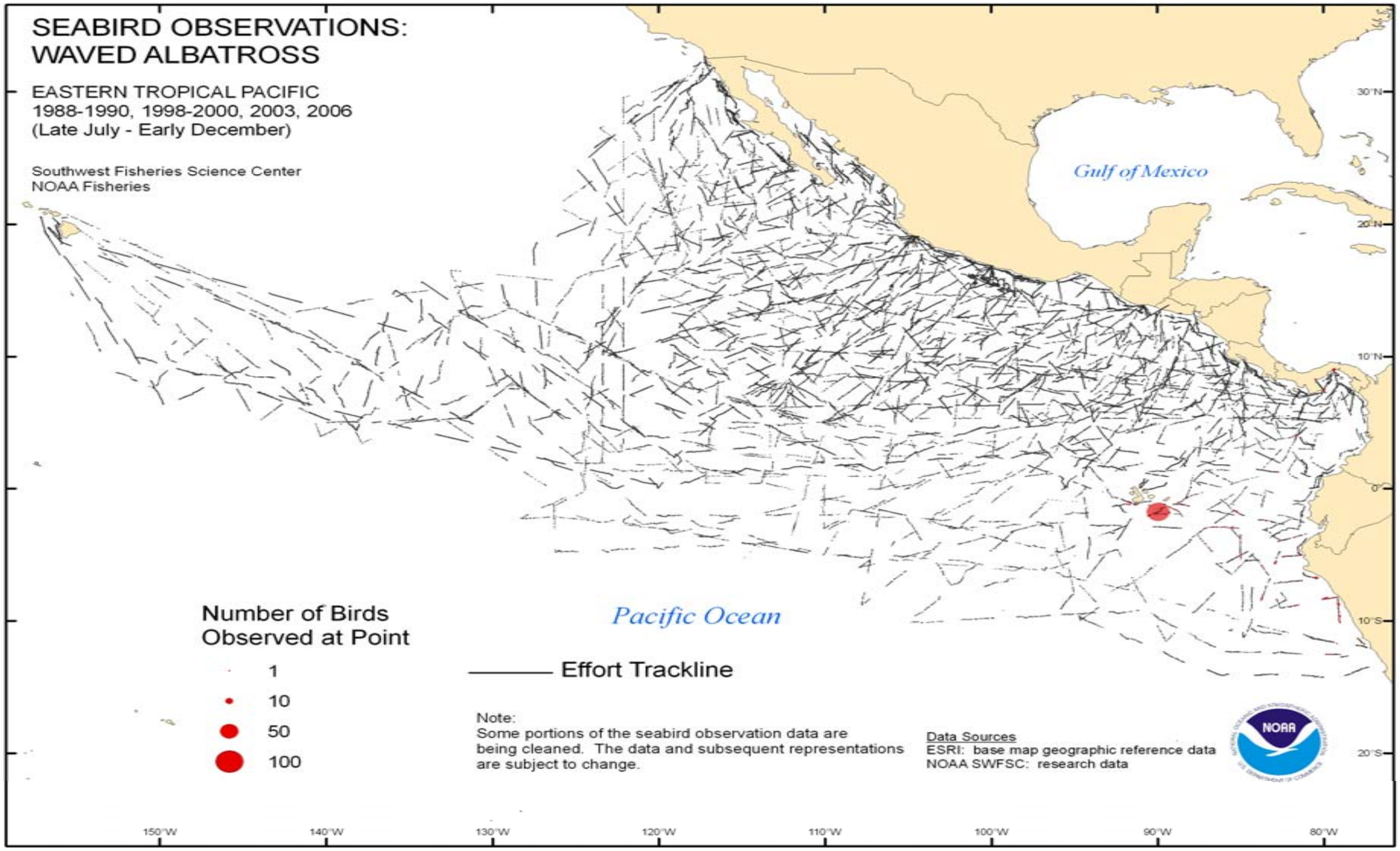


Figure 2. Map showing all locations of waved albatrosses sighted during NOAA Southwest Fisheries Science Center cruises along the Eastern Tropical Pacific region (Ballance and Pitman unpub. data).



Appendix C

Plan of Action for the Development of a Baseline on the By-catch of Albatrosses and Other Marine Species in Ecuador (Draft)

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Background

Ecuador is a member of the Agreement on the Conservation of Albatrosses and Petrels (ACAP), however all existing data are still incomplete, on a national scale, on the by-catch of these species and this has not enabled us to comply with our obligations as a country within the Agreement. Furthermore, the Galápagos Albatross (*Phoebastria irrorata*) is a species which is threatened with extinction (or endangered as per BirdLife International, 2004) and endemic to the Galápagos Archipelago. All data on its biology (Anderson *et al.* 2004) suggest that it travels to the continental shores of Peru for foraging purposes, although there is one small nesting colony in the Isla de la Plata, Manabí, which points to its presence in the Ecuadorean continental coast.

Additionally, there have been reports of Galápagos Albatrosses captured with longlines along the Guayas coast in Ecuador (Ben Haase, *com. pers.*) which indicates it is imperative to undertake further efforts to establish a baseline on the by-catch of this and other marine species, not only in continental Ecuador but also in its islands.

In light of this background, we have prepared the following proposal with a view to establishing the reality of seabird by-catch and other species in Ecuador.

Broad Aim	**Specific Goal**	**Activities**	**Expected Outcomes**	**Indicators**
To establish the context of by-catch of seabirds and other species in Ecuador	1. To raise awareness in the national fishing sector on the importance of identifying by-catch and the implementation of mitigation measures	1. Undertake two socialization projects in each coastal province of Ecuador 2. Prepare and distribute informational materials on this issue 3. Design a long-term awareness raising programme	The fishing sector in Ecuador proves to be receptive to the establishment of a baseline on seabird by-catch. Local population is informed on the issues and is interested in some kind of cooperation. New generations joining the small-scale sector apply mitigation measures.	Reports from all 3 workshops. Letters of commitment from leaders of the fishing sector with the acceptance of observers onboard. Information materials. Strategic planning documentation and other resources necessary for funding.
	2. To develop a baseline on the by-catch of seabirds and other species in Ecuador	1. Identify amongst fishermen / local inhabitants any potential observers onboard. 2. Define the methodology and contents of a training workshop for observers onboard. 3. Undertake a training workshop on the established methodology for observers onboard. 4. Undertake field trips with observers	A sufficiently larger group is prepared to compile data on vessels. Methodology is defined and a suitable workshop is undertaken. Group of observers onboard are trained appropriately. Methodology is suitably applied and	Letter of commitment from potential observers onboard confirms their interest in training and in implementing said training. Methodology documentation and other documents resulting from the workshop. Report from the Workshop. Analysis of data;

		onboard, in their respective provinces and fleets. 5. Compile and analyse data on seabird by-catch, submitted by the observers, for a period of at least one year.	its preliminary results are satisfactory. Data subjected to statistical analysis and baseline on by-catch is established.	reports from field trips and suggestions on methodology. Final report with conclusive data.

Tentative Activity Flowchart

Activities / months	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Specific Goal 1. To raise awareness in the national fishing sector on the importance of identifying by-catch and the implementation of mitigation measures																								
Commencement phase of project	X																							
1. Undertake two socialization projects in each coastal province of Ecuador		X	X	X	X																			
2. Prepare and distribute informational materials on this issue		X	X	X	X																			
3. Design a long-term awareness raising programme						X	X	X	X	X	X	X	X											
Specific Goal 2. To develop a baseline on the by-catch of seabirds and other species in																								

Ecuador																								
1. Identify amongst fishermen / local inhabitants any potential observers onboard.		X	X	X	X																			
2. Define the methodology and contents of a training workshop for observers onboard.			X	X	X	X																		
3. Undertake a training workshop on the established methodology for observers onboard.							X																	
4. Undertake field trips with observers onboard, in their respective provinces and fleets.								X	X	X	X	X												
5. Compile and analyse data on seabird by-catch, submitted by the observers, for a period of at least one year.													X	X	X	X	X	X	X	X	X	X	X	X