Waved Albatross
Phoebastria irrorata

Albatros des Galapagos
Albatros de las Galápagos/ Albatros Ondulado

CRITICALLY ENDANGERED | ENDANGERED | VULNERABLE | NEAR THREATENED | LEAST CONCERN | NOT LISTED

Sometimes referred to as
Galápagos Albatross

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TAXONOMY

Order Procellariiformes
Family Diomedeidae
Genus *Phoebastria*
Species *P. irrorata*

Originally described as *Diomedea irrorata* (Salvin 1883), the species was transferred from *Diomedea* to *Phoebastria* along with three other species of North Pacific albatross by Nunn *et al*. (1996) [1].

CONSERVATION LISTINGS AND PLANS

International

- Agreement on the Conservation of Albatrosses and Petrels – Annex 1 [2]
- 2008 IUCN Red List of Threatened Species – Critically Endangered (since 2007) [3]
- Convention on Migratory Species - Appendix II (as *Diomedea irrorata*) [4]
- Action Plan for Waved Albatross *Phoebastria irrorata* 2008 [5]

Chile

- National Plan of Action for reducing by-catch of seabirds in longline fisheries (PAN-AM/CHILE) 2007 [6]

Ecuador

- Texto Unificado de la Legislación Secundaria del Ministerio del ambiente: Libro IV De La Biodiversidad – Endangered (Annex 1, as *Diomedea irrorata*) [7]

Perú

- Categorizacion de Especies Amenazadas de Fauna Silvestre, *Decreto Supremo Nº 034-2004-AG (22.09.04)* - Vulnerable [8]

BREEDING BIOLOGY

Most *P. irrorata* breed annually, arriving at the colony in March, followed by egg laying from mid-April to late June. The average nestling period is 167 days. Young adults can return to colony for the first time as early as age one year, but this is unusual; representation of age classes in the colony increases with cohort age until age six years, at which age most living cohort members are present. The youngest adults are present late in the breeding season, and older adults appear at progressively earlier dates in the breeding season up to age six years. A minority of adults first breed at age four, and most adults are breeding by the age of six [9].

Table 1. *Breeding cycle* P. irrorata.

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
At colonies	X	X	X	X	X	X	X			X	X	X
Egg laying	X										X	X
Incubating	X	X	X								X	X
Chick provisioning	X	X	X	X	X	X	X					

BREEDING STATES

Table 2. *Distribution of the global* P. irrorata *population among Parties to the Agreement.*

	Ecuador
Breeding pairs	100%

BREEDING SITES

Virtually the entire breeding population nests on Isla Española (Hood Island), Galápagos Islands, Ecuador, in the southern half of the island. Irregular observations suggest that less than 1% breeds on Isla de La Plata, Ecuador (Figure1) [10]. At least one egg has been laid on Isla Genovesa, Galápagos, in 2006, but did not hatch (M. Prieto, pers. comm.). The breeding population size on Española is poorly known, estimated most recently as 9,607 pairs in 2001, with an additional 5,495 breeding adults not nesting in 2001, and an unknown number of breeding-capable adults that nonetheless bred in neither year [10]. The breeding population on Isla de La Plata apparently numbers less than 10 pairs, and may often be 0 [10, 11]. The total adult population in 2001 on Española (including adults not present that year) was estimated as 31,818-34,694, with up to 30 birds (but typically <10) present on Isla de La Plata (M. Prieto, pers. comm.), and up to 11 adults (but typically 0) on Isla Genovesa [10].

Figure 1. The approximate range of P. irrorata *inferred from satellite tracking and at sea observations [12, 13, 14, 15, 16, 17]. The boundaries of selected Regional Fisheries Management Organisations (RFMOs) are also shown.*

CCAMLR – Commission for the Conservation of Antarctic Marine Living Resources
CCSBT - Commission for the Conservation of Southern Bluefin Tuna
IATTC - Inter-American Tropical Tuna Commission
ICCAT - International Commission for the Conservation of Atlantic Tunas

Table 3. Monitoring methods and estimates of the population size (annual breeding pairs) of P. irrorata *for each breeding site. Table based on D. Anderson unpublished data and Anderson* et al. *2002* [10].

Breeding site location	Jurisdiction	Years monitored	Monitoring method	Monitoring accuracy	Annual breeding pairs (last census)
Isla Española 1°20' S, 89° 40' W	Ecuador	1970-1971, 1994, 2001, 2007	A [1]	Low [2]	9,607 (2001) [10]
Isla Genovesa 0° 20' N, 89° 58' W	Ecuador	1961-present, Irregularly [3]	A, B, C	High	≤1
Isla de La Plata 1° 16' S, 81° 06' W	Ecuador	1975-1990, irregularly [4]	A, B, C	Medium	≤10

[1] corrected for nests not present at time of survey

[2] The thick vegetation prevents detection of an unknown proportion of birds. The Central Colony has not been counted since 1970

[3] Casual observations since the 1960s, principally by tour guides and sometimes by scientists

[4] Casual observations for an unknown number of years

CONSERVATION LISTINGS AND PLANS FOR THE BREEDING SITES

International

Isla Española and Isla Genovesa (and surrounding waters)

- UNESCO World Heritage Site (inscribed in 1978, extended 2001) [18]
- UNESCO World Heritage in Danger List – 2007 [19]

Ecuador

Isla Española and Isla Genovesa

- Ley Especial de la Provincia de Galápagos/ Libro VII - Del Régimen Especial: Galápagos [20]
- Galápagos National Park
- Galápagos Marine Reserve (IUCN Category IV)
- Galápagos National Park Management Plan 2006 [21]
  - zona de Protección Absoluta de Ecosistemas

Isla de La Plata

- Machalilla National Park (IUCN Category Ib)

POPULATION TRENDS

The breeding population on Isla Española appears to be decreasing in the long term, but there is a lack of accurate, continuous data to allow a trend to be calculated with a high degree of confidence (D. Anderson pers. comm. 2008). The population trends on the other two islands are unknown, with very few birds breeding there.

Table 4. *Summary of population trend data for* P. irrorata*. Table based on Anderson* et al. *2008* [22] *and unpublished D. Anderson data.*

Breeding site	Current Monitoring	Trend Years	% average change per year	Trend	% of population
Isla Española	Yes	1970-1971, 1994, 2001, 2007	-	Decreasing [22]	?
Isla Genovesa	Yes	1961-present, irregularly	-	Increasing from unoccupied to occasional presence of <11 adults	100%
Isla de La Plata	Yes	1975-1990, irregularly	-	Unknown	-

Mean breeding success in a subpopulation on Española was 22.9% during 2000-2004 (ranging from 7.9% during a mild El Niño-Southern Oscillation event in 2003 to 36.9%) [22] (Table 5). Movement of eggs by parents, up to 40 metres over several days, often results in egg loss, and may be contributing to the low breeding success [9, 11]. Between 1999-2006, average adult survival for males ranged from 85.9% (95% CI 79.2-90.7%) in a mild ENSO event (2002-2003), to between 92.1% (95% CI 87.5-95.1%) and 93.0 % (95%CI 89.5-95.4%) in non-ENSO years. Female survival was virtually identical to males [22]. Juvenile survival has not been assessed.

Breeding success and survival rates have not been investigated for the extremely small populations at La Plata and Genovesa.

Table 5. *Demographic data for the three* P. irrorata *breeding sites. Table based on Anderson* et al. *2008* [22].

Breeding site	Mean breeding success (±SD; Years)	Mean juvenile survival	Mean adult survival (Years)
Isla Española	22.9% (± 9.6%, 2000-2004)	No data	85.9% (ENSO, 2002-2003) 92.1 - 93.0% (non-ENSO, 1999-2001, 2004-2006)
Isla de La Plata	No data	No data	No data
Isla Genovesa	No data	No data	No data

BREEDING SITES: THREATS

Few threats exist at any of the breeding sites of *P. irrorata* (Table 6) and all sites are legally protected.

Table 6. *Summary of known threats at the breeding sites of* P. irrorata. *Table based on unpublished D. Anderson data.*

Breeding site	Human disturbance	Human take	Natural disaster	Parasite or Pathogen	Habitat loss or degradation	Predation by alien species	Contamination
Isla Española	No	No	No	No [a]	No [b]	No	No
Isla Genovesa	No	No	No	No	No	No	No
Isla de La Plata	No	Unknown	No	No	No	No	No

[a] Increased abundance of mosquitoes *Aedes taeniorhynchus* during warm ENSO years with heavy rainfall produces distress in the birds and results in mass abandonment of eggs [23, 24].

[b] Increasing vegetative cover on Española due to anthropogenic reduction of tortoise *Geochelone hoodensis* populations prior to 1900, and the 1978 eradication of feral goats *Capra hircus* present during the 1900s is speculated to restrict breeding habitat generally, with strong evidence of this effect at one site [9, 10, 25].

FORAGING ECOLOGY AND DIET

Diet studies in this species are at present limited in extent. Casual observations indicate that both fish and squid are present in the current diet of breeding adults. Regurgitations from nestlings in 1970-1971 showed that squid were present in 52.9% of 259 samples, fish in 41.3% and crustaceans in 71.8%. Other invertebrates (found in a total 1.5% of samples) were the only other items noted. 80% of the squid beaks were in the families Histioteuthidae and Octopoteuthidae. Fish families included Exocetidae, Carangidae, and Clupeidae [9]. Indirect data on diet from stable isotope ratios from adults suggest that males may consume prey items of higher trophic level such as those obtained from fishery discards and baited hooks [26].

Phoebastria irrorata fly mostly during the day in Galápagos waters and rest on the water at night, which may or may not reflect on the timing of foraging activity [14].

No data are available from subadults or non-breeders, and there are no studies from Genovesa or La Plata.

MARINE DISTRIBUTION

Satellite tracking provided distribution data for breeders from the Punta Cevallos, Española colony during the incubation periods of 1995, 1996, 2000 and 2001, the brooding periods of 1996 and 2001, and the rearing period of 1996 (summarized in Anderson *et al.* 2003 [13]). GPS tracking provided data from breeding birds during the brooding periods of 2003 [14] and 2004 (J. Awkerman unpub.) and non-breeding birds during the 2004 breeding season [27]. These data show a repeatable pattern of distribution, with breeders commuting to the Peruvian continental shelf and shelf break on most trips during the incubation and chick-rearing periods, and remaining near Española during the brooding period, in the south-eastern quadrant of the Galápagos Archipelago. These results are consistent with sea-based observations between 1881 and 1995 which showed the same distribution [17] and with band recoveries in fisheries operations over the Peruvian continental shelf [27]. Absences of non-breeders during the breeding period suggests that they alternate trips to the Peruvian continental shelf with periods spent close to the colony (J. Awkerman unpub.).

There is some indication that *P. irrorata* distribution contracts during warm ENSO events, with foraging concentrated in the vicinity of localised upwelling cells that serve as refugia for fish (Jahncke *et al.* unpub, in [5]).

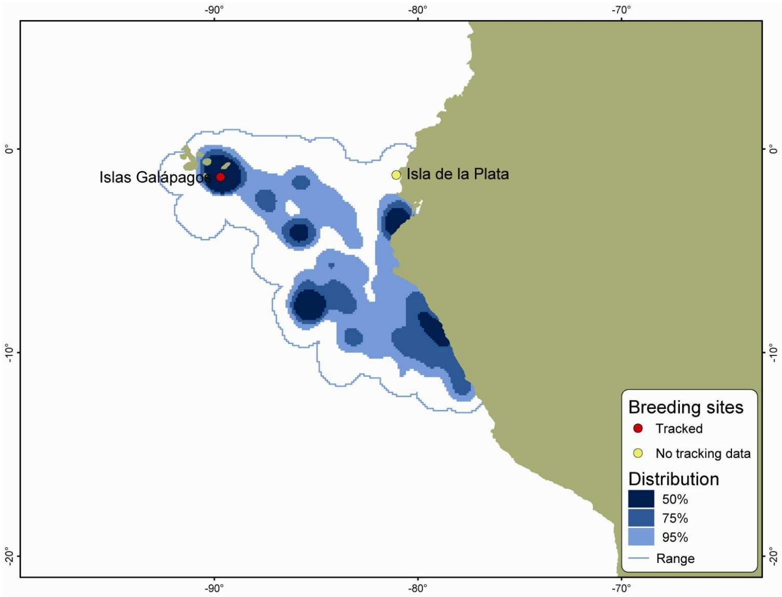

Figure 3. *Distribution of breeding adult* P. irrorata *based on satellite and GPS tracking data submitted to the BirdLife Global Procellariiform Tracking Database (Number of tracks = 44 PTT + 21 GPS)*.

Satellite-tracking data indicate that the *P. irrorata* breeding and foraging range overlaps with only one Regional Fisheries Management Organisation known to be particularly important to albatross and petrel conservation, the IATTC (Figure 1). The species also overlaps with the soon to be established South Pacific Regional Fisheries Management Organisation (SPRFMO) that would cover both pelagic and demersal fisheries in the region (predominantly discrete high seas stocks and those stocks which straddle the high seas and the EEZs of coastal states). Ecuador and Perú are the principal Range States for *P. irrorata* (Table 7).

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Table 7. *Summary of the known ACAP Range States, non-ACAP Exclusive Economic Zones and Regional Fisheries Management Organisations that overlap with the marine distribution of* P. irrorata.

	Resident/ Breeding and feeding range	Foraging range only	Few records - outside core foraging range
Known ACAP Range States	Ecuador	Perú	-
Exclusive Economic Zones of non-ACAP countries	-	-	Colombia
Regional Fisheries Management Organisations[1]	IATTC SPRFMO[2]	-	-

[1] See Figure 1 and text for list of acronyms

[2] Not yet in force

MARINE THREATS

Artisanal fishing fleets catch significant numbers of birds, perhaps accidentally in some cases [13] and certainly intentionally in others ([27]; D. Anderson pers. comm..), and this mortality has been implicated in the recent decline in annual adult survival [22]. Matrix modelling of available data on vital rates indicate a declining population at Punta Cevallos, Española [22], and low quality data on population size for Española are consistent with a decline since 1994 [22]. Longline fishing is currently banned within the Galápagos Marine Reserve (GMR), but fishery mortality has been reported nonetheless when *P. irrorata* target single baited hooks in the legal artisanal tuna fishery within the GMR [13].

Observer data on seabird bycatch rates from industrial longline fleets in the central and southeast Pacific IATTC area has not been collected. Although *P. irrorata* is not reputed to be a ship-follower [11], its distribution has a high overlap with IATTC longline fishing effort (1997-2004) [28, 29].

The single year of study of plastic ingestion indicated that this is limited [22].

KEY GAPS IN SPECIES ASSESSMENT

The interaction of albatrosses with the artisanal fishery off the Peruvian and southern Ecuadorian coasts requires on-site observation and experimental study in relation to the recently documented take in that fishery and ought to be of highest priority [5]. One topic of special interest should be the apparently higher risk of males to fishery mortality [27], which may be involved in the present female bias in adult sex ratio [30], a bias which has implications for population growth in this species with bi-parental care [22].

In addition, further study of distribution of different demographic classes at sea and better estimation of vital rates should be undertaken. The general features of at-sea distribution of breeders from Española are reasonably well-studied, but the details of oceanographic features correlated with distribution of this demographic class have been studied only in one year and only during the brooding period [14]. Distributions of non-breeders during the breeding season has been studied in only one year (J. Awkerman unpub.), and distribution of adults during the non-breeding season has not been studied using electronic tracking. The distribution of juveniles and prebreeding subadults is completely unstudied with electronic tracking.

Current monitoring of vital rates estimates annual adult survival, but for one sub-population on Española only. Expansion of this monitoring to other parts of the Española population is advisable, as is similar expansion of monitoring of breeding success, again conducted currently in only two plots. Population size is estimated poorly to date, and requires use of methods that provide estimates of error and overcome current limitations imposed by thick vegetative cover.

The effect (if any) of changing vegetative cover on the breeding grounds deserves attention. Any possible interactions that might occur with the re-introduced Galápagos tortoises are also worth investigating. A significant source of breeding failure is the unique habit of moving eggs across the ground, frequently landing them in holes or other inaccessible locations [9]. Explaining this phenomenon has so far confounded investigators [31].

Almost nothing is known about the birds found on La Plata and Genovesa and systematic diet studies have not been conducted since 1971.

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COMPILED BY

Dave Anderson
Department of Biology
Wake Forest University, USA

CONTRIBUTORS

Jill Awkerman
Environmental Protection Agency, USA

Mark Tasker
Vice-chair, ACAP Advisory Committee

ACAP Bycatch Working Group
Contact: Barry Baker
barry.baker@latitude42.com.au

ACAP Breeding Sites Working Group
Contact: Richard Phillips
raphil@bas.ac.uk

ACAP Status and Trends Working Group
Contact: Rosemary Gales
Rosemary.Gales@dpiw.tas.gov.au

ACAP Taxonomy Working Group
Contact: Michael Double
Mike.Double@aad.gov.au

BirdLife International,
Global Seabird Programme
Contact: Cleo Small
Cleo.Small@rspb.org.uk
Maps: Frances Taylor
Satellite-tracking data contributors: Dave Anderson and Jill Awkerman, Wake Forest University, USA.

RECOMMENDED CITATION

Agreement on the Conservation of Albatrosses and Petrels. 2009. ACAP Species assessment: Waved Albatross *Phoebastria irrorata.* Downloaded from http://www.acap.aq on 20 October 2009.

GLOSSARY AND NOTES

(i) **Years**.
The "split-year" system is used. Any count (whether breeding pairs or fledglings) made in the austral summer (e.g. of 1993/94) is reported as the second half of this split year (i.e. 1994).

The only species which present potential problems in this respect are *Diomedea* albatrosses, which lay in December-January, but whose fledglings do not depart until the following October-December. In order to keep records of each breeding season together, breeding counts from e.g. December 1993-January 1994 and productivity counts (of chicks/fledglings) of October-December 1994 are reported as 1994.

If a range of years is presented, it should be assumed that the monitoring was continuous during that time. If the years of monitoring are discontinuous, the actual years in which monitoring occurred are indicated.

(ii) Methods Rating Matrix (based on NZ rating system)

METHOD
A Counts of nesting adults (Errors here are detection errors (the probability of not detecting a bird despite its being present during a survey), the "nest-failure error" (the probability of not counting a nesting bird because the nest had failed prior to the survey, or had not laid at the time of the survey) and sampling error).
B Counts of chicks (Errors here are detection error, sampling and nest-failure error. The latter is probably harder to estimate later in the breeding season than during the incubation period, due to the tendency for egg- and chick-failures to show high interannual variability compared with breeding frequency within a species).
C Counts of nest sites (Errors here are detection error, sampling error and "occupancy error" (probability of counting a site or burrow as active despite it's not being used for nesting by birds during the season).
D Aerial-photo (Errors here are detection errors, nest-failure error, occupancy error and sampling error (error associated with counting sites from photographs), and "visual obstruction bias" - the obstruction of nest sites from view, always underestimating numbers).
E Ship- or ground- based photo (Errors here are detection error, nest-failure error, occupancy error, sampling error and "visual obstruction bias" (the obstruction of nest sites from view from low-angle photos, always underestimating numbers)
F Unknown
G Count of eggs in subsample population
H Count of chicks in subsample population and extrapolation (chicks x breeding success - no count of eggs)

RELIABILITY
1 Census with errors estimated
2 Distance-sampling of representative portions of colonies/sites with errors estimated
3 Survey of quadrats or transects of representative portions of colonies/sites with errors estimated
4 Survey of quadrats or transects without representative sampling but with errors estimated
5 Survey of quadrats or transects without representative sampling nor errors estimated
6 Unknown

(iii) Population Survey Accuracy
High Within 10% of stated figure;
Medium Within 50% of stated figure;
Low Within 100% of stated figure (eg coarsely assessed via area of occupancy and assumed density)
Unknown

(iv) Population Trend
Trend analyses were run in TRIM software using the linear trend model with stepwise selection of change points (missing values removed) with serial correlation taken into account but not overdispersion.

(v) Productivity (Breeding Success)
Defined as proportion of eggs that survive to chicks at/near time of fledging unless indicated otherwise

(vi) Juvenile Survival
defined as:
1 Survival to first return/resight;
2 Survival to x age (x specified), or
3 Survival to recruitment into breeding population
4 Other
5 Unknown

(vii) Threats
level of threat:
A combination of scope (proportion of population) and severity (intensity) provide a level or magnitude of threat. Both scope and severity assess not only current threat impacts but also the anticipated threat impacts over the next decade or so, assuming the continuation of current conditions and trends.

		Scope (% population affected)			
		Very High (71-100%)	High (31-70%)	Medium (11-30%)	Low (1-10%)
Severity (likely % reduction of affected population within ten years)	Very High (71-100%)	**Very High**	**High**	**Medium**	**Low**
	High (31-70%)	**High**	**High**	**Medium**	**Low**
	Medium (11-30%)	**Medium**	**Medium**	**Medium**	**Low**
	Low (1-10%)	**Low**	**Low**	**Low**	**Low**

(viii) Maps
The tracking maps shown were created from platform terminal transmitter (PTT) and global-positioning system (GPS) loggers. The tracks were sampled at hourly intervals and then used to produce kernel density distributions, which have been simplified in the maps to show the 50%, 75% and 95% utilisation distributions (i.e. where the birds spend x% of their time). The full range (i.e. 100% utilisation distribution) is also shown. Note that the smoothing parameter used to create the kernel grids was 1 degree, so the full range will show the area within 1 degree of a track. In some cases the PTTs were duty-cycled: if the off cycle was more than 24 hours it was not assumed that the bird flew in a straight line between successive on cycles, resulting in isolated 'blobs' on the distribution maps. It is important to realise that these maps can only show where tracked birds were, and blank areas on the maps do not necessarily indicate an absence of the particular species.