Northern Royal Albatross
Diomedea sanfordi

Albatros royal du Nord
Albatros real del norte

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

Photo courtesy of L Perriman (New Zealand Department of Conservation)

TAXONOMY

Order Procellariiformes
Family Diomedeidae
Genus *Diomedea*
Species *D. sanfordi*

This monotypic species was originally described in 1917 by Murphy, but was subsequently considered to be a subspecies of the long-established *D. epomophora,* the Southern Royal Albatross. In 1998, Robertson and Nunn [1] restored *D. sanfordi* to specific status based on several key morphological differences between the two taxa. Although Penhallurick and Wink (2004) [2] argued that this split was not warranted based on the available molecular data, and although hybridisation between the two taxa can occur, *D. sanfordi* is treated as a species by ACAP [3], BirdLife International [4], and several recent monographs and field guides of Southern Ocean seabirds [5, 6, 7].

CONSERVATION LISTINGS AND PLANS

International

- Agreement on the Conservation of Albatrosses and Petrels – Annex 1 [3]
- 2008 IUCN Red List of Threatened Species – Endangered (since 2000) [8]
- Convention on Migratory Species - Listed Species (Appendix II; as *D. epomophora*) [9]

Australia

- *Environmental Protection and Biodiversity Conservation Act 1999* (*EPBC ACT*) [10]
  - Endangered (as *D. epomophora sanfordi*)
  - Listed Migratory Species
  - Listed Marine Species
- Recovery Plan for Albatrosses and Petrels (2001) [11]
- Threat abatement plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (2006) [12]
- **South Australia:** *National Parks and Wildlife Act 1972* – Endangered (as *D. epomophora sanfordi*) [13]
- **Western Australia:** *Wildlife Conservation Act 1950 - Wildlife Conservation (Specially Protected Fauna) Notice 2008 (2)* – Fauna that is rare or is likely to become extinct [14]

Brazil

- National Species List of Brazilian Fauna Threatened with Extinction (*Lista Nacional das Espécies da Fauna Brasileira Ameaçadas de Extinção*) – Endangered [15]
- National Plan of Action for the Conservation of Albatrosses and Petrels (NPOA-Seabirds Brazil) 2006 [16]

Chile

- National Plan of Action for reducing by-catch of seabirds in longline fisheries (PAN-AM/CHILE) 2007 [17]

New Zealand

- *Wildlife Act 1953* [18]
- New Zealand Threat Classification System List 2008 – Naturally Uncommon (as *D. epomophora sanfordi*) [19]
- Recovery plan for albatrosses in the Chatham Islands 2001-2011 [20]
- Action Plan for Seabird Conservation in New Zealand; Part A: Threatened Seabirds [21]

South Africa

- *Sea Birds and Seals Protection Act, 1973 (Act No. 46 of 1973) (SBSPA)* [22]
- *Marine Living Resources Act (Act No. 18 of 1996)*: Publication of Policy on the Management of Seals, Seabirds and Shorebirds: 2007 [23]
- National Plan of Action (NPOA) for Reducing the Incidental Catch of Seabirds in Longline Fisheries 2008 [24]

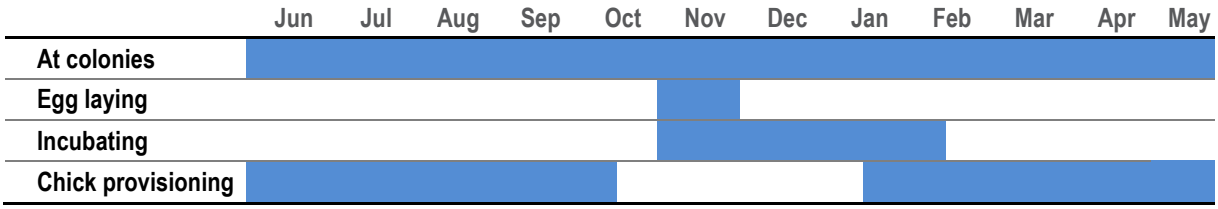
Uruguay

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

BREEDING BIOLOGY

Diomedea sanfordi is a colonial, biennial-breeding species if successful in rearing a chick. Breeding birds return to colonies from late August to mid November. Non-breeding birds can be present from September to late May (L. Perriman pers. comm. 2009). Eggs are laid between 26 October and 1 December (mean date 11 November at Taiaroa Head, n=720 eggs 1938-2008), hatching mostly in late January and early February (mean incubation 78.8 ± 1.5 days) and chicks fledge in September/October after about 240 (± 9) days [26] (Table 1). Juvenile birds start returning to colonies when three years old, but the mean is four years of age [27]. Age at first breeding is usually eight years (average for females 8.5, n=86, 8.6 for males, n=84, L. Perriman pers. comm. 2009), but can be as early as six years of age [27].

Table 1. *Breeding cycle of* D. sanfordi.



BREEDING STATES

Table 2. *Distribution of the global* D. sanfordi *population among Parties to the Agreement.*

	New Zealand
Breeding pairs	100%

BREEDING SITES

Diomedea sanfordi is a New Zealand endemic (Table 2), breeding only in the Chatham Islands to the east of New Zealand (>99% of the population, of which 60% breed at the Forty Fours) and at Taiaroa Head on the Otago Peninsula on New Zealand's South Island (Figure 1; Table 3). The total breeding population was estimated to be approximately 6,500 - 7,000 pairs in 1995, with 5,200 pairs breeding annually, equivalent to a total mature population of about 17,000 individuals [28, 29]. A total of 50 pairs bred at Taiaroa Head in 2006-2008 (three seasons), including eight individuals which are hybrid progeny of *D. epomophora* x *D. sanfordi* (L. Perriman pers. comm. 2009). Two *D. sanfordi* were also recorded breeding with D. *epomophora* at Enderby Island in the Auckland group from 1993-1995 [29].

Table 3. *Estimates of the population size (annual breeding pairs) for the main* D. sanfordi *breeding sites.*

Breeding site location	Jurisdiction	Years monitored	Monitoring method	Monitoring accuracy	Annual breeding pairs (last census)
Taiaroa Head	New Zealand	1938-2009	A	High	32 (2009) [30]
Chatham Islands 44° 23'S, 176° 17'W Forty Fours Big Sister Little Sister	New Zealand	1973-1976, 1989-1996, 2003	D	?	5,800 (2003) [31]

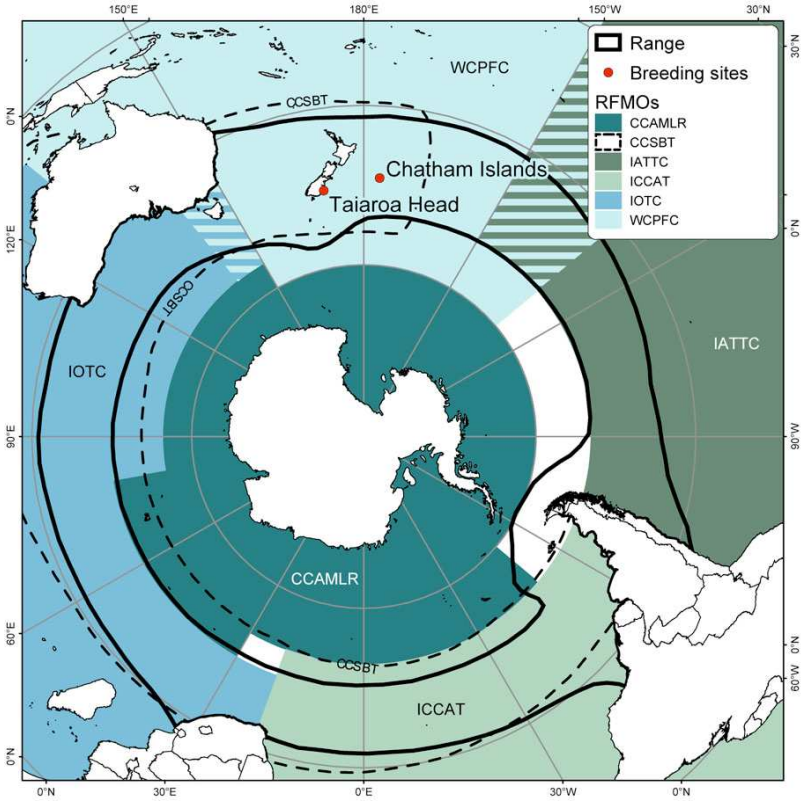


Figure 1. *The location of the main breeding sites and approximate range of* D. sanfordi *with the boundaries of selected Regional Fisheries Management Organisations (RFMO) also shown.*

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

CONSERVATION LISTINGS AND PLANS FOR THE BREEDING SITES

International

Enderby Island

- UNESCO World Heritage List (inscribed 1998) [32]

New Zealand

Taiaroa Head

- Nature Reserve – *Reserves Act 1977* [33]

Enderby Island

- Nature Reserve – *Reserves Act 1977* [33]
- Conservation Management Strategy. Subantarctic Islands 1998-2008 [34]

Forty Fours, Big Sister, Little Sister (Privately Owned)

- Chatham Islands Conservation Management Strategy [35]

POPULATION TRENDS

Monitoring at Taiaroa Head has been ongoing since 1937, however this colony represents only about 0.5 % of the total population and the quality and quantity of early records vary [27]. Nevertheless, it is clear that this colony is increasing, with 50 pairs in total breeding between 2006-2008 (with 32 pairs breeding in 2008/2009), compared to a total breeding population of 27 pairs reported for the site in 1995, with 18 pairs breeding that year [29].

The only data available for Chatham Islands are aerial photographs from 1973-1976 and 1989-1996, plus a count from 2003 [31]. Although the number of chicks in the 1990s was 50% of those recorded in the 1970s [28], the current population trend for the Chatham Islands is unknown (Table 4). There were an estimated 5,200 annual breeding pairs in 1995 compared to 5,800 pairs in the 2002/2003 season [31]. However, the comparability of methods between the surveys is unclear. As *D. sanfordi* is a biennially breeding species, several consecutive counts are necessary to accurately assess the population trend and account for the annual variability in the number of birds attempting to breed.

Table 4. *Summary of population trend data for* D. sanfordi.

Breeding site	Current monitoring	Trend Years	% average change per year	Trend	% of population
Taiaroa Head	Yes	1938-2009	-	Increasing	100%
Chatham Islands	No	1973-1976, 1989-1996	-	Declining? [28]	100%

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Breeding success at Taiaroa Head increased from 46% between 1938 and 1995 [28] to 60% between 1999 and 2008 (Table 5). Improved management of fly infestation and heat stress impacts has resulted in a dramatic decrease of egg and chick losses (L. Perriman pers. comm. 2009), while an intensive trapping programme for stoats *Mustela ereminea*, ferrets *Putorius putorius* and cats *Felis catus* reduces the incidence of predation [28]. On the Chatham Islands, severe storms in 1985 and subsequently have destroyed the nesting habitat and resulted in very low mean breeding success, especially on the Forty Fours [28]. Higher nesting densities following storm events are also associated with thinner egg shells and egg breakages which exacerbate problems caused by the lack of vegetation available for nest building, low soil moisture and rocky substrate [28]. Juvenile survival at Taiaroa Head was 69% until 2004 (L. Perriman pers. comm. 2009), but there are no data for the Chatham Islands. Average adult survival is comparable between the two sites, at 94.6% [27] and 95.2% [28] (Table 5).

Table 5. *Demographic data for the main* D. sanfordi *breeding sites. Table based on L. Perriman, Department of Conservation (DOC) unpublished data (Taiaroa Head) and published references as indicated.*

Breeding site	Mean breeding success	Mean juvenile survival ±SE	Mean adult survival ±SE
Taiaroa Head	46% (1938-1995) [28] 60% (1999-2008)	69.4 ±4.6 % (1938-1988)[1] [27] 69% (1938-2004)	94.6 ±1.5 (1938-1993) [27]
Chatham Islands	18% (1990-1996) [28]	No data	95.2 % [28]
Forty Fours	48% (1973-1976) [28] 8% (1990-1996) [28] 54% (1973-1976) [28]		

[1] survival to 5 years of age

BREEDING SITES: THREATS

The three breeding islands in the Chatham group which contain over 99% of the population are privately owned.

Table 6. *Summary of known threats causing population level changes at the main breeding sites of* D. sanfordi*. This table is based on unpublished DOC data submitted to the ACAP Breeding Sites Working Group in 2008.*

Breeding site	Human disturbance	Human take	Natural disaster	Parasite or Pathogen	Habitat loss or alteration	Predation (alien species)	Contamination
Taiaroa Head	No [a]	No	No	No	No [b]	No [c]	No [d]
Chatham Islands							
Forty Fours	No [a]	No [a]	No [b]	No	No [b]	No [c]	No [d]
Big Sister	No [a]	No [a]	No [b]	No	No [b]	No [c]	No [d]
Little Sister	No [a]	No [a]	No [b]	No	No [b]	No [c]	No [d]

[a] There is a history of significant harvesting of *D. sanfordi* on the Chatham Islands by local residents [20]. Harvesting of chicks may still occur, although this is likely to be limited in extent. At Taiaroa Head, the density of breeding birds away from visitor activity has increased, but the numbers in view of the observatory have remained stable since public viewing started [28].

[b] The major threat to this species could be habitat degradation on the islands as a result of severe storms and changed climatic conditions [20]. Both Taiaroa Head and the Chatham Islands have experienced increased temperatures and drying of habitat since the 1970s [28]. The loss of soil and nesting material on the Forty Fours and The Sisters resulted in poorer quality nests and egg losses, and heat stress has caused deaths of adults and chicks as well as egg losses at Taiaroa Head [28].

[c] Feral cats, stoats and ferrets have taken chicks and eggs at Taiaroa Head but these predators are intensively controlled [28]. Norway rats *Rattus norvegicus* are not known to impact on albatrosses at this site [21]. The Chatham Island colonies are free of introduced mammals.

FORAGING ECOLOGY AND DIET

The foraging ecology and diet of *D. sanfordi* are known from stomach contents and regurgitations of fledglings and adults on Middle (Little) Sister from 1973-1983 and at Taiaroa Head from 1981-1996 [36]. Cephalopods (20 families), fish, tunicates (mostly Salpidae) and crustaceans (isopods probably ingested as parasites of the primary fish prey) were the main food items by estimated biomass. Although *Moroteuthopsis ingens* was the most important cephalopod species in terms of biomass at both sites (69.6% at Chatham Islands, 39.8% at Taiaroa Head), *Histioteuthis atlantica* was the most frequently consumed (45.1% of beaks on Chatham Islands, 34.4% at Taiaroa Head) [36]. At Taiaroa Head, *Octopus cordiformis* was also important (31.7% of biomass and 23.4% of beaks), whereas *Nototodarus sloanii* was more prominent in samples collected between 1973-1978 (58.2% of beaks), but not in subsequent years, possibly due to human overexploitation of this species [36]. The fish component of the diet is not as well documented due to lack of recognisable remains and difficulty with species identification. Intact specimens or well preserved otholiths included either fisheries targets such as Hoki *Macruronus novaezelandiae* or bycatch species (Macrouridae, *Thyrsites atun*) [36]. Stones, pumice and plastics were also recorded in samples from both sites. Food is considered to be obtained mainly by scavenging of dead or moribund prey, discards and offal from fishing vessels and to a limited extent, through active predation [36].

MARINE DISTRIBUTION

Diomedea sanfordi has a circumpolar distribution from subantarctic to subtropical latitudes. Satellite-tracking of breeding birds shows they forage close to their breeding sites, over the shallow waters of the Chatham Rise out to the shelf slope (1,500 – 2,000 m deep) [37, 38] (Figure 2). Failed breeders and non-breeding birds, including newly fledged juveniles, rapidly traverse the Pacific Ocean to the continental shelf and slope off Chile and the Patagonian Shelf (Figure 3) [37, 39]. On the Patagonian Shelf, they are widespread 200-350 km offshore in waters <200 m deep but extending to, and over, the shelf break to 1000 m depth between 36 and 49°S [37]. Further south, near the Falkland Islands (Islas Malvinas) the birds are restricted to the shelf west of the islands, and do not venture to the deeper shelf slope [37]. The species has also been reported in waters off Uruguay and Brazil [40, 41].

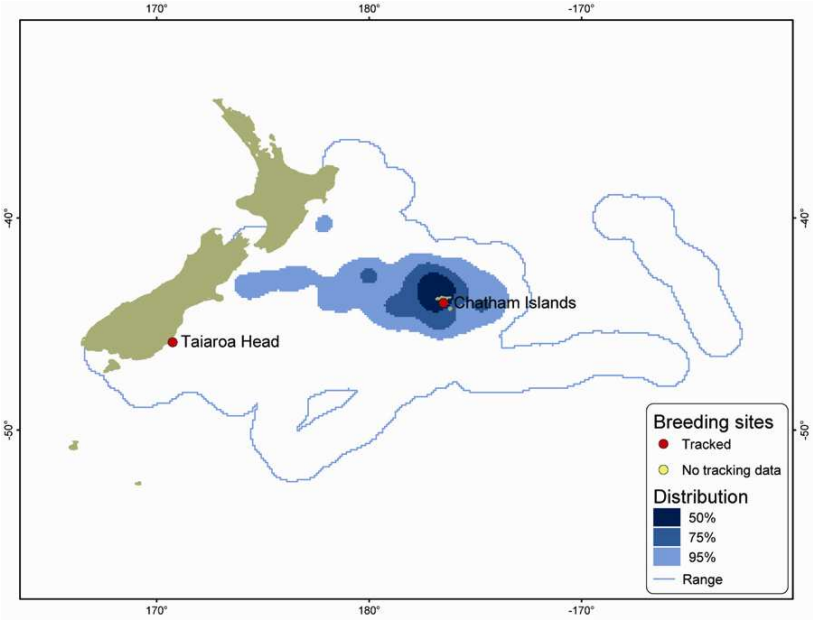

Figure 2. *Tracking data of breeding* D. sanfordi *(Number of tracks = 50 GPS + 31 PTT). Map based on data contributed to BirdLife Global Procellariiform Tracking Database.*

Analysis of squid species consumed by *D. sanfordi* corroborates available tracking data and indicates that they forage over shelf waters around New Zealand and southern South America rather than in oceanic waters or south of the Antarctic Polar Front [36].

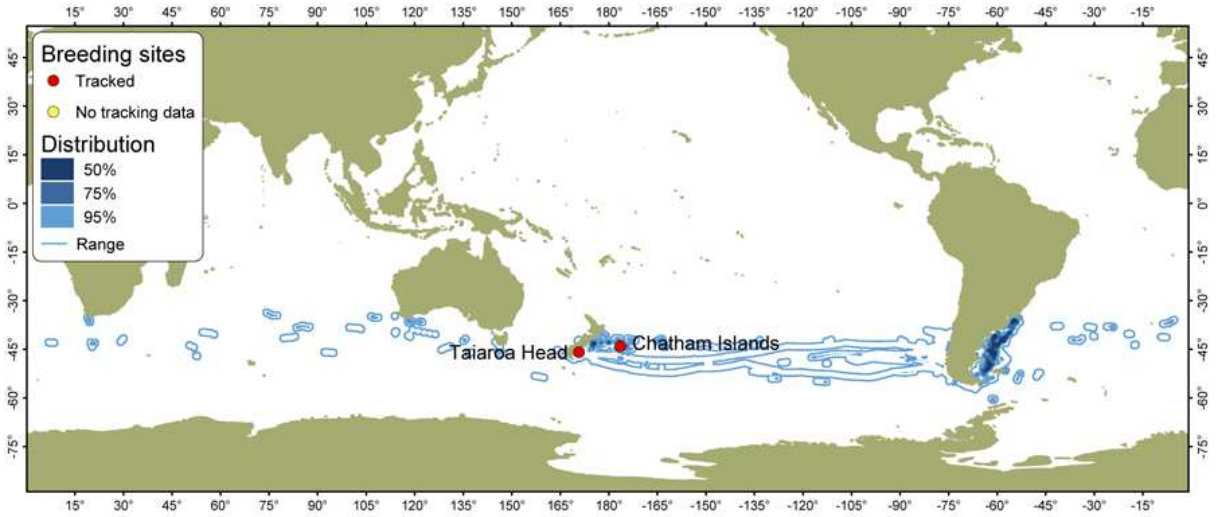

Figure 3. *Satellite-tracking data of non-breeding* D. sanfordi *(Number of tracks = 31). Map based on data contributed to BirdLife Global Procellariiform Tracking Database.*

The full migratory route of *D. sanfordi* is circumpolar and downwind, generally between 30 and 45°S [42] and hence the species overlaps with most Regional Fisheries Management Organisations, but principally the WCPFC, CCSBT, IATTC and ICCAT (Figure 1; Table 7). Consultations are also currently underway to establish the 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). New Zealand, Chile Argentina and Uruguay are the principal Range States for *D. sanfordi* (Figure 2; Table 7).

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* D. sanfordi.

	Breeding and feeding range	**Foraging range only**	**Few records - outside core foraging range**
Known ACAP Range States	New Zealand	Australia Argentina Chile Disputed [1] South Africa Uruguay	Brazil
Non-ACAP Exclusive Economic Zones	-	-	-
Regional Fisheries Management Organisations[2]	WCPFC CCSBT SPRFMO [3]	IATTC ICCAT IOTC SEAFO SIOFA	-

[1] 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.

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

[3] Not yet in force

MARINE THREATS

The relatively high survival rates of adults and juveniles suggest that fisheries-related mortality is not a major threat to this species. Although *D. sanfordi* have been reported as bycatch in longline fishery operations around New Zealand, Australia, Brazil, and Uruguay, the capture rates have been low [40, 41, 43, 44]. *Diomedea sanfordi* was the least common of all albatross species returned for identification in New Zealand fisheries between 1998 and 2004, with two birds observed caught by trawl vessels in the Chatham Rise sector [45]. However, observer coverage in this period was less than 5% of total fishing effort [45]. There were no mortalities observed in the Argentine longline fleet along the Patagonian Shelf between 1999 and 2001 [46], nor have *D. sanfordi* been recorded as bycatch in longline vessels operating off the coast of Chile, but the data set is limited [40].

Although a variety of persistent chlorinated organic compounds (PCDDs, PCDFs, PCBs and DDT group) were detected in eggs and chicks collected between 1995 and 1998, the level of residues was considered low and not expected to have adverse effects on bird health [47].

KEY GAPS IN SPECIES ASSESSMENT

Demographic data for the Taiaroa Head colony is comprehensive but intensive monitoring and management of the population needs to be sustained to ensure continued success. In contrast, recent census and demographic data for the Chatham Islands where 99% of the population breed is sparse and recruitment rates have not been determined. Information on the at-sea distribution of fledglings is limited. A greater understanding of the fishing operations and extent of incidental capture of *D.sanfordi* in waters around southern South America is also required.

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Satellite-tracking data contributors: Christopher Robertson (Department of Conservation, New Zealand), David Nicholls (Chisholm Institute), M.D. Murray, Susan Waugh (Ministry of Fisheries, New Zealand), Akira Fukuda (Faculty of Engineering, Shizuoka University), Makio Suzuki (School of Marine Science and Technology, Tokai University).

PHOTOGRAPHS

Tui De Roy, The Roving Tortoise
Worldwide Nature Photography,
photos@rovingtortoise.co.nz

Aleks Terauds
http://www.aleksterauds.com/

L Perriman, DOC, New Zealand
http://www.doc.govt.nz/

RECOMMENDED CITATION

Agreement on the Conservation of Albatrosses and Petrels. 2009. ACAP Species assessments: Northern Royal Albatross *Diomedea sanfordi*. Downloaded from http://www.acap.aq on 31 August 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).
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 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.