



White-chinned Petrel

Procellaria aequinoctialis

Puffin à menton blanc
Pardela gorgiblanca / Petrel barba blanca

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



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TAXONOMY

Order Procellariiformes
Family Procellariidae
Genus *Procellaria*
Species *P. aequinoctialis*

Until recently, White-chinned Petrels and Spectacled Petrels (*Procellaria conspicillata*) were considered a single species. Following Brooke (2004) ^[1], *Procellaria aequinoctialis* ^[2, 3] has been split into *P. aequinoctialis* (white-chinned) and *P. conspicillata* (spectacled). There are considerable differences in colouration, breeding range and vocalisation between these two species ^[4]

CONSERVATION LISTINGS AND PLANS

International

- Agreement on the Conservation of Albatrosses and Petrels – Annex 1 ^[5]
- 2008 IUCN Red List of Threatened Species – Vulnerable (since 2000) ^[6]
- Convention on Migratory Species - Listed Species (Appendix II) ^[7]

Australia

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC ACT)* ^[8]
 - Listed Migratory Species
 - Listed Marine Species
- Action Plan for Australian Birds 2000 ^[9]
- Threat Abatement Plan 2006 for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations ^[10]

Brazil

- National Species List of Brazilian Fauna Threatened with Extinction (*Lista Nacional das Espécies da Fauna Brasileira Ameaçadas de Extinção*) ^[11]
 - Vulnerable

Chile

- National Plan of Action for reducing by-catch of seabirds in longline fisheries (PAN-AM/CHILE) 2007 ^[12]

Falkland Islands (Islas Malvinas)

- *Conservation of Wildlife and Nature Ordinance 1999* ^[13]
- *Fisheries (Conservation and Management) Ordinance 2005* ^[14]
- Falkland Islands FAO National Plan of Action for Reducing Incidental Catch of Seabirds In Longline Fisheries 2004 ^[15]

France

- *Ministerial Order of 14 August 1998 (Arrêté du 14 août 1998)* ^[16]
 - Listed Protected Species

New Zealand

- *New Zealand Wildlife Act 1953* ^[17]
- Action Plan for Seabird Conservation in New Zealand; Part A: Threatened Seabirds ^[18]
- New Zealand Threat Classification System List 2008 – At Risk: Declining ^[19]

South Africa

- *Sea Birds and Seals Protection Act, 1973 (Act No. 46 of 1973) (SBSPA)* ^[20]
- *Marine Living Resources Act (Act No. 18 of 1996): Publication of Policy on the Management of Seals, Seabirds and Shorebirds: 2007* ^[21]
- National Plan of Action (NPOA) for Reducing the Incidental Catch of Seabirds in Longline Fisheries (2008) ^[22]

South Georgia (Islas Georgias del Sur)

- *Falkland Island Dependencies Conservation Ordinance 1975* ^[23]
- FAO International Plan of Action-Seabirds: An assessment for fisheries operating in South Georgia and South Sandwich Islands ^[24]

Uruguay

- National Plan of Action for Reducing the Incidental Catch of Seabirds in Uruguayan Fisheries (PAN - Aves Marinas Uruguay) 2007 ^[25]

BREEDING BIOLOGY

Many aspects of the life history of *P. aequinoctialis* are not well known in comparison with those of surface-nesting albatrosses and giant petrels and only a few attempts have been made at studying them in the past ^[26, 27, 28, 29].

Procellaria aequinoctialis is a colonial species that breeds annually, and is the largest petrel (c. 1100 – 1500 g) to nest in burrows. The breeding season extends from October to May ^[27]. Although the first birds arrive at their breeding colonies in mid September, some 50 days before laying, established breeders return on average in mid October and depart around two weeks later on a pre-laying exodus that lasts a mean of 17 days ^[30] (Table 1). Eggs are usually laid in mid-October to mid-November. At South Georgia (Islas Georgias del Sur), the mean laying date was 22 November with 92% of eggs being laid in the first 15 days ^[28]. A single egg is incubated for approximately 59 days. Chicks fledge after about 98 days ^[3, 28]. At South Georgia (Islas Georgias del Sur) failed breeders departed in February, which was two months earlier than successful birds ^[30]. The age at first breeding is on average six years (range 4-9 years, C. Barbraud pers. comm.).

Table 1. *Breeding cycle of P. aequinoctialis.*

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

BREEDING STATES

Table 2. *Distribution of the global P. aequinoctialis population among Parties to the Agreement based on surveyed sites.*

	Disputed*	France	New Zealand	South Africa
Breeding pairs	75%	25%	?%	?%

*A dispute exists between the Governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Islas Malvinas), South Georgia and the South Sandwich Islands (Islas Georgias del Sur y Islas Sandwich del Sur) and the surrounding maritime areas.

BREEDING SITES

Procellaria aequinoctialis has a wide distribution and is known to breed on the French, New Zealand and South African subantarctic islands, as well as on South Georgia (Islas Georgias del Sur) and the Falklands (Islas Malvinas) (Table 2, Figure 1).

Population data are scarce and accurate census data for several breeding sites are currently lacking (Table 3). Studies at some of the breeding sites will in part rectify this situation; New Zealand researchers have recently secured funding to investigate foraging ecology, breeding frequency, survival rates and population estimates over five years between 2008 – 2012 (P. Sagar pers. comm.).

South Georgia (Islas Georgias del Sur) is thought to hold the largest breeding population of *P. aequinoctialis* in the world, with an estimated 900,000 breeding-age pairs associated with the islands during the 2005/06 and 2006/07 survey seasons [31].

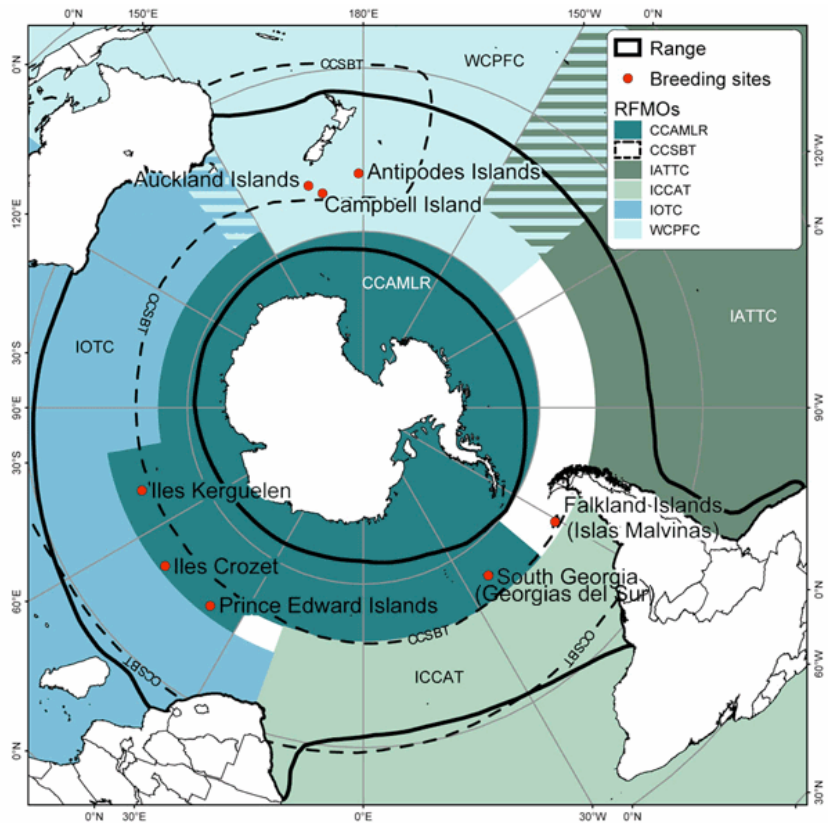


Figure 1. The location of the breeding sites and approximate range of *P. aequinoctialis* with the boundaries of selected Regional Fisheries Management Organisations (RFMOs) also shown.

CCAMLR – Commission for the Conservation of Antarctic Marine Living Resources
 CCSBT - Convention for the Conservation of Southern Bluefin Tuna
 IATTC - Inter-American Tropical Tuna Commission
 ICCAT - International Commission for the Conservation of Atlantic Tunas
 IOTC - Indian Ocean Tuna Commission
 WCPFC - Western and Central Pacific Fisheries Commission



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Table 3. Monitoring methods and estimates of the population size (annual breeding pairs) for each breeding site. Table based on unpublished Centre National De La Recherche Scientifique (CNRS) Chizé data and published references as indicated.

Breeding site location	Jurisdiction	Years monitored	Monitoring method	Monitoring accuracy	Annual breeding pairs (95%CI; last census)
Falkland Islands (Islas Malvinas) [32]					
51°42'S, 57°51'W	Disputed*				
Kidney Island		2005, 2006		High	27 (2006)
New Island		2005, 2006	C & call	High	26 (2006)
Bottom Island		2005, 2006	playbacks	High	2 (2006)
South Georgia (Islas Georgias del Sur)					
54°00'S, 38°36'W	Disputed*	2006, 2007	C & call playbacks	Medium	773,150 (2007) [31]
Total					773, 205
Iles Crozet					
46°26'S, 51°47'E	France				
Ile de la Possession		1983, 2004	A	High	5,783 (5,538-6,028; 2004) [33]
Ile de l'Est		1984, 2004	A	Medium	16,100 (3,900-27,800; 2004)
Ile des Apôtres and Ile des Pingouins		1984, 2004	A	Medium	1,700 (400-3,000; 2004)
Total					23,600 (9,800-36,800)
Iles Kerguelen					
49°09'S, 69°16'E	France	2005	C	Medium	234,000 (186,000-297,000; 2005)
Eastern Kerguelen		2005	C	Medium	74,000 (58,000-95,000; 2005)
Total					234,000 (186,000-297,000)
Auckland Islands					
50°42'S, 166°5'E	New Zealand				
Adams Island		-	-	-	unknown
Disappointment Island					
Campbell Islands					
52°32'S, 169°8'E	New Zealand				
Monowai Island		-	-	-	unknown
Antipodes Islands					
49°42'S, 178°47'E	New Zealand				In progress
Prince Edward Islands					
46°38'S, 37°57'E	South Africa				unknown
Total for all surveyed sites					1,030,205 (969,005-1,107,005)

* see Table 2 footnote

CONSERVATION LISTINGS AND PLANS FOR THE BREEDING SITES

International

Auckland Islands, Campbell Islands and Antipodes Islands

- UNESCO World Heritage List (inscribed 1998; Criteria: (ix) (x), Core zone: 76458 ha, Ref: 877) [34]

Prince Edward Islands, Iles Crozet and Iles Kerguelen

- RAMSAR Convention List of Wetlands of International Importance (inscribed 2007 and 2008) [35]

Falkland Islands (Islas Malvinas)

Kidney Island

- Nature Reserve - *Conservation of Wildlife and Nature Ordinance 1999* [13]

France

Crozet and Kerguelen Islands

- National Nature Reserve - *Décret no 2006-1211* [36]

French Southern Territories (TAAF - Terres australes et antarctiques françaises)

Ilots des Apôtres

- Controlled access areas - *Arrêté 15 du 30 juillet 1985* [37]

New Zealand

Auckland Islands, Campbell Islands, and Antipodes Islands

- National Nature Reserve - *New Zealand Reserves Act 1977* [38]
- Conservation Management Strategy. Subantarctic Islands 1998-2008 [39]

South Africa

Prince Edward Islands

- Special Nature Reserve (declared 1995) - *National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003)* [40]
- Prince Edward Islands Management Plan 1996 [41]

South Georgia (Islas Georgias del Sur)

- South Georgia Environmental Management Plan 2000 [42]
- South Georgia: Plan for Progress. Managing the Environment 2006 – 2010 [43]

Bird Island

- Specially Protected Area (SPA) - South Georgia: Plan for Progress. Managing the Environment 2006 – 2010 [43]

POPULATION TRENDS

There are few data on population trends (Table 4). Berrow *et al.* (2000) reported an overall decrease in burrow occupancy of 28% from 1981 to 1998 at Bird Island [44]. More recent surveys from Marion Island estimated the population in a 15 ha study plot to have declined by 34% between 1997 and 2000 [45]. A complete survey of Ile de la Possession (Crozet) in 1983 and 2004 also indicated an overall decrease of 37.1% from 8,377 (95%CI: 8,020-8,733) to 5,783 (95%CI: 5,538-6,028) breeding pairs [33]. There was an estimated 186,000 to 297,000 *P. aequinoctialis* burrows at Iles Kerguelen in 2005 (C. Barbraud pers. comm.), which is similar to an earlier survey that estimated 100,000 to 300,000 breeding pairs in 1985-1987 [46]. Overall breeding success of *P. aequinoctialis* ranges from 21.8 - 51% [28, 33, 44, 47, 48] but data for other demographic parameters are lacking for most sites (Table 5).

Table 4. Summary of population trend data for *P. aequinoctialis*.

Breeding site	Current Monitoring	Trend Years	% average change per year	Trend	% of population for which trend calculated
Falkland Islands (Islas Malvinas)	?	-	-	Unknown	-
South Georgia (Islas Georgias del Sur)					
Bird Island	Yes	1981, 1998	-1.65 [44]	Declining	?
Iles Crozet					
Ile de la Possession	Yes	1983, 2004	-1.76 [33]	Declining	100%
Iles Kerguelen	Yes	-	-	Unknown	-
Auckland Islands	No	-	-	Unknown	-
Campbell Islands	No	-	-	Unknown	-
Antipodes Islands	Yes	-	-	Unknown	-
Prince Edward Islands					
Marion Island	No	1997 – 2000	-14.1 [45]	Declining	?

Table 5. Demographic data for *P. aequinoctialis* breeding sites.

Breeding site	Mean breeding success (study period)	Mean juvenile survival	Mean adult survival
Falkland Islands (Islas Malvinas)	No data	No data	No data
South Georgia (Georgias del Sur)			
Bird Island	44.4% (1996, 1998) ^[44]	No data	No data
Îles Crozet			
Île de la Possession	50.2%* (1994-2001) ^[47] 38.2% (1986-2004) ^[33] 51.4% (1995-2004) ^[33]	39.3% ($\pm 29.2\%$) ^[33]	89.5% ($\pm 1.9\%$) ^[33]
Îles Kerguelen	No data	No data	No data
Auckland Islands	No data	No data	No data
Campbell Islands	No data	No data	No data
Antipodes Islands	No data	No data	No data
Prince Edward Islands			
Marion Island ^[48]	36.2% (1980/81) 21.8% (1991/92)	No data	No data

*with intensive rat poisoning

BREEDING SITES: THREATS

Currently the most serious threat to *P. aequinoctialis* is predation by introduced rodents (Black rat *Rattus rattus* and Norway rat *R. norvegicus*) on many of the islands (Table 6).

Table 6. Summary of known threats causing population level changes at the breeding sites of *P. aequinoctialis*.

Breeding site	Human disturbance	Human take	Natural disaster	Parasite or pathogen	Habitat loss or degradation	Predation (alien species)	Contamination
Falkland Islands (Islas Malvinas)							
Kidney Island	no	no	no	no	no	no	no
New Island	no	no	no	no	no	low ^a	no
Bottom Island	no	no	no	no	no	no ^b	no
South Georgia (Islas Georgias del Sur)	no	no	no	no	low ^c	low ^c	no
Îles Crozet							
Île de la Possession	no	no	no	no	no	low ^d	no
Île de l'Est	no	no	no	no	no	no	no
Île des Apôtres	no	no	no	no	no	no	no
Île des Pingouins	no	no	no	no	no	no	no
Îles Kerguelen	no	no	no	no	low ^e	low ^e	no
Auckland Islands	no	no	no	no	no	no	no
Adams Island							
Disappointment Island	no	no	no	no	no	no	no
Campbell Islands	no	no	no	no	no	no	no
Antipodes Islands	no	no	no	no	no	no ^f	no
Prince Edward Islands	no	no	no	no	no	no ^f	no

^a Rats, mice and feral cats *Felis catus* present - some evidence of predation of chicks by feral cats (P. Catry, unpubl. in ^[32]).

^b Rats were eradicated in 2001 ^[32].

^c Norwegian rats *R. norvegicus* predate chicks and reindeer *Rangifer tarandus* trample habitat.

^d Introduced rats (*R. rattus* and *R. norvegicus*) prey on chicks and can account for 41% of breeding failures ^[47].

^e Introduced rats (*R. rattus*) and cats prey on the birds while moufflon *Ovis ammon* and reindeer trample habitat.

^f Mice are present but are not known to prey upon *P. aequinoctialis* (D. Thompson and J. Cooper pers. comm.).

FORAGING ECOLOGY AND

DIET

Procellaria aequinoctialis feed by surface seizing but they are capable of diving to approximately 15 m [49]. The diet of *P. aequinoctialis* from South Georgia (Islas Georgias del Sur) was composed mainly of krill (41-42% by wet weight) followed by fish (39-29%) and to a lesser extent squid (19-25%) [50]. Amphipods can also be abundant in their diet [51]. They readily follow ships and feed on fisheries discards or dive on baited hooks, making them highly vulnerable to accidental death in longline fisheries [52]. During the pre-laying exodus and incubation, *P. aequinoctialis* from South Georgia (Islas Georgias del Sur) routinely travel 2000 km to feed on the Patagonian Shelf and shelf break. Such long trips are rare during chick-rearing, when birds instead target the Polar Frontal zone, and shelf and shelf slope waters to the south of the colony [30, 53]. At the Crozet Islands, foraging locations during incubation and during chick rearing ranged from the sub-Tropics to the edge of the Antarctic pack-ice [53]. Diet mainly comprised Antarctic krill *Euphausia superba*, the amphipod *Themisto gaudichaudii* and small pelagic fish [54, 55]. Tunicates and offal comprised a minor component of the diet [55]. Chicks also received some food that was probably obtained from baited hooks of longliners [54]. During incubation, breeding birds on foraging trips also reach the Benguela Current [56]. The Benguela Current area is also important for non-breeding birds, and trawler offal has been reported to be a significant component of the diet for *P. aequinoctialis* foraging in that region [57].

MARINE DISTRIBUTION

The distribution and abundance of *P. aequinoctialis* off western South America was examined over several seasons by Spear *et al.* (2005) [58]. *Procellaria aequinoctialis* were observed in high densities near the continental slope in spring (breeding) and autumn (non-breeding) rather than in the pelagic zone. They also tended to concentrate off Chile in the cool waters of the Convergence zone [58]. Adults and newly fledged birds were most abundant on the continental shelf and shelf-slope areas during the austral winter.

During the breeding season *P. aequinoctialis* from South Georgia (Islas Georgias del Sur) are widely distributed in oceanic, shelf and shelf-slope waters, foraging on the Patagonian Shelf between incubation shifts; failed breeders appear to move south towards the South Orkney Islands [30, 53]. In winter, most *P. aequinoctialis* forage across a wide area ranging from south-eastern Brazil to the southern Patagonian Shelf, but with c. 20% of birds spending the latter part of the winter in the Humboldt Current region off western Chile. On the Patagonian Shelf, birds were concentrated off the River Plate, Uruguay and south-eastern Brazil [30].

On their pre-laying foraging trips, *P. aequinoctialis* from South Georgia (Islas Georgias del Sur) also headed westwards towards the Patagonian Shelf, tending to target more inshore areas than those favoured during the winter [30].

Based on band recoveries and unpublished tracking data, no adults or immatures from Crozet and Kerguelen winter in the Benguela Current area [59].

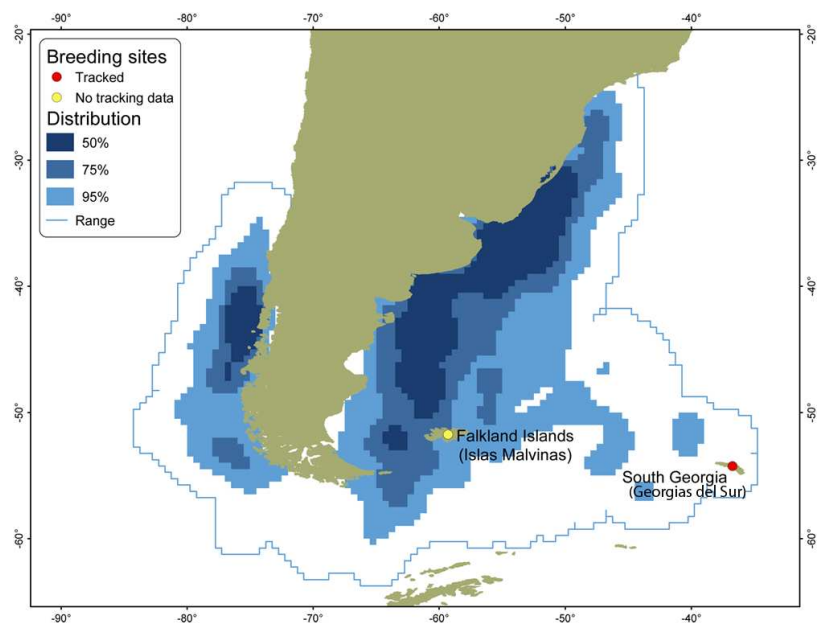


Figure 3. Satellite-tracking data from non-breeding adult *P. aequinoctialis* (Number of tracks = 10). Map based on data submitted to the BirdLife International Global Procellariiform Tracking Database [60].

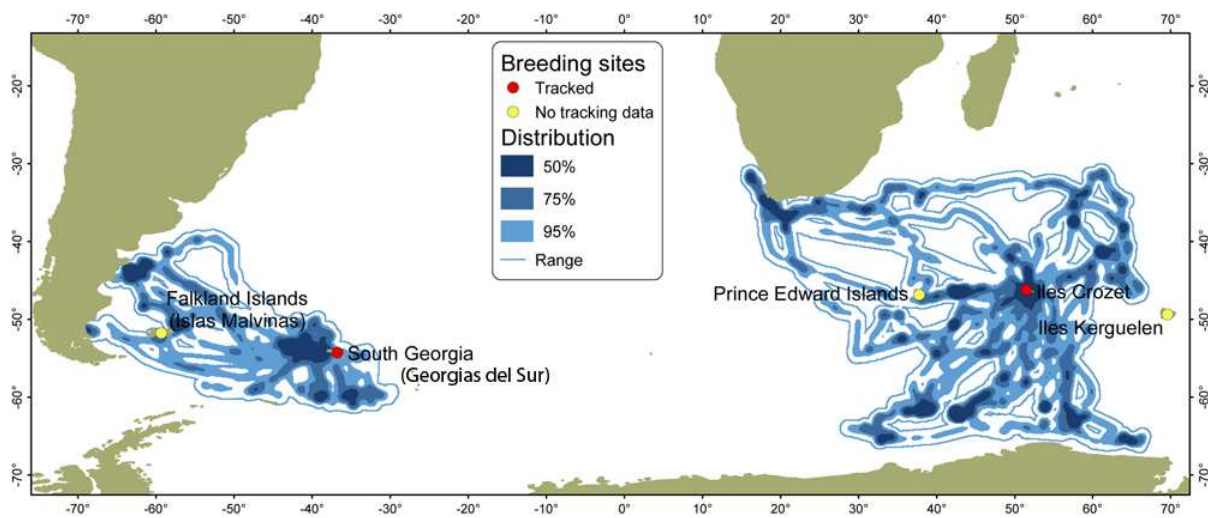


Figure 4. Satellite-tracking data from breeding adult *P. aequinoctialis* (Number of tracks = 39). Map based on data submitted to the BirdLife International Global Procellariiform Tracking Database ^[60].

France, South Africa, New Zealand, and the disputed territories of Falkland Islands (Islas Malvinas) and South Georgia (Georgias del Sur) are the principal Range States for *P. aequinoctialis* (Figure 1; Table 7). The species overlaps with 10 Regional Fisheries Management Organisations, but principally the WCPFC, CCAMLR, CCSBT, SIOFA (Southern Indian Ocean Fisheries Agreement), SWIOFC (South-West Indian Ocean Fisheries Commission) and the yet to be established South Pacific Regional Fisheries Management Organisation, SPRFMO (Figure 1; Table 7). IATTC, ICCAT, IOTC, and SEAFO (South-East Atlantic Fisheries Organisation) also overlap with the foraging range of *P. aequinoctialis*. SEAFO, SWIOFC, and SIOFA are aimed at ensuring the long-term conservation and sustainable use of fishery resources other than tuna and are principally responsible for trawl and artisanal fisheries; however, SEAFO also manages pelagic species such as the Patagonian toothfish (*Dissostichus eleginoides*). SPRFMO 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).

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

	Resident/ Breeding and feeding range	Foraging range only	Few records - outside core foraging range
ACAP Range States	Disputed ¹ France New Zealand South Africa	Australia Brazil Chile Peru Uruguay	Ecuador
Exclusive Economic Zones of non-ACAP countries	-	Mozambique Madagascar Namibia	Angola Tanzania
Regional Fisheries Management Organisations²	WCPFC CCAMLR CCSBT SIOFA SWIOFC SPRFMO ³	IATTC ICCAT IOTC SEAFO	-

¹ see Table 2 footnote

² see Figure 1 and text for list of acronyms

³ not yet in force

MARINE THREATS

In the southern hemisphere, *P. aequinoctialis* is one of the species most vulnerable to incidental mortality in fisheries (trawl and longline) where seabirds interact with commercial vessels [49, 61, 62, 63, 64, 65, 66]. Martin *et al.* (2009) [31] suggest that up to 276,000 individuals from the South Georgia (Islas Georgias del Sur) region are removed from the population each year by incidental mortality. *Procellaria aequinoctialis* is known to be killed in longline fisheries off southern Africa, Brazil, Chile, Uruguay, and around the subantarctic Islands in the Indian Ocean, as well as in trawl fishing operations around the Kerguelen Islands and in New Zealand waters. In trawl fisheries, the birds usually die when they strike warps or get entangled in the mesh of the net; some strike netsonde cables. There are also reports that floating lines from small vessels have been used to target *P. aequinoctialis* in the waters off southern Angola [67].

The worst fatalities occur in longline fisheries, and a disproportionate number of males to females are killed [63, 68]. *Procellaria aequinoctialis* was the most common species observed caught in New Zealand fisheries between 1998 and 2004, with 767 out of 936 birds killed in longline operations [69]. Over 26,000 seabirds were reported killed off the Crozet and Kerguelen Islands (CCAMLR Subarea 58.6 and Division 58.5.1) from September 2001 to August 2003, the vast majority (c. 92%) being *P. aequinoctialis* [63]. Although from 2003 to 2006 the number of *P. aequinoctialis* killed in that area was reduced from > 14,000 in 2002/03 to c. 2,500 in 2005/06, approximately 40,000 *P. aequinoctialis* have been killed incidentally since [66, 70, 71, 72]. At the Crozet Islands, mortality is much lower than at Kerguelen, and a detailed demographic analysis indicates that both climate and fisheries have affected the population and are responsible for its decline [33].

In terms of other threats, Ryan (1988) found that adult birds had ingested plastic particles and passed them on to at least some of the fledglings [73].

KEY GAPS IN SPECIES ASSESSMENT

Population data for *P. aequinoctialis* are extremely difficult to obtain as the burrowing activity of these petrels results in a fragile substratum which is prone to collapse underfoot. Although surveys have been conducted in recent years at the key breeding sites, data are lacking for some sites and longterm datasets on demographic parameters, i.e. information on breeding success, juvenile survival, and recruitment are largely not available.

The impact of introduced predators also remains undocumented for most breeding sites. Further information on bycatch levels in all fisheries is needed and effective mitigation measures against fisheries-related mortality for this nocturnal foraging and relatively deep-diving species need to be examined in more detail.



Photo © Ben Phalan

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RECOMMENDED CITATION

Agreement on the Conservation of Albatrosses and Petrels. 2009. ACAP Species assessment: White-chinned Petrel *Procellaria aequinoctialis*. Downloaded from <http://www.acap.aq> on 14 September 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

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 satellite-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.