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Agreement on the Conservation of Albatrosses and Petrels

Fourth Meeting of Advisory Committee

Cape Town, South Africa, 22 – 25 August 2008

PLAN OF ACTION FOR THE WAVED ALBATROSS
(*Phoebastria irrorata***)**

Ecuador - Peru - ACAP Advisory Committee

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1. INTRODUCTION

The waved albatross (or Galápagos albatross) *Phoebastria irrorata* is a tropical seabird that breeds almost exclusively on Isla Española in the Galapagos archipelago (Tickell 2000, Anderson *et al*. 2002). Its distribution is restricted to the eastern Pacific Ocean between the Galápagos archipelago and the adjacent mainland of South America from Ecuador to Peru (Anderson *et al*. 1998, 2003, Tickell 2000, Fernández *et al*. 2001). A reduction in adult survival and a likely reduction in population size have been associated with increased mortality from incidental catch in fisheries and intentional catch for human consumption (Anderson *et al*. 2002, Awkerman *et al*. 2006, Ayala *et al*. 2008). This evidence indicates a high risk of extinction and has led to its recategorisation from Vulnerable to Critically Endangered by the IUCN Red List (Birdlife 2007, IUCN 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 summary of the biology, status, and threats, together with actions needed to improve the conservation status of the species. 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 minimise human impact, prevent further population declines, and secure the future of this species. The geographical scope of this plan includes the Galápagos 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 waters off Panama, Colombia and the north of Chile where birds may occasionally disperse.

2. RECOMMENDED ACTIONS

The recommended actions were discussed during the second workshop for the Plan of Action held in Guayaquil, Ecuador on 5-6 May 2008. The workshop recommended that: (a) given the lack of full certainty of knowledge, actions to manage potential threats to waved albatrosses were required under the precautionary principle, (b) where possible, all actions on fisheries should be implemented with the support and coordination of artisanal and industrial fishery unions, (c) progress with implementing the Plan of Action should be evaluated in 2011, and (d) formal indicators of progress should be developed.

2.1 Fisheries Interactions

It is apparent that fisheries are affecting waved albatrosses adversely. Our knowledge of interactions at sea is not perfect, so the main actions listed are designed to improve this situation while attempting to tackle those issues where some evidence of adverse effect already exists. The identified actions were: (a) complete collection of information on fisheries, including incidental and intentional capture, (b) analyze the cumulative levels of incidental and intentional capture, (c) develop and implement mitigation measures, (d) develop education and training programmes, and (e) promote inter-institutional management.

2.1.1 Determine and prioritise which fisheries within the at-sea core range of waved albatross require further research to understand level of interaction with waved albatross. Observer programmes 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 subject to mis-reporting. An observer programme should be conducted in parallel to any questionnaires to control for bias in responses from fishermen. The information on fisheries should state the gear used areas and seasonality.

2.1.2 Develop an observer programme to encompass all relevant fisheries and where necessary improve the quality of those in progress. The lack of observer programmes in some regions or the non-implementation of standard data gathering protocols for seabirds-fisheries interactions is a high priority. The development of training programmes for observers would be very cost-effective in improving the quality of information and is essential for the development and implementation of mitigation measures.

2.1.3 Continue studies on artisanal fisheries, their seasonality, gear, effort, fishing methods and areas, targeted species and bycatch including non targeted fish and wildlife. Bycatch of waved albatross (and other seabird species) should be included in any assessments of whether a fishery is sustainable or not.

2.1.4 Coordinate with the Inter-American Tropical Tuna Commission and the Secretariat of the Galápagos Agreement, who manage fisheries within the foraging range of waved albatrosses, to continue and where needed, improve the monitoring of fisheries and to reduce bycatch.

2.1.5 Where bycatch is found to occur, determine the best mitigation measures and ways of ensuring that mitigation is undertaken. This may include information transferral and rising of awareness of mitigation measures, ensuring that fishermen have access to inexpensive mitigation devices and training in their use. The better management of offal and garbage is likely to prove important.

2.1.6 Continue studies to identify ports from which fishermen are deliberately catching waved albatrosses. In such ports, including Salaverry, Chimbote and San José that have already been identified, research the cause and extent of intentional captures. Develop and implement ways to discourage these practices.

2.1.7 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 their concerns/approaches can be addressed to encourage seabird conservation. Work with those taking waved albatrosses deliberately to gain greater acceptance and compliance with legislation protecting the albatrosses. Gather historic information and work with the communities promoting integration and involvement.

2.1.8 Consider the development of economic alternatives for fishing villages (e.g. educational programmes, ecolabelling, trials on mitigation measures, local capacity building). Waved albatrosses and other marine wildlife have the potential to attract tourists. Ecotourism is likely to have positive effects in the overall economy of the village increasing demand for services and opening new job possibilities.

2.1.9 Provide information to fishermen to make clear that metal and plastic bird bands and electronic devices 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.

2.1.10 Promote the education and training of the fishing sector and coastal communities, including working with fishers unions, developing and distributing information leaflets and other materials.

2.2 Interactions on land

2.2.1 Eradicate introduced predators on Isla de La Plata in order to improve conditions for the waved albatross population that breeds on the island.

2.2.2 Develop a monitoring programme for the changing vegetation on Isla Española.

2.2.3 Develop a monitoring programme for the changing vegetation on Isla de La Plata.

2.2.4 Monitor mosquito populations on Isla Española annually and seasonally. This is important particularly in warm ENSO years given the higher abundance of mosquitoes due to increased rainfall.

2.2.5 Re-examine tourist activity on Isla de La Plata, including whether routes of paths might be better designed, whether guides might benefit form further training and whether current number of tourists is excessive.

2.3 Population monitoring

Monitoring will be needed in order to determine if management measures are achieving their objectives in terms of the size of the population. Any management and therefore monitoring programme needs to be sustained for a very long period.

2.3.1 Establish and undertake a monitoring programme for the waved albatross population on Isla Española. Researchers from the Charles Darwin Foundation (in coordination with the Galápagos National Park) are developing this monitoring programme with the following objectives:

(a) documenting annual adult survival; (b) documenting annual reproductive output; (c) estimating annual changes in population size for samples of the Española population; (d) monitoring changes in whole island population size using counts based on aerial photographs every 1 to 3 years; (e) forging partnerships and working agreements among Charles Darwin Foundation, Galápagos National Park, associated and visiting scientists and other stakeholders to implement and maintain this monitoring programme.

2.3.2 Undertake regular monitoring as described in 2.3.1 for waved albatrosses on Isla de La Plata.

2.4. Research on biology of Waved albatrosses

Greater understanding on aspects of the biology of waved albatrosses is likely to lead to more appropriate management measures. There is insufficient information on limitations on nesting habitat neither on land nor on the distribution and foraging ecology of birds at sea.

2.4.1 Determine if nesting habitat for waved albatrosses is limited on Isla Española.

2.4.2 Determine if Galápagos tortoises have an impact on the reproductive success of waved albatrosses on Isla Española. About 2000 tortoises have been released on Isla Española and it is going to take several years until they reach a size large enough to contribute to the clearing of nesting habitats for albatrosses; meanwhile there is a lack of information on other types of interaction that may occur between these species.

2.4.3 Initiate dietary studies of waved albatrosses in breeding and foraging areas. There is very little information on the prey taken by albatrosses near their colonies and no information on prey consumed off Peru. The identification of the prey organisms that link waved albatrosses and the Peruvian upwelling region, and that most affect their distribution and abundance off Peru may help in developing appropriate conservation strategies to reduce the interaction with fishermen.

2.4.4 Continue and extend studies on the distribution and behaviour of waved albatrosses at sea. Satellite telemetry has been useful in showing the general foraging location of the birds during incubation and chick rearing periods. There is lack of information on distribution of non-breeding birds and insufficient information during the chick brooding period. Studies of birds from different sub-colonies are needed to assess whether birds use similar foraging locations. At-sea studies can help to understand which oceanographic or biological variables may be driving the distribution and abundance of birds, and can be used to study foraging behaviour. Existing studies should be published and efforts made to synthesise the results from satellite telemetry, oceanographic data and fisheries distribution, among other variables.

2.4.5 Assess the exposure of waved albatrosses to toxic chemicals.

2.4.6 Identify and monitor the occurrence of infectious diseases and parasites of waved albatrosses during years with different climatic conditions.

2.4.7 Conduct a Population Viability Analysis of the waved albatross population on Isla Española. This analysis would estimate species persistence and measure population trends under different scenarios of threats and demographic traits over the next 20-50 years. This modelling 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 should be included in the model.

2.5. Maintenance of relevance of plan

2.5.1 This plan should be reviewed on a five-yearly basis. This should help ensure: (a) continued communication among parties; (b) that governments, managers, scientists, and stakeholders analyse the efficacy of conservation measures and redirect their focus to the most important threats; (c) the dispersion and transparency of knowledge obtained by government officers, non-profit organizations, fishermen associations and other agencies implementing the plan.

2.6. Funding

2.6.1 Seek sources of funding, both from within and outside National Governments to support management, research, education and outreach oriented towards the conservation of waved albatrosses and other related threatened species.

3. BIOLOGY

3.1 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 colour under parts. The bill is yellow, the eyes are dark brown with prominent orbital ridges, and the feet are bluish. Juveniles look like the adults but have a whiter head (Murphy 1936). Birds can be sexed by size and general appearance with moderate consistency; males are on average larger than females with wingspan of about 2.2 meters, larger bills and prominent orbital ridges; however morphological measures for a large proportion of birds fall within a range of overlap (Harris 1973, Jiménez-Uzcátegui and Wiedenfeld 2003, Awkerman et al. 2007).

3.2 Distribution

The waved albatross breeds almost exclusively on Isla Española (1°22’S, 89°40’W) in the Galápagos archipelago, but a few birds breed on Isla de La Plata (1°17’S, 81°3’W) off the central coast of Ecuador (Tickell 2000, Anderson *et al*. 2002). Waved albatrosses are restricted to the eastern Pacific Ocean; birds range mostly over a relatively small area delimited by the Galápagos Islands, the central Ecuadorian coast and the central Peruvian coast (Pitman 1986, Tickell 1996, 2000, Anderson *et al*. 1998, 2003, Fernández *et al*. 2001, Awkerman *et al*. 2005a) (Fig. 1).

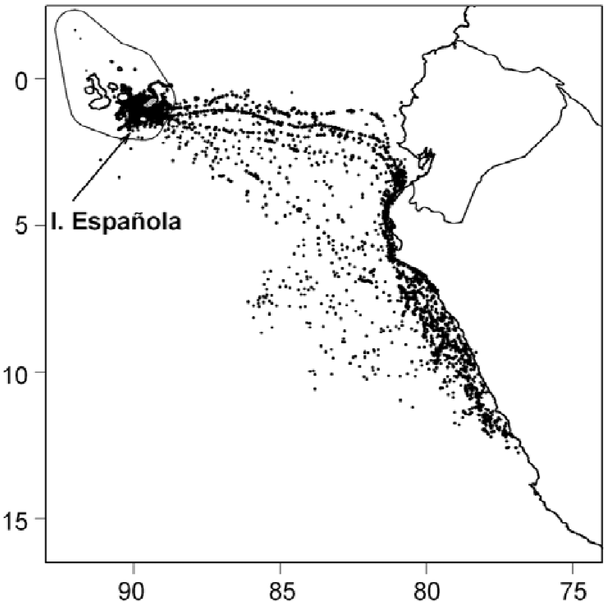

Figure 1. *At sea locations of Waved Albatrosses during the breeding season, determined from bird-mounted Platform Transmitter Terminals (PTTs) in 1995, 1996, 2000 and 2001, and from Global Positioning System (GPS) units between 2003 and 2005 (Anderson et al. 1998, 2003, Fernández et al. 2001, Mouritsen et al. 2003, Awkerman et al. 2005, Anderson et. al 2008) (47 birds and 57 observed trips). The boundary of the Galápagos Marine Reserve is indicated by a line surrounding the archipelago.*

Waved albatrosses are rarely seen north of the Equator, 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 Islas Fernandina and Isabela (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). Birds may disperse into southern Peru and probably northern Chile (Goya unpub. data). Censuses conducted by IMARPE show a strong seasonal and annual variability in the use of areas by the waved albatrosses during normal years compared with El Niño and La Niña events (Goya, unpubl. Data) (Fig 2).

3.3 Population

3.3.1 Isla Española (more than 99.9% of the population)

The first complete censuses were conducted by Harris in 1970 and 1971 (Harris 1973). He visited all nesting areas (Fig. 3) and counted eggs (or chicks in one area) as a proxy for the breeding population size. Harris monitored egg laying and egg loss 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 –egg count adjusted for egg laying and egg loss– was directly comparable to Harris' (1973) and indicated at least 18,254 breeding pairs (Douglas 1998).

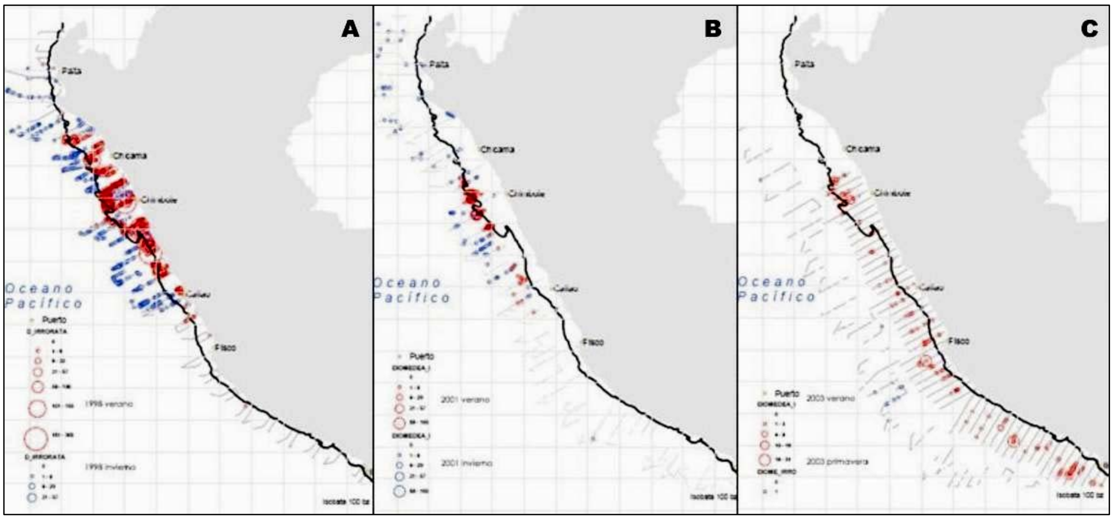

Figure 2. *Abundance and distribution of waved albatrosses estimated through censuses conducted by IMARPE (Peru) during El Niño events (A), La Niña (B) and normal years (C). Red dots are showing the summer distribution, brlue dots the winter distribution (Goya et al. unpubl. Data).*

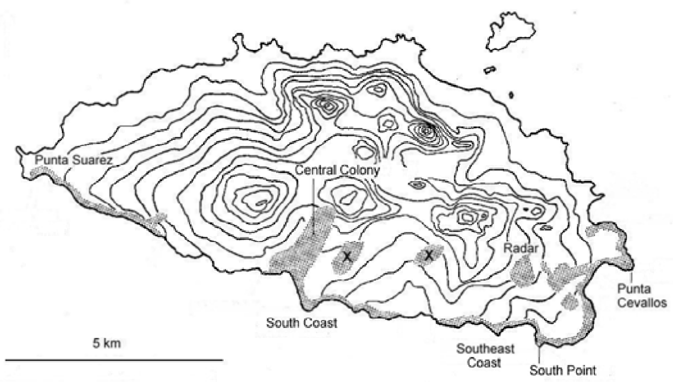

Figure 3. *Distribution of waved albatross nesting areas in Isla Española (Harris 1973). Areas that are apparently no longer used are marked with an "X" (Anderson et al. 2002)*

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 with earlier authors. 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. They estimated a total 19,214 breeding adults (i.e. 9,607 breeding pairs) on the island in 2001. 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) warm event (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.

The most recent count in 2007, using the same methods as in Anderson *et al*. (2002), indicates a further decline (Fig. 4A). The proportional decline in breeding population size between 1994 and 2007 was essentially identical at the two large colonies at Punta Suárez and Punta Cevallos (Fig. 4B)

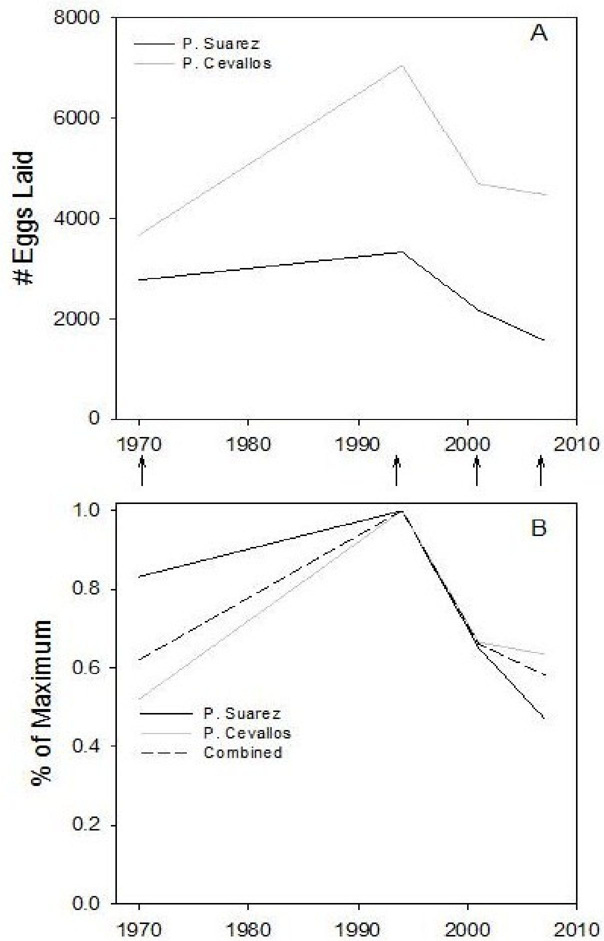

Figure 4. *Trend in breeding population of waved albatrosses at two principal breeding sites on Isla Española, Galápagos. A: estimate of number of eggs laid in each breeding season corrected for egg loss and gain. B: corrected number of eggs laid per season scaled to the maximum number observed. (Anderson et al. 2008)*

3.3.2 Isla de La Plata (less than 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).

3.3.3 Isla Genovesa

Up to 11 birds have been seen aggregated on land on this island in the northeast corner of Galápagos, and at least one breeding attempt (a single egg laid) has been documented (D. J. Anderson and K. P. Huyvaert unpubl. data).

3.4 Nesting habitat

Waved albatrosses nest along the southern coastline of Isla Española 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 *Geochelone hoodensis* population that was depleted by human consumption during the 17th to 19th centuries. The land tortoises are the only endemic herbivore on the Island. In the 1970s only 9 individuals were found on the Island, these were removed and used for captive breeding at the Charles Darwin Foundation (F. Cruz pers. omm..). Feral goats *Capra hircus* inhabited the island for about 80 years and may have created additional clearings, benefiting the albatross population. Birds also colonised a 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 GalápagosNational Park Service by 1978, and the vegetation across the island closed in thereafter (Douglas 1998). Two hillside inland colonies disappeared entirely by 1994 (Douglas 1998). Overall declines in population at other inland areas might be related with habitat loss due to regrowth of vegetation (Anderson *et al*. 2002), but more information is needed in this regard.

3.5 Breeding

Waved albatrosses on Isla Española breed from April to December (Harris 1973). Most of the population breeds annually, though some pairs defer breeding (Rechten 1986). Pairs are monogamous and return to breed within 10 metres 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 (Huyvaert *et al*. 2006), and older more experienced birds arrive earlier than younger birds. They lay a single egg of 285 grams on flat ground and the egg which is often moved up to 40 metres within a few days (Castro and Phillips 1996, Awkerman *et al*. 2005b). 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.

In the 70's the estimates of hatching success were low, ranging from 10 to 56% in 1970 and 1971; as much as 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 when aged five or six (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).

3.6 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 likely underestimates as some adults may have been alive but not recaptured. 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).

Preliminary ranking of models (Anderson *et al*. 2004) initially produced a model yielding survival parameter estimates that were generally similar to that of Harris (1973). In a subsequent insight, a new model that specified constant survival except during the 2002/03 ENSO event fit the survival data markedly better (Awkerman *et al*. 2006) than did any of the models in the original set (Anderson *et al*. 2004).

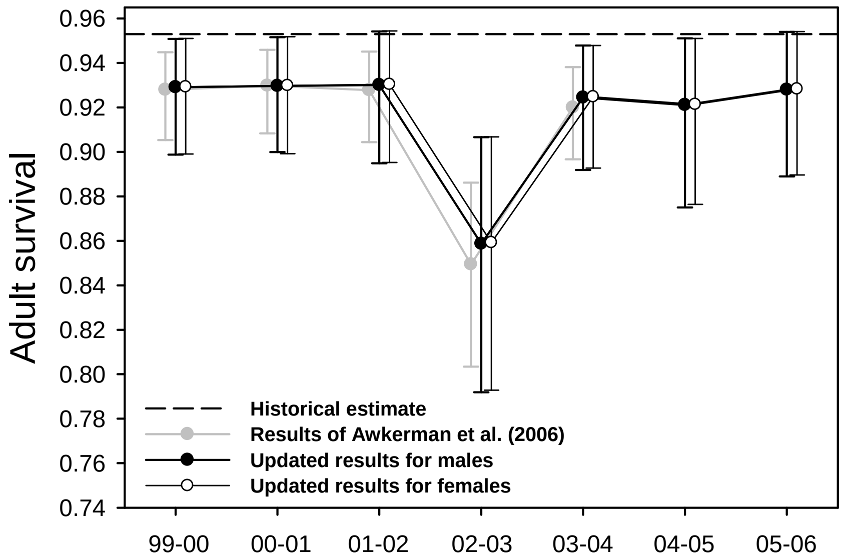

Fig. 5. *Parameter estimates and 95% confidence limits of annual adult survival for adult waved albatrosses based on band-resight histories (Awkerman et al. 2006, Anderson et al. 2008).*

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 (Fig 5). They used a periodic matrix population modelling approach to estimate the sensitivity of lambda (population growth rate) to variation in demographic parameters. The matrix included generous estimates of juvenile and inexperienced breeder survival and mild effects of warm ENSO events every five or six years. Elasticities indicated that changes in adult survival had the largest effect on population growth rate. 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. There are no estimates of effects due to longline (tuna) and trawl fisheries, which overlap with waved albatross distribution and may further affect the population (IATTC 2006). The expansion of the vegetation in breeding sites and the consequent occurrence of collisions might also affect survival.

Anderson *et al*. (2008) updated the model by incorporating current survival estimates (Fig. 5), a previously unnoticed bias in adult sex ratio (Awkerman *et al*. 2007), and correcting an error in the fecundity parameter. The new results reinforced the conclusion that lambda was most sensitive to changes in adult survival and indicated that the elasticity to annual adult survival was larger than initially reported. The updated model indicated a stable population during the 1960s (lambda = 1.00). The current deterministic matrix models indicate decreasing population growth using recent estimates of vital rates representative of years 1999-2001 and 2003-2005 (lambda = 0.97), and a rapidly decreasing population growth using vital rates from during the 2002/03 warm ENSO (lambda = 0.88). Further modelling will be undertaken to determine stochastic environmental events on the population growth rate. These results indicate that the overall lifespan, and especially the reproductive lifespan, are influenced dramatically by these reductions in adult survival (Fig. 6). Preliminary estimations conducted during the Second Workshop for the Waved Albatross Plan of Action (Guayaquil 2008) show that on the basis of estimated survival rates, the additional mortality of 50 albatrosses per year could drive the species to the extinction in less than 400 years in the best scenario and less than 100 years in the worst one (Awkermann *et al*. pers. comm.).

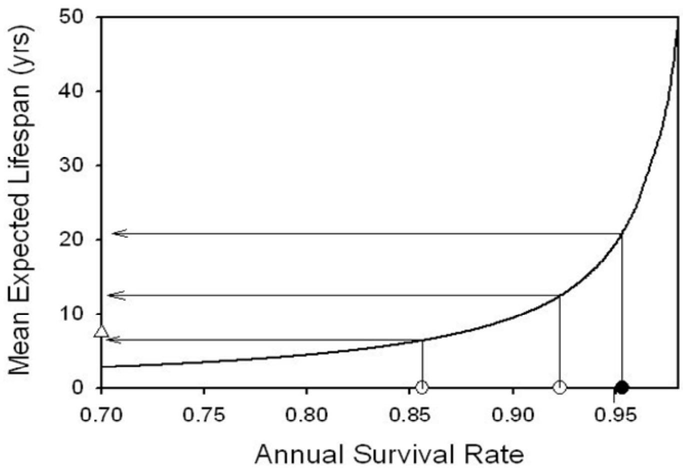

Fig. 6. *Mathematical relationship between annual adult survival and mean lifespan. Dark circle shows the value from the 60s, as estimated from the data in Harris (1973); open circles show estimations for recent non-ENSO(larger value) and 2002 ENSO (smaller value) years (Awkerman et al. 2006). The triangle shows the mean age at first breeding (Harris 1973). Reproductive lifespan under current non-ENSO annual survival is less than half that under annual survival in the 60s.*

3.7 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 Galápagos Islands (Anderson and Cruz 1998, Cherel and Klages 1998). The bulk of the food fed to chicks of waved albatross on Isla Española was composed of squid (53% by occurrence), 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, Mexican scad *Decapterus scombrinus* and round herring *Etrumeus teres*, 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 chick diets.

The scavenging behaviour of waved albatrosses was disregarded as a source of food due to scarcity of documented events and the 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 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 Isla Española 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 Galápagos 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 Isla Española remain within the Galápagos 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 the continental shelf off Peru (Jahncke *et al*. unpub. data). 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. This backscatter, as indicated by targeted samples, included epipelagic fish species such as chub mackerel *Scomber japonicus* (Scombridae), Inca scad *Trachurus murphyi* (Carangidae), Pacific sardines *Sardinops sagax* (Clupeidae) and anchoveta *Engraulis ringens* (Engraulidae). Most of the backscatter at the shelf edge in late winter corresponded to the mesopelagic oceanic lightfish *Vinciguerria lucetia*.

3.8 Climate variability and El Niño - Southern Oscillation

Most information on the effects of climate variability on waved albatrosses, particularly El Niño Southern Oscillation (ENSO) warm events, is anecdotal. Warm ENSO may result in late arrival to breeding colonies and reduced attendance of breeding birds, particularly males (Rechten 1986). 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 although reproductive success was greatly reduced (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) as well as reduced fledging success in 2002 and 2003 (Awkerman *et al*. 2007). Mass desertions have been associated with increased abundance of mosquitoes *Aedes taeniorhynchus* which thrive in pools of water formed by the heavy rains of warm ENSO years (Harris 1969, Anderson and Fortner 1988).

Prey abundance and availability within Galápagos and off Peru changes dramatically during ENSO years. For example, achoveta off Peru migrate southwards or seek refuge in upwelling cells close to shore in search of optimal habitat conditions during warm ENSO years; schools disperse further offshore during cold ENSO years (Ñinquen and Bouchon 2004). There is insufficient information to assess the ecological effects of these changes in prey distribution on waved albatrosses. Preliminary information suggests that waved albatross distribution contracts during warm ENSO events and that birds forage in the vicinity of localised upwelling centres that serve as refugia for fish (Jahncke *et al*. unpub. data). Adult survival of waved albatrosses was greatly reduced during one warm ENSO event, suggesting greater natural mortality and/or increased attention from fishermen (Awkerman *et al*. 2006).

4 CONSERVATION AND LEGAL STATUS

The waved albatross has been recently reclassified from Vulnerable to Critically Endangered on the IUCN Red List of Threatened Species, prepared by Birdlife International (IUCN 2007). The waved albatross was previously considered by IUCN as Vulnerable because the risk of chance events could potentially threaten the world population on Isla Española and off Peru. In recent years, uplisting to Endangered was considered but not carried out as it was thought that regrowth of vegetation had affected their breeding distribution (IUCN 2007). 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 Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention). Appendix II includes migratory species of "unfavourable" 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 ACAP.

In Ecuador, the waved albatross is considered Endangered (Garnizo 2002) and benefits from complete protection. The Ecuadorian Law and the Galápagos Special Law mentions that all endemic and native species, including the waved albatross, are legally protected with severe fines and penalties of up to 3 years of imprisonment for violations of those protections (W. Tapia pers. comm.). The main breeding colony on Isla Española is protected by the Galápagos National Park and the small colony on Isla de La Plata is protected by the Machalilla National Park (see section 5.5).

The Galápagos and its marine reserve have been inscribed on the List of World Heritage sites. The nomination dossier for the extension of the Galápagos World Heritage site to include the marine reserve (2001) specifically identifies the waved albatross as one of the component species which gives the site its "outstanding universal value". The Convention states that it is the duty of the international community to cooperate in protecting World Heritage sites. It also states that each State Party to the World Heritage Convention undertakes not to take any deliberate measures which might damage directly or indirectly the natural heritage of other State Parties.

In Peru, the waved albatross is listed as Vulnerable in the Categorization of Threatened Wildlife Species (D.S. 034-2004-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 there are no sanctions to help enforce the law.

5 CURRENT AND POTENTIAL THREATS

5.1 Introduced species

Introduced feral goats *Capra hircus* inhabited Isla Española for more than 80 years, grazing heavily on native flora, and changing the landscape (Harris 1973, Anderson and Cruz 1998, Tickell 2000). Goats were eradicated by the Galápagos National Park Service by 1978 (Hamann 1984), and the vegetation across the island has largely grown back with a consequent reduction in nesting habitat for waved albatross (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 seem well below their potential densities (Anderson and Cruz 1998). The cactus *Opuntia megasperma,* once common on the islands, was severely reduced by goats and has not yet regrown (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 islands. Goats had dramatic effects on the landscape and thus 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 albatross habitat.

5.2 Loss of habitat

An estimated population of 12,000 tortoises once inhabited Isla Española, probably creating a significant amount of breeding habitat for albatrosses as they grazed and moved through the vegetation. Galápagos tortoises, the native dominant herbivore on Isla Española, were nearly extinct by the 1960s. The few remaining tortoises were relocated to establish a captive breeding programme while introduced goats were eradicated. About 1600 young Galápagos tortoises have been reintroduced to Española and wild breeding was confirmed in 1994 (W. Tapia pers. comm.).

5.3 Disease and parasites

Exposure to common infectious diseases can have dramatic effects on bird populations. Serum from albatrosses was tested for several common avian pathogens and evidence of exposure to adenovirus group 1 and avian encephalomyelitis was found. 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.

5.4 Disturbance

The only potential source of disturbance to waved albatrosses on land is the presence of humans in Punta Suárez on the western side of Isla Española. A trail of about three kilometres in length runs along the southern coast of Punta Suárez, at times approaching close to albatross nests (Anderson and Cruz 1998). The path was designed to minimise disturbance and no obvious negative influence on the birds has been detected, albatrosses appear to be indifferent to the presence of tourists, all of whom are well-regulated and accompanied by a trained guide (Anderson and Cruz 1998). Interactions with visitors might also occur in the small colony at Isla de La Plata.

5.5 Pollution and contamination

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’. There is no information on chemical contaminants in waved albatrosses either in Galápagos or at sea. 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 can affect their reproductive success and lead to population declines (Environment Australia 2001).

Some albatrosses are know to ingest large quantities of plastic and other marine debris which have a wide range of lethal effects (Auman *et al*. 1998). 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). Data from 2007 on plastic ingestion in the Española colony indicated that only 3 of 43 (7%) dead birds contained possible plastic items in the proventriculus. Three of these birds were of adult size and may have been either fledglings or adults, and 40 were nestlings. Two of the birds with possible plastic had small items (8mm x 18mm and smaller) that appeared to be of anthropic origin (D. J. Anderson pers. comm.).

In 2001 the fuel tanker *Jessica* grounded off San Cristóbal Island, 54 km north of Isla Española. No albatrosses were known to have been affected, probably 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. Shipping traffic is no longer a major concern inside the Galápagos Marine Reserve because all international shipping traffic has been routed outside the reserve and artisanal fishing and tourism-related boats are the only vessels allowed inside reserve waters. There is a buffer area extending 20 nm beyond the marine reserve where vessels carrying hazardous substances or using intermediate (or heavier) fuel oil IFO-120 are prohibited, further reducing potential threats to the reserve.

5.6 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. Decreased upwelling during warm ENSO may result in prey redistribution including a southward shift in foraging areas or increased foraging near the coast. The frequent use of upwelling centres 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.

5.7 Fisheries and interactions with fisheries

5.7.1 Evidence for potential interactions

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, these vessels have become the primary factor in seabird mortality since the 1990s (Crowder and Myers 2001).

In the past, fishing activities were not considered a risk to waved albatrosses because birds apparently lacked the ship-following behaviour of other albatrosses that leads to bycatch in longlines (Anderson *et al*. 1998) and other fishing gear. However, waved albatrosses scavenge dead fish when available and this behaviour represents a threat in the presence of longline fisheries (Merlen 1996). Net and longline fishery for blue shark *Prionace glauca*, mako shark *Isurus oxyrinchus*, and mahi mahi *Coryphaena hippurus* has been reportedly (through surveys to fishermen) taking waved albatrosses off Peru (Jahncke *et al*. 2001, Mangel *et al*. 2005). The Inter-American Tropical Tuna Commission (IATTC) recognized that artisanal vessels could be a problem for waved albatrosses in a recent report (IATTC 2006). Preliminary information from a pilot study conducted in Santa Rosa (Ecuador) suggests possible capture of seabirds, including the waved albatross off that port also (Andres Baquero, pers. comm.)

Although waved albatrosses are distributed within the area delimited by Galápagos and the coasts off Ecuador and Peru, most of their foraging activity occurs over the continental shelf off northern Peru and southern mainland Ecuador (Anderson *et al*. 1998, 2003, Fernández *et al*. 2001, Awkerman *et al*. 2005a). Longline and driftnet fishing are currently banned within the Galápagos 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 and Southern Ecuador, which may represent a potential threat to waved albatrosses.

5.7.2 Ecuador Exclusive Economic Zone

The Ecuadorian fishing sector is regulated by the following Governmental Organizations: the Ministry of Agriculture and Fisheries (MAGAP), the Secretary of Fishing Resources (SRP), the General Fisheries Direction (DGP), and the National Fisheries Institute (INP, conducting the research). There exist two basic fleets, industrial and artisanal.

The industrial fleet of 1,329 vessels is composed by purse seiners vessels (*bolicheros*), vessels targeting tuna, trawler vessels targeting shrimps, and longliners (foreign flagged and operating under contract with local companies) (www.subpesca.gov.ec/). The artisanal fleet totals 1,114 vessels, is mainly composed by wooden boats and fibreglass boats (*fibras*), but sometimes accompanied by larger or supply vessels (*nodrizas* or *botes*). These large vessels may support between 3 and 15 *fibras*.

Available fishing resources comprise different small pelagic species such as chub mackerel *Scomber japonicus*, Pacific sardine *Sardinops sagax*, thread herring *Opisthonema* spp., as well as large pelagic species including dorado *Coryphaena hippurus*, tuna and marlin, bottom dwelling species such as drums and relatives, sharks, crustaceans and molluscs. Despite there being a domestic and international market, sharks are not directly targeted but are often taken as bycatch.

- Artisanal longlines

There are two major fishing seasons. A 'warm water' fishery from November to April that targets mahi mahi (or dolphinfish) *Coryphaena hippurus* and a 'cold water' fishery from May to October that targets bigeye tuna *Thunnus obesus*, as well as a variety of billfish and sharks. The artisanal fishery operates in an organised fashion with 5 small fiberglass boats (*fibras*) working together with a larger supply boat (*bote*) which acts as a mothership. The *fibras* are generally 7.5 m long while *botes* are about 20 m long. When the fibres use short lines, the longlines extend from 2.5 to 6 nm. The number of hooks ranges from 130 to 163 during the tuna season and 280 to 380 during the mahi mahi season. Trip duration ranges from 13 to 17 days during which a total of 8 - 9 sets take place (Lagarcha *et al*. 2005).

Part of the fishing fleet use longlines, in some cases locally referred as "*espineles*". Surface longlines are used to target dorado, marlin and swordfish *Xiphias gladius*. Additionally, yellow-fined tuna *Thunnus albacares*, bigeye tuna, amberjack *Seriola* spp., wahoo *Acanthocybium solandri*, Pacific sierra *Scomberomorus sierra*, escolar *Lepidocybium flavobrunneum*, giant squid *Dosidicus gigas* and some skate species are targeted. Surface longlines have an average length of 10 km, branch lines of 5.8 m and hold some 500 number 4 /number 5 hooks. The peak season for the surface longlining occurs between December and March. Bottom longlines hold 400 to 500 hooks number 1, 2 or 5 and 6. Fishermen usually carry two longlines per boat. Pacific bearded brotula *Brotula clarkae* and other bottom fish of medium and low commercial value, locally known as "*menudo*", together with skates and others are common targets.

- Industrial longliners

Bigeye tuna are the main target of the industrial longline fleet. Additional targets include: yellow-fin tuna, Albacore tuna *Thunnus alalunga*), skipjack tuna *Katsuwonus pelamis*, striped marlin *Tetrapturus audax*, blue marlin *Makaira mazara*, black marlin *M. indica*, swordfish and Indo-Pacific sailfish *Istiophorus platypterus* are targeted (Rodríguez and Morán 1996). Reported bycatch includes shark and dorado. Between 1993 and 1997 the size of the fleet fluctuated between 20 and 31 vessels of between 24 and 494 Tonnes.

The length of longlines may be up to 46 km, fishing down to 35-50 m depth (Herdson *et al*. 1985). However, Rodríguez and Morán (1996) reported vessels carrying longlines of 135 km in length. Currently, the Spanish fleet in the Pacific is composed by 27 vessels targeting swordfish. In Ecuador, these vessels use the harbours of Guayaquil and Manta. In 2004 and observers programme commenced in Manta, with the main objective of analysing the levels of captures of fish and turtles by J and circular hooks. Vessels participating in this programme have modified their gear, mixing J and circular hooks of different sizes to test the differences in catchability. Observers note of fish and turtle captures by type of hook in the experimental longlines.

- Nets

Three gears are used in the artisanal netter fleet. (a) Surface and mid-water trammel nets with yellow - finned tuna, bigeye tuna and marlin as main targets. Additionally dorado, swordfish, jacks, wahoo, escolar and the giant squid can be taken. (b) Bottom trammel nets targeting flounders *Paralichthys* spp. (taken with a particular net locally known as "*lenguadera*"), whitefin weakfish *Cynoscion albus* and other drums, as target species, as well as skates and other species of lesser commercial value. (c) bottom "*camaronero*" trammel nets having the white shrimp or prawn *Penaeus* spp. as main target species (other bottom fish and skates are taken).

The industrial fishery for tuna has grown steadily in the recent times. In 1985 the total capture was 40,000 metric tonnes, while in 1999 the capture reached 204,000 tonnes. In 1975 the tuna fleet comprised 26 vessels while in 2007 this number was 77. The fleet is mostly uses purse seines. While targeting large pelagic fish, the fleet may capture sharks also, using for these purposes nets of about 173 by 8 meters. The industrial shrimp trawl fleet also targets small and medium sized sharks of the Carcharhinidae, Sphyrnidae and Triakidae families (Martínez, 1999). The tuna fleet also catch Carcharhinidae sharks incidentally.

5.7.3 Waters under Peruvian jurisdiction

- Industrial demersal longlines

In Peru, the industrial demersal longline fishery forms 1% of the fleet of vessels that have a storage capacity greater than 30 metric tonnes (Goya and Cárdenas 2004). This fishery 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). There are no vessels currently using demersal longlines in these waters. Catches were made between 800 and 2,250 m depth and there were latitudinal differences in fish abundance: yields are greater between 12°S and 18°S. Average annual total effort of the fleet was around 1,410,000 hooks from 1996 to 1999. Mean effort by month was 128,000 hooks, with minimum and maximum average effort levels being recorded in March (35,500 hooks) and July (277,000 hooks), respectively. Annual catches from 1996 to 2002 had fluctuated according to effort levels from 370 metric tonnes in 1996 to 173 metric tonnes in 2000, with mean annual catches of 254 metric tonnes (Goya and Cárdenas 2004). No information on seabird bycatch has been reported in this fishery.

- 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 to 6 Japanese pelagic longline vessels operated under permits in Peruvian waters targeting 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 were no official records on seabird bycatch by the Japanese fleet.

- Artisanal pelagic longlines

In 1995-1996, approximately 28,000 artisanal fishermen and 6,250 fishing boats operated from ports on 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 the vessels are longliners with an additional 9% that switch gears during the year (Estrella *et al*. 2007). This represents between 946 and 1,814 longliners, including those vessels that change fishing gear seasonally. The number of longline boats increased considerably during warm ENSO years, as was the case in ENSO years 1997/98 (Goya and Cárdenas 2004).

A description of longline fishing practices comes from 297 surveys was conducted by Mangel and Alfaro-Shigueto (2004) in 19 fishing ports where longlines are used. They reported that the artisanal fleet in these areas target blue *Prionace glauca* and mako *Isurus oxyrinchus* sharks from March to November and mahi mahi *Coryphaena hippurus* 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 nautical 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 7-35 km long, contains an average of 800 hooks and is set at 18 meters depth (Gilman *et al*. 2008). Fewer hooks are used for mahi mahi, with 5 o 7 m branch lines. Weighted branch lines are used in some ports and steel leaders are often used to reduce gear loss during shark season (Gilman *et al*. 2008). Baits used include squid (45% by occurrence), mackerel (21%) and sardines (17%); these were fresh (35%), frozen (15%) or salted (50%).

Half of the fishermen interviewed reported seeing albatrosses or petrels while at sea (note that several albatross species other than waved occur also in Peruvian waters). 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 austral summer (60%) than during 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 that incidental mortality of seabirds might be of importance. 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 2004).

An onboard observer program carried out by Pro Delphinus 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 capture of a black-browed albatross *Thalassache melanophrys* caught by the beak after the longline was deployed while fishing for sharks from 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 off the coast in 2002. The methodological limitations in the estimated mortality rates need to be considered. Further research is needed to come up with 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).

- Artisanal demersal longlines

In waters north of Peru there is a small artisanal demersal longline fleet of some 80 vessels (Carlota Estrella pers. comm.). These vessels use bottom longlines and operate in the area of Cancas, targeting Pacific bearded brotula *Brotula clarkae*, bighead tilefish *Caulolatilus affinis* and Specklefin cusk eel *Lepophidium negropinna.* Each longline hold between 200 and 440 Mustad number 8 and 9 hooks (Salazar *et al*. various IMARPE reports). There are no reports of interactions with albatrosses and petrels.

- Industrial purse seiners targeting anchovy

The industrial purse seine fishing fleet comprises 609 steel-hulled vessels, averaging 287 metric tonnes hold capacity, dedicated exclusively to the capture of anchovy and 600 wooden hulled vessels, with hold capacities ranging from 32 to 110 metric tonnes, permitted to fish for 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 satellite monitoring and onboard observers from IMARPE (Programa Bitácoras de Pesca) that, 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 variegate,* and gulls has been noted but not properly quantified, although data sheets have been modified to better record these interactions in future (E. Goya pers. comm.).

- 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 metric tonnes are monitored by onboard observers from 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.

- Artisanal gillnets

Gillnets are the most common fishing gear 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, allowing for seasonal changes in fishing gears.

Gillnets are known to cause mortality among diving animals (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. In Peru, drift nets were banned in the 1990s. 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).

A description of gillnet fishing practices comes from results from 426 surveys conducted by Mangel and Alfaro-Shigueto (2004). Their results show that 33 fishing ports indicated that gillnets were used year-round and targeted sharks (13% by occurrence), 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%), cormorants (44%) and boobies (20%).

An onboard observer programme 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. It is interesting to note that no albatrosses were captured with this gear; however, Majluf *et al*. (2002) did note the take of albatrosses in San Juan without mentioning the specific species captured. 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). It is plain that some albatrosses are caught in gillnet fisheries off Peru, but further observations will be required before a more precise estimate of bycatch of albatrosses and other seabirds in this fishery can be made.

5.7.4 International waters

IATTC (Inter-American Tropical Tuna Commission) has data on albatross abundance in the area of the waved albatross for the period 1997/2007 (M. Hall pers. comm.). This information, together with a recent analysis conducted by ACAP shows that the waved albatross is entirely distributed within the IATTC area at all times of the year (ACAP 2008). The IATTC regional observers programme (Peru and Ecuador) for marine turtles has observed 540 longline trips (c. 600,000 hooks set). In addition to this 420,000 hooks set were observed by APECO (Peru) and 350,000 hooks set observed by BP. None of these observations showed cases of incidental mortality of seabirds in the fishery (M. Hall pers. comm.). This lack of interaction might be attributed to the characteristics of the fishing operation in this fleet that uses very small boats, performs side setting and night setting, and uses fresh bait. However, there are important gaps in information from certain areas and portions of the fleet such as demersal longliners, trammel nets and Asian longliners (M. Hall pers. comm.). Recent reports from the Taiwanese fleet show capture rates between 0.05 and 0.20 birds /1000 hooks for waters in the vicinity of Galápagos (Huang *et al*. 2008). However, sample sizes are reduced for the area of interest and no information on the species affected is included.

5.8 Human consumption

Through surveys to fishermen, Mangel *et al*. (2006) documented intentional capture of waved albatrosses in Salaverry, Peru. 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. More recently, intentional captures associated to the gillnet fishery were documented in Salaverry, Chimbote and San José (Ayala *et al*. 2008). At least one isolated intentional capture was reported in Islas Española, presumably for consumption (D. Anderson pers. comm.).

Recovered bands provided further evidence suggesting that catch of albatrosses in Salaverry may be occurring on an unusually large scale (Jimenez-Uzcategui *et al*. 2006b). 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 were captured because they carried 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). All banding of waved albatrosses is conducted in Galápagos by the Charles Darwin Research Station, by the Galápagos National Park, and especially by visiting scientists responsible to these two bodies. None have ever paid to recover bands on instruments deployed on waved albatrosses (D. Anderson, pers. comm.).

6. PREVIOUS MANAGEMENT ACTIONS

6.1 Animal eradication

Isla Española 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 Galápagos National Park Service which is part of the National Protected Area System, under the Ministry of Environment. The Management Plan for the Galápagos National Park mandates continuous monitoring of introduced species and has correctly made control and eradication of introduced vertebrates a top priority. This action however appears to have reduced the historical extent of the nesting habitat of waved albatrosses and apparently has led to disappearance of several sub-colonies.

6.2 Tortoise reintroduction

Following the near extinction of tortoises (the only indigenous large herbivore) on Isla Española in earlier years, the Charles Darwin Foundation's captive breeding programme has been able to return some 1,600 tortoises in the last 30 years and they are naturally breeding on the island. It will take many more years for abundance to return to former levels, and probably many more years beyond that for vegetation patterns and growth to return to a more natural, tortoise-browsed, condition (F. Cruz pers. com.). Further work might be needed to reduce vegetation growth in areas important for waved albatrosses and to mimic the effects of a larger tortoise population.

6.3 Colony-based monitoring

At present, there is no systematic programme for seabird monitoring on the Galápagos Islands (F. Cruz pers. comm.). Several seabird populations including waved albatrosses, Galápagos petrels *Pterodroma phaeopygia*, Galápagos penguins *Spheniscus mendiculus*, flightless cormorants *Phalacrocorax harrisi*, and lava gulls *Larus fuliginosus* are monitored regularly by staff of the Galápagos National Park and the Charles Darwin Research Station (F. Cruz pers. comm.), and D. J. Anderson's group monitors Nazca boobies (*S. granti*) on Isla Española (D. J. Anderson. 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 re-sights 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 that have led to the results reported in Awkerman *et al*. (2006). Cooperative plans involving these visiting scientists and the Galápagos 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.).

6.4 At-sea studies

An at-sea programme to assess the distribution and abundance of marine birds and mammals was established in 1998 off Peru. This effort currently 'piggybacks' on acoustic research cruises conducted by IMARPE to determine the stocks of anchovy and other pelagic fish along the Peruvian continental shelf and up to 150-200 nm off shore (performing transversal transects to the shoreline). This project has a multidisciplinary approach and contemplates the participation of specialized personnel, including seabirds and marine mammal observers. At least two cruises are carried out every year one in late summer and another in late winter. During anomalous years, particularly during warm ENSO years, more than two cruises per year are conducted using standard strip transect methods.

6.5 Tourism restrictions

Tourism is by far the main economic activity in the Galápagos 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 70 land and 62 marine sites that can be visited (W. Tapia pers. comm.). Tourists are required to have a trained guide to visit most sites except for a few located near populated areas. Tourism on Isla Española is organized in groups of 5 to 20 groups of tourists per day that visit Punta Suárez and Gardner Bay. A trail of about 3 km in length runs along the southern coast of Punta Suárez and was designed to allow tourists to see and photograph albatrosses and other seabirds, while minimizing disturbance (Anderson and Cruz 1998).

6.6 Zoning and Marine Protected Areas

The main breeding colonies on Isla Española are protected by the Galápagos National Park and the small colony on Isla de La Plata is protected by the Machalilla National Park. The Galápagos National Park comprises 97% of the total land mass of the Galápagos Islands and is located within the Galápagos Marine Reserve which extends 40 nm from the outer points around the islands; therefore it has a total of 138,000 km². The main foraging grounds of pre-breeding adults and breeding age adults skipping one or more breeding seasons occurs in the south-eastern portion of the Galápagos 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 Galápagos Marine Reserve (Awkerman *et al*. 2005a). At present, longline and driftnet fishing is banned within the Reserve but the presence of illegal fishing boats might affect seabirds in Galápagos waters.

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APPENDIX A - RECOMMENDED ACTIONS

The following table shows additional information about priorities, stakeholders, schedules and funding of the recommended actions that were discussed and agreed by concensus during the 2nd Workshop for the Plan of Action that took place in Guayaquil, Ecuador.

2.1 Fisheries interactions

ACTIONS	PRIORITY	STAKEHOLDERS	SCHEDULE	DETAILS & FUNDING
2.1.1 Determine and prioritise which fisheries require further research to understand the level of interaction with waved albatrosses.	HIGH	Political: MAGAP-SRP, MAE Technical: INP, PMRC, IMARPE. Others: Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	2008 - 2009	
2.1.2 Develop an observer programme for the different fisheries and improve the quality of those already active.	HIGH	Political: MAGAP-SRP, MAE DIGMER, PRODUCE Technical: INP, PMRC, IMARPE Others: Birdlife, FCD, ABC, CI, WWF, IATTC, A&C	Starting 2009	There is a developing capacity building project for observers' training in Ecuador, funded by Birdlife International.
2.1.3 Continue studies on artisanal fisheries, their seasonality, gear, effort, fishing methods and areas, targeted species and bycatch including non targeted fish and wildlife	HIGH	Political: MAGAP-SRP, MAE DIGMER, PRODUCE Technical: INP, PMRC, IMARPE Others: Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	2008 – 2009	
2.1.4 Coordinate with the Inter-American Tropical Tuna Commission and the Secretariat of the Galápagos Agreement to continue and improve the monitoring of fisheries and to reduce bycatch	MEDIUM / HIGH	Political: MAGAP-SRP, MAE DIGMER, PRODUCE Technical: INP, PMRC, IMARPE RFMOs: IATTC, CPPS Others: FCD, Birdlife, PNG	2008 – 2010	
2.1.5 Where bycatch is found to occur, determine the best mitigation measures and ways of ensuring that mitigation is undertaken	HIGH	Political: MAGAP-SRP, MAE DIGMER Technical: INP, PMRC, IMARPE Others: Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	2009 – 2010	
2.1.6 Continue studies to identify ports from which fishermen are deliberately catching waved albatrosses	HIGH+	Political: MAGAP-SRP, MAE - PNG Technical: INP, PMRC, IMARPE Others: Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	2008 – 2009	
2.1.7 Integrate studies of the socio-economic and cultural background of fishermen communities.	HIGH	Political: MAGAP-SRP, MAE Technical: INP, PMRC, IMARPE Others: FLA, Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	2009	
2.1.8 Consider the development of alternative economies for fishermen communities.	HIGH	Political: MAGAP-SRP, MAE Technical: INP, PMRC. MINTUR, IMARPE Others: Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	From 2008	

ACTIONS	PRIORITY	STAKEHOLDERS	SCHEDULE	DETAILS & FUNDING
2.1.9 Provide information to fishermen to make clear that metal and plastic bird bands and electronic devices on birds have no refund value.	HIGH	Political: MAGAP-SRP, MAE Technical: INP, PMRC, IMARPE Others: Birdlife, SSS, FCD, ABC, CI, WWF CIAT and fisheries unions.	2008 – 2009	
2.1.10 Promote the education and training of the fishing sector and coastal communities, including working with fishers unions, developing and distributing information leaflets and other materials.	HIGH	Political: MAGAP-SRP, MAE, PMRC, DIGEIM - PEAMCO Technical: INP, PMRC, IMARPE Others: Birdlife, SSS, FCD, ABC, CI, WWF, IATTC and fisheries unions.	2008 - 2010	Responsibility of the Programa de Educación Ambiental Marino – Costera, Ecuador (Marine – Coastal Environmental Educational Programme, Ecuador).

2.2 Interactions on land

ACTIONS	PRIORITY	STAKEHOLDERS	SCHEDULE	DETAILS & FUNDING
2.2.1 Eradicate introduced predators on Isla de La Plata in order to improve conditions for the waved albatross population that breeds on the island.	HIGH	PNM in coordination with PNG	2009 - 2010	Approximated cost USD 200.000. HP Foundation identified as a potentional fund. Development of a monitoring programme considered relevant.
2.2.2 Develop a monitoring programme for the changing vegetation on Isla Española	MEDIUM	PNG – FCD – CV (with collaboration of IGM, CLIRSEN)		The WG understood the importance of the evaluation of the necessity for the implementation of experimental studies with controls for the vegetation to analyze its effect on nest distribution and reproductive success.
2.2.3 Develop a monitoring programme for the changing vegetation on Isla de La Plata	MEDIUM	PNM – EA (with collaboration of IGM, CLIRSEN – Guides Association PNM)	Starting 2009	Searching for funding.
2.2.4 Monitor mosquito populations on Isla Española annually and seasonally.	MEDIUM	Kate Huyvaert (Colorado State University) and Gustavo Jiménez (FCD) leading the project	Starting 2009	Approximated cost USD 4.000 per year. PNG will provide logistic support (in coordination with other activities) and will collaborate in the search for additional funding.
2.2.5 Re-examine tourist activity on Isla de La Plata.	HIGH	PNM – EA	Starting 2008	Including whether routes of paths might be better designed, whether guides might benefit form further training and whether current number of tourists is excessive

2.3 Population monitoring

ACTIONS	PRIORITY	STAKEHOLDERS	SCHEDULE	DETAILS & FUNDING
2.3.1 Establish and undertake a monitoring programme for the waved albatross population on Isla Española	HIGH	PNG – FCD – CV	Starting 2009	Approximated annual cost USD 30.000. Searching for funding.
2.3.2 Undertake regular monitoring of waved albatrosses of Isla de La Plata	HIGH	PNM – USFQ (other assistant scientists)	Starting 2008	Available funding and in process of securing by Equilbrio Azul and Conservation International.

2.4 Research on the biology of waved albatrosses

ACTIONS	PRIORITY	STAKEHOLDERS	SCHEDULE	DETAILS & FUNDING
2.4.1 Determine if nesting habitat of waved albatross is limited on Isla Española.	HIGH	PNG – FCD – CV		
2.4.2 Determine if Galápagos tortoises have an impact on the reproductive success of waved albatrosses in Isla Española.	HIGH	PNG – FCD – CV	Starting 2008	This information will be considered for decisions about stopping tortoise releasing.
2.4.3 Initiate dietary studies of waved albatrosses in breeding and foraging areas.	HIGH	PNG – FCD – CV – Contact IMARPE (Pro Delphinus as a potential collaboration, Subsecretaria de Pesca)	2009?	The feasibility of developing studies in breeding and foraging areas was analyzed. The analysis of carbon and nitrogen isotopes in albatross (chicks, juveniles and adults) and potential prey was suggested as a valuable and economic tool.
2.4.4 Continue and extend studies on the distribution and behaviour of waved albatrosses at sea.	HIGH	PNG – FCD – CV – EA – USFQ – PNM	In progress	New devices recently attached to individuals. Approximated annual cost USD 40.000 (already secured). IMARPE has information on albatross at-sea distribution and fish backscatter registered with acoustic methods that could be analyzed with oceanographic data.
2.4.5 Assess the exposure of waved albatrosses to toxic chemicals.	LOW	PNG – FCD – CV	Every 5 years	Approximated cost USD 30.000 every 5 years
2.4.6 Identify and monitor the occurrence of infectious diseases and parasites of waved albatrosses during years with different climatic conditions.	MEDIUM	PNG – FCD – CV	Every 2 - 3 years	Approximated cost USD 10.000 to 15.000 each time.
2.4.7 Conduct a Population Viability Analysis of the waved albatross population on Isla Española.	MEDIUM	PNG – FCD – CV	In progress	Approximated cost USD 20.000 including a workshop.

ABBREVIATION LIST

A&C – Aves & Conservación
ABC – American Bird Conservancy
CI – Conservation International
CLIRSEN - Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos
CPPS – Comisión Permanente del Pacífico Sur
DIGEIM - Dirección General de Intereses Marítimos
DIGMER - Dirección General de la Marina Mercante y del Litoral
EA - Equilibrio Azul
FCD – Fundación Charles Darwin
FFLA - Fundación Futuro Latinoamericano
IATTC – Inter-american Tropical Tuna Commission
IGM – Instituto Geográfico Militar
IMARPE – Instituto del Mar del Perú
INP – Instituto Nacional de Pesca
MAE – Ministerio de Ambiente del Ecuador
MAGAP-SRP – Ministerio de Agricultura, Ganadería, Acuacultura y Pesca, Subsecretaría de Recursos Pesqueros, Ecuador
MINTUR – Ministerio de Turismo
PEAMCO - Programa de Educación Ambiental Marino - Costera
PMRC – Programa de Manejo de Recursos Costeros
PNG – Parque Nacional Galápagos
PNM – Parque Nacional Machanilla
PRODUCE - Ministerio de la Producción del Perú
SSS - Southern Seabird Solutions
USFQ – Universidad San Francisco de Quito
WWF – World Wildlife Fund