COSEWIC
Assessment and Status Report

on the

Black-footed Albatross
Phoebastria nigripes

in Canada

SPECIAL CONCERN
2007

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

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COSEWIC
Assessment Summary

Assessment Summary – April 2007

Common name
Black-footed Albatross

Scientific name
Phoebastria nigripes

Status
Special Concern

Reason for designation
This long-winged, long-lived (up to 40 years) seabird breeds on remote islands in the Hawaiian chain, but significant numbers feed off the coast of British Columbia each year, including adults making long foraging trips to feed their young. Black-footed Albatross numbers declined at one of two major colonies in the 1990s, but the population seems generally stable. Some population models have predicted serious declines, while others predict stable populations. Many are caught as bycatch in longline fisheries; most suffer from ingestion of plastic and accumulate high levels of pollutants. The long-term effects of these threats are unclear.

Occurrence
Pacific Ocean

Status history
Designated Special Concern in April 2007. Assessment based on a new status report.

COSEWIC
Executive Summary

Black-footed Albatross
Phoebastria nigripes

Species information

The Black-footed Albatross (*Phoebastria nigripes* Audubon 1839) is a relatively small member of the albatross family. Adult birds are completely dusky brown except for a whitish area around the base of the bill and under the eye, and white plumage over the base of the tail and undertail coverts; bill is dark and legs and feet are black. Juvenile birds have darker plumage than adults and lack white upper and undertail coverts. Sexes are similar although males are generally larger than females. Over the past decade, the use of genetic analyses has reawakened earlier controversy regarding classification of the Diomedeidae. Debate continues on the taxonomy of southern hemisphere albatross species but reclassification of the North Pacific albatrosses to the genus *Phoebastria* from their previous lumping with the southern genus *Diomedea* is well-supported, based on morphology and behaviour as well as on genetic data. Within *Phoebastria* the Black-footed Albatross is a well-established lineage as it diverged from its closest relative, the Laysan Albatross (*P. immutabilis*), about 7.9 million years ago. For present-day populations of Black-footed Albatross, analysis of mitochondrial DNA indicates significant genetic differentiation between birds breeding in Hawaii and Japan, suggesting that these two populations may be reproductively isolated despite considerable overlap in their at-sea distributions. There is little evidence to indicate the origin of birds visiting Canadian waters, although 13 birds caught as bycatch in a British Columbia-based longline fishery were all found to be of Hawaiian origin.

Distribution

Black-footed Albatross do not nest in Canada. The species currently breeds at 12 established sites worldwide and has recently begun to colonize or re-colonize at least four other localities. Breeding distribution is almost entirely restricted to the Northwestern Hawaiian Islands, where more than 95% of the global population breeds. The majority of the Hawaiian population nests at Midway Atoll and Laysan Island, but lesser colonies occur from Lehua in the main Hawaiian group to Kure Atoll at the western extreme of the Leeward Chain. Smaller colonies are also situated on islands off the coast of Japan. The species has also recently been recorded nesting at Guadalupe, San Benedicto and Clarión Islands in Mexico and has newly recolonized Wake Atoll in the central Pacific.

At sea, Black-footed Albatrosses range throughout the central North Pacific from the tropics to the Bering Sea, and from the west coast of North America to the coasts of China, Japan and the Sea of Okhotsk. This is the most common albatross in the eastern North Pacific but it is relatively scarce in the western sector. Adult birds are concentrated around the colonies during the egg-laying, incubation and chick brooding periods while during chick-rearing breeding adults range at least 4,500 km from the colony to forage in more productive waters towards the west coast of North America.

In Canada, the Black-footed Albatross is the only albatross species seen regularly off the Pacific coast. At-sea observations are recorded for every month of the year from waters off south-western Vancouver Island to Dixon Entrance off the north coast of the Queen Charlotte Islands/Haida Gwaii. The Black-footed Albatross is considered an offshore species but it is commonly seen over waters within a few nautical miles of the British Columbia coast from May to October; during summer an estimated 2,500 birds occur within Canadian waters. Recent data indicate that during the chick rearing stage breeding birds forage in the California Current as far north as British Columbia. Black-footed Albatross numbers peak in Canadian waters during the post-breeding dispersal in August and early September, particularly along the continental shelf break. In late September to October, numbers decline along the British Columbia coast when birds return to their breeding colonies in Hawaii or Japan.

Habitat

Black-footed Albatrosses typically nest on exposed sandy beaches or on the adjacent, sparsely vegetated fringes of low-lying coral and sand islands in the low-latitude Pacific. Breeding territory is confined to the nest site and its immediate vicinity, and is active only during mating and nesting periods. Approximately 35% of the global Black-footed Albatross population breeds at Midway Atoll, a US National Wildlife Refuge (NWR), while similar numbers of birds nest at Laysan Island in the Hawaiian Islands NWR. Most of the remaining US Black-footed Albatross colonies occur on other islands and atolls also within the Hawaiian Islands NWR and the state of Hawaii's seabird sanctuary system (Kure Atoll); thus the vast majority of the world's Black-footed Albatrosses nest at protected sites.

Marine habitat use by the Black-footed Albatross is constrained and influenced by life history stages. During the chick brooding stage, birds make restricted foraging trips over the warm, nutrient-poor oceanic waters in the vicinity of the colony. When chicks are old enough breeding albatrosses expand their foraging range to access the cold, productive coastal waters along the continental shelf of North America, from central California to British Columbia. With the onset of the post-breeding period, Black-footed Albatrosses disperse across the North Pacific, where they use a broad range of oceanic domains characteristic of tropical, sub-tropical, transition zone and sub-arctic waters. Over scales of 10 to 100 km, processes that aggregate prey, e.g., convergence or frontal zones, likely influence the distribution of the Black-footed Albatross. At-sea survey data from Canadian and US pelagic studies show that Black-footed Albatross are most abundant over the outer continental shelf, particularly at the shelf break. This species frequents boundaries between water masses and areas of strong and persistent upwelling. Seamounts may also be important oceanic features for Black-footed Albatrosses.

There is little protection in place for the marine habitat of the Black-footed Albatross, in part because birds use high seas waters outside of national jurisdictions. Throughout their known range, Black-footed Albatrosses also occur within the territorial waters of Canada, USA, Mexico, China, Guam, Japan, the Republic of Korea, the Marshall Islands, the Federated States of Micronesia, the Northern Mariana Islands, Russia, and Taiwan.

Biology

Black-footed Albatrosses have been studied extensively at their Hawaiian nesting colonies since the 1950s. Behaviour at sea is also relatively well-known as Black-footed Albatrosses have been included in numerous multi-species surveys and studies of seabirds and other marine predators in subsequent decades. Black-footed Albatrosses are monogamous, with a pair bond that remains intact until the death or disappearance of a mate. Adults usually breed at the age of seven or eight. Breeding birds return to the colony in late October and lay a single egg between mid-November and early December; hatching occurs between mid-January and early February. Chicks are fed a diet of flying fish eggs and stomach oil derived from squid. The nestling period lasts 140–150 d with chicks fledging in June or July. Adult and juvenile birds undergo moult at sea during the post-breeding dispersal.

Principal food items for Black-footed Albatrosses consist of flying fish eggs, fish, squid, scavenged offal, and deep-water crustaceans. Birds primarily feed by seizing food items from the surface of the water and scavenging represents an important mode of obtaining prey. Black-footed Albatrosses are well known ship-followers that are drawn to fishing vessels, and this behaviour makes them particularly vulnerable to drowning in longlining and driftnet fisheries, as well as to localized oil spills. Black-footed Albatrosses are long-lived birds, with an average lifespan of 12–40 years.

Population sizes and trends

The current global population of the Black-footed Albatross is estimated at approximately 300,000 individuals. In 2005, the total number of breeding pairs was estimated at 61,141 breeding at 12 colonies, with 21,006 and 21,829 pairs nesting at Laysan Island and Midway Atoll, respectively. The Japanese population consists of approximately 2,450 breeding pairs. The French Frigate Shoals colony, while only one quarter the size of the two largest colonies (Midway and Laysan) has the longest continuous time series of direct nest counts. The number of active nests there declined steadily from 1987 to 1996, following one of the lowest counts at this colony, but numbers steadily increased to reach pre-1985 values in 2005.

Population estimates at Midway and Laysan are by indirect methods prior to 1998 and are not directly comparable with later surveys. Both Laysan Island and Midway Atoll show a relative increase in breeding pairs in the early 1990s, a decline in the mid–late 1990s, and a subsequent increase to early 1990 counts since 2000. The long-term population trends for this species are unclear despite a published estimate of as much as a 60% decline in three generations. Current data suggest that the interannual variability in counts of active nests is extremely high in this species and thus an assessment of the status of the population would vary depending on what time period was examined. Some population projection model results have showed weak to dramatic declines while others show a relatively stable population. Inadequate demographic parameters, as well as information on fisheries effort and bycatch rates in domestic and international fisheries, are serious problems for all population projection models. In January 2006, a draft status assessment using all available data for Laysan and Black-footed Albatross was submitted to the US Fish and Wildlife Service (USFWS). After acceptance and release by the USFWS, it will provide the most comprehensive and up-to-date assessment of population trends for both Laysan and Black-footed albatrosses. There is no specific trends analysis available for Black-footed Albatross in Canadian waters.

Limiting factors and threats

Like most pelagic seabirds, Black-footed Albatross are a long-lived species with small clutch size and low fecundity, slow chick growth and lengthy parental care period, delayed age of first breeding, and high adult survival rates, and are thus highly vulnerable to adult mortality. Historically, the greatest threats to the Black-footed Albatross consisted of poaching by feather and egg hunters, with the loss of as many as 300,000 birds per year between the late 1800s and early 1900s. Other important historical threats included alteration of habitat through military occupation and the introduction of domestic rabbits and non-native vegetation, and population control of nesting birds during wartime preparations and subsequent military operations. Being caught as bycatch in longline and driftnet fisheries is the most significant threat to the Black-footed Albatross today. Other current or imminent threats include chronic and catastrophic oil spills; climate change and its interaction with natural climate cycles; heavy loads of chemical contaminants such as organochlorines and heavy metals; plastic ingestion; and invasive alien species including habitat-altering plants as well as vertebrate predators.

While the validity of the worst-case scenario of a 60% decline in three generations is still unclear since the most recent population assessment is not yet available, several facts make it clear that there is justifiable concern for this species: there is a high degree of interannual variability within the number of breeders returning to the colony each year even though long-term averages appear relatively stable; there are multiple documented threats that affect annual adult and chick survival; they are the third-most commonly reported seabird species caught as fisheries bycatch in the North Pacific (and the most commonly reported species in Canadian fisheries); and there is near-unanimous agreement among scientists in the US and Canada that there is a large amount of uncertainty surrounding estimates of mortality in foreign pelagic longline fisheries. Because of the multiple threats, the degree of uncertainty surrounding total mortality, and the high variability in the number of adults returning to breed each year, a precautionary approach is recommended. There is no doubt that sustained adult mortality from human activities can cause severe population declines in long-lived seabirds.

Special significance of the species

Sailors have traditionally viewed albatrosses as kindred spirits or the reincarnated souls of lost shipmates, and sailors today still feel an affinity for these birds that follow in the wake of their vessel. As the most common albatross in the eastern North Pacific, the Black-footed Albatross is of special significance to the mariners who transit these waters. Despite its offshore habits, the Black-footed Albatross was also known to coastal First Nations, as evidenced by the presence of a name for this species in the Haida lexicon.

The Black-footed Albatross is a top trophic level predator in the marine food web of the North Pacific Ocean. Although this is not a particularly abundant seabird in comparison to other top trophic level species, maintaining albatross populations at or returning them to historical levels is nonetheless part of maintaining a healthy and functioning marine ecosystem in the North Pacific Ocean.

Existing protection

The Black-footed Albatross is protected in Canada under the *Migratory Birds Convention Act, 1994* as well as under the *British Columbia Wildlife Act*. The species is listed as Threatened in Hawaii and in Mexico, and in 2004 the USFWS received a petition to list the Black-footed Albatross as a threatened or endangered species. This petition is now under review by the USFWS. In 2003, the World Conservation Union (IUCN) uplisted the Black-footed Albatross from Vulnerable to Endangered (EN A3bd) on the basis of a projected future population decline >60% over the next three generations (i.e., 56 years), based on the estimated rate of incidental mortality from demersal and pelagic North Pacific longline fisheries. The Black-footed Albatross is also listed under Appendix II of the Convention on Migratory Species, i.e., the Bonn Convention.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

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Phoebastria nigripes

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2007

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SPECIES INFORMATION

Name and classification

Scientific name:	*Phoebastria nigripes*, Audubon 1839
English name:	Black-footed Albatross
French name:	Albatros à pieds noirs
Aboriginal names:	Sk'aay (Haida; Harfenist *et al*. 2002)
Classification:	Class – Aves
	Order – Procellariiformes
	Family – Diomedeidae
	Genus – *Phoebastria*
	Species – *nigripes*

Classification follows the American Ornithologists' Union (AOU 2005). First described by Audubon in 1839 as *Diomedea nigripes*. Nunn *et al*. (1996) recommended re-instating *Phoebastria* and moving all four North Pacific albatrosses to this genus to resolve problems of paraphyly within the Diomedea. Official taxonomic status of the Black-footed Albatross was changed in 1997 (AOU 1998; Integrated Taxonomic Information System (ITIS) 2006; NatureServe 2006).

Vernacular names

Most vernacular synonyms for the Black-footed Albatross originated with mariners. These names are sometimes also used to refer to albatross species in general (Jameson 1961), and include gooney or gooney bird, alternatively spelled gony, goony and goonie (Mayr 1945; Yocum 1947; Alexander 1955; Hatler *et al*. 1978; American Heritage Dictionary 2004). Other common names in the US are Black Albatross, moli and, in Hawaii, ka'upu (US Fish and Wildlife Service (USFWS) 2005a; Hawaii Department of Land and Natural Resources 2005). In French, a secondary common name for the species is Albatros à pattes noires (Canadian Wildlife Service (CWS) 1991) and in Spanish the vernacular synonym is Albátros pata negra (ITIS 2006). In Japan the word for albatrosses in general is aho-dori, or fool birds; the Black-footed Albatross specifically is called Kuroashiahoudori (Oikonos 2005).

Morphological description

At 64-74 cm long and with a wingspan of 193-216 cm, the Black-footed Albatross is a relatively small member of the Diomedeidae (Figure 1; Whittow 1993). Reported mean body mass ranges from 2,800 to 4,975 g (Whittow 1993; Nunn and Stanley 1998; Sibley 2003, K. Morgan, pers. comm.). Adult birds are completely dusky brown except for a whitish area around the base of the bill and under the eye, and white plumage over the base of the tail and undertail coverts (Whittow 1993; Hyrenbach 2002). This white plumage increases in extent until around the age of first breeding (i.e., five to six years of age; Hyrenbach 2002). Bill colour varies from dark chestnut with blackish base to wholly glossy blackish grey (Harrison 1983). Legs and feet are black. Juvenile birds have darker plumage than adults and lack white upper and undertail coverts. Flight is steady on long, slender wings (Sibley 2003). At sea, the Black-footed Albatross may be confused with immature Short-tailed Albatross (*P. albatrus*) but the bill and feet of the latter are pink rather than dark, and overall size of Short-tailed Albatross is larger at 84-94 cm in length and with a wingspan from 213-229 cm (Harrison 1987). Black-footed Albatross sexes are similar although males are generally larger than females, and have a longer beak (Rice and Kenyon 1962a; Whittow 1993); according to Warham (1990), sexual dimorphism is such that males and females can be distinguished when mated pairs are standing together. Birds nesting in Japan are reportedly smaller than birds of Hawaiian origin (Walsh and Edwards 2005).

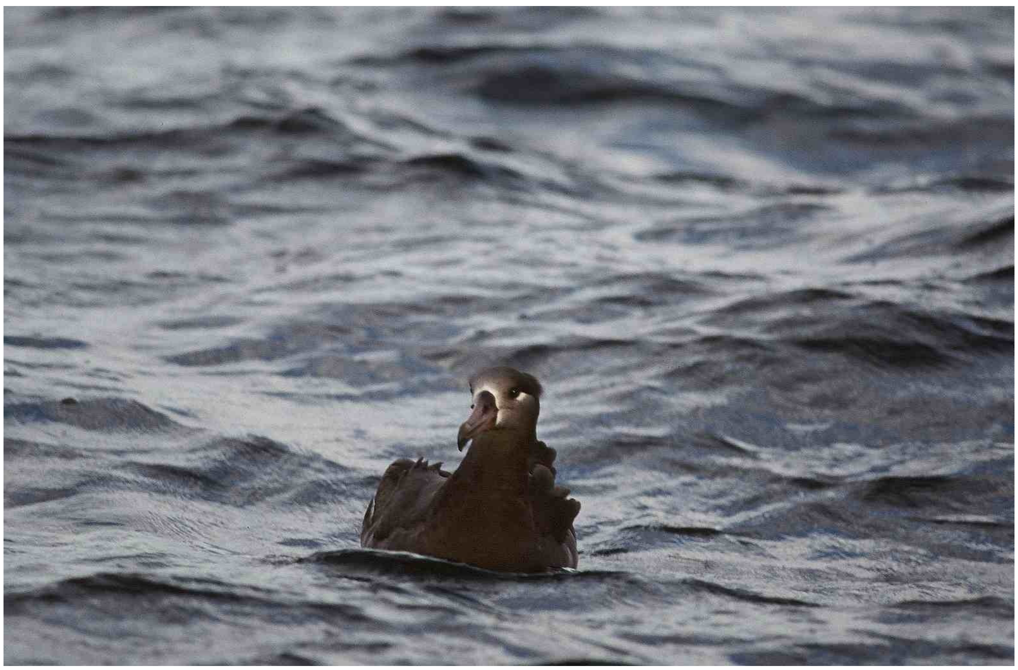

Figure 1. Black-footed Albatross *Phoebastria nigripes*. (Photo by L.K. Blight.)

Black-footed and Laysan (*P. immutabilis*) albatrosses occasionally interbreed. Hybrid offspring are pearly grey with a dark grey back, pale ventral surface and a dark bill (Fisher 1972; Whittow 1993).

Genetic description

Over the past decade, the availability and application of genetic analyses has reawakened earlier controversy (cf. Alexander *et al*. 1965) regarding classification of the Diomedeidae (Nunn *et al*. 1996; Nunn and Stanley 1998; Robertson and Nunn 1998; Penhallurick and Wink 2004). While the debate continues on the taxonomy of southern hemisphere albatross species (Nunn *et al*. 1996; Robertson and Nunn 1998; Penhallurick and Wink 2004), monophyly and reclassification of the North Pacific albatrosses (Genus *Phoebastria*) from their previous lumping with the southern genus

Diomedea is well-supported, based on morphology and behaviour as well as mitochondrial cytochrome-*b* gene sequencing (Nunn *et al*. 1998; Penhallurick and Wink 2004). The split between the genera *Diomedea* and *Phoebastria* occurred approximately 13.2 million years ago, based on amino acid distances, while within *Phoebastria* the Black-footed Albatross is a well-established lineage as it diverged from its closest relative, the Laysan Albatross, about 7.9 million years ago (Penhallurick and Wink 2004).

For present-day populations of Black-footed Albatross, analysis of mitochondrial DNA (cytochrome-*b* gene) indicates significant genetic differentiation ($\Phi_{ST} = 0.914$; $P<0.0001$ by 1000 permutations) between birds breeding in Hawaii and Japan, suggesting that these two populations may be reproductively isolated despite considerable overlap in their at-sea distributions (Walsh and Edwards 2005). No further studies exist to support this hypothesis, although genetic sequences of ticks living on Black-footed Albatross in Japan and Hawaii (Argasidae: *Carios capensis* (Neumann)) indicate the possibility of albatross-mediated gene flow between tick populations at these sites (Ushijima *et al*. 2003). There is little evidence to indicate the origin of birds visiting Canadian waters except for one study that examined 13 birds caught as bycatch in British Columbia-based Pacific longline fisheries (2002-2003) and found them to be all of Hawaiian origin (Walsh and Edwards 2005).

Designatable units

Not applicable.

DISTRIBUTION

Global range

Breeding range

Black-footed Albatross do not nest in Canada. The Black-footed Albatross currently nests at 12 established sites worldwide and has recently begun to colonize or re-colonize at least four other localities (see below, this section) (Figure 2; Alexander *et al*. 1997; Pitman and Ballance 2002; USFWS 2005a). The species' breeding distribution is almost entirely restricted to the Northwestern Hawaiian Islands (NWHI), where more than 95% of the global population breeds. The majority of the Hawaiian population nests at Midway Atoll and Laysan Island but lesser colonies occur from Lehua (near Niihau) in the main Hawaiian group to Kure Atoll at the western extreme of the Leeward Chain. Smaller colonies are also situated on islands off the coast of Japan, with colonies on the Muko Jima group in the northern Bonin Islands, Toroshima in the Izu Island group, and the Senkaku Islands in the southern Ryukyu archipelago (Rice and Kenyon 1962b; McDermond and Morgan 1993; Whittow 1993; Alexander *et al*. 1997; USFWS 2005a). The species has recently been recorded breeding at Guadalupe Island, Mexico and colonizing San Benedicto and Clarión Islands in the Revillagigedo

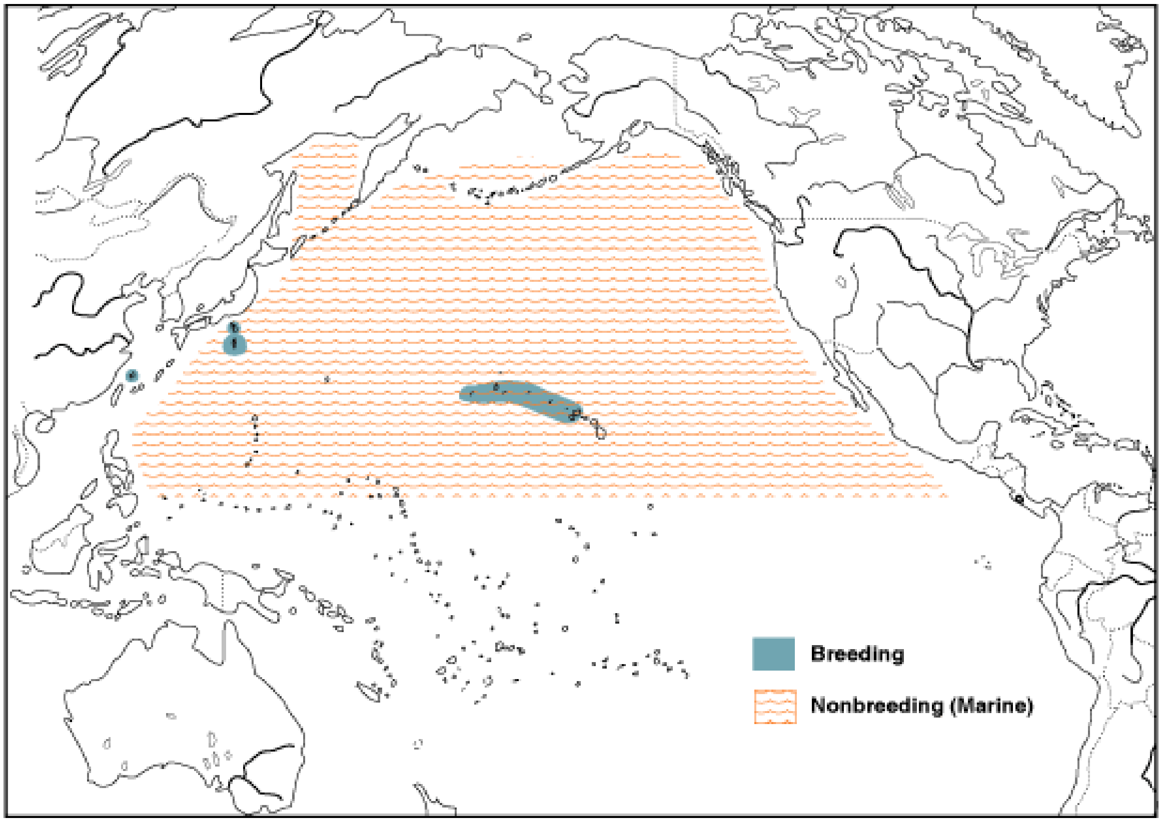

Figure 2. Global range of the Black-footed Albatross (from Whittow 1993).

group, 370 km south of Baja California (Pitman and Ballance 2002; Henry pers. comm. 2006; Tershy pers. comm. 2006), and within the last couple of years it has also expanded its breeding range to the Haha Jima group of the southern Bonin Islands (Hasegawa pers. comm. 2006). Historically, Black-footed Albatross nested at Johnston Atoll, Marcus Island, Marshall Islands, the Northern Marianas and Iwo Jima (Volcano Islands in the Bonin archipelago); these colonies were wiped out by feather hunters in the 19th century and by military occupation during World War II. The species has recently recolonized Wake Atoll in the central Pacific (Rice and Kenyon 1962b; Whittow 1993; USFWS 2005a).

Marine range

This widespread, trans-Pacific species ranges throughout the central North Pacific from the tropics to the Bering Sea, and from the west coast of North America to the coasts of China, Japan and the Sea of Okhotsk (15°N to 53°N and 112°W to 118°E; Gould and Piatt 1993; Whittow 1993; Shuntov 2000; Smith and Hyrenbach 2003). This is the most common albatross in the eastern sector of the North Pacific (Sanger 1974; McDermond and Morgan 1993; Springer *et al*. 1999) but it is "relatively scarce" in the western zone (McDermond and Morgan 1993), where the sympatric Laysan Albatross is more common (Gould and Piatt 1993; Springer *et al*. 1999; Figure 3). Cherel *et al*. (2002) have shown similar large-scale spatial segregation of foraging areas for southern hemisphere albatross species. The southern limits of the Black-footed Albatross' marine range coincides with the southerly sweep of the California Current near Baja California, and the North Equatorial Counter Current in the central North Pacific, with birds occasionally found as far south as 10°N (McDermond and Morgan 1993) or, rarely, in the Southern Hemisphere (BirdLife International 2004a).

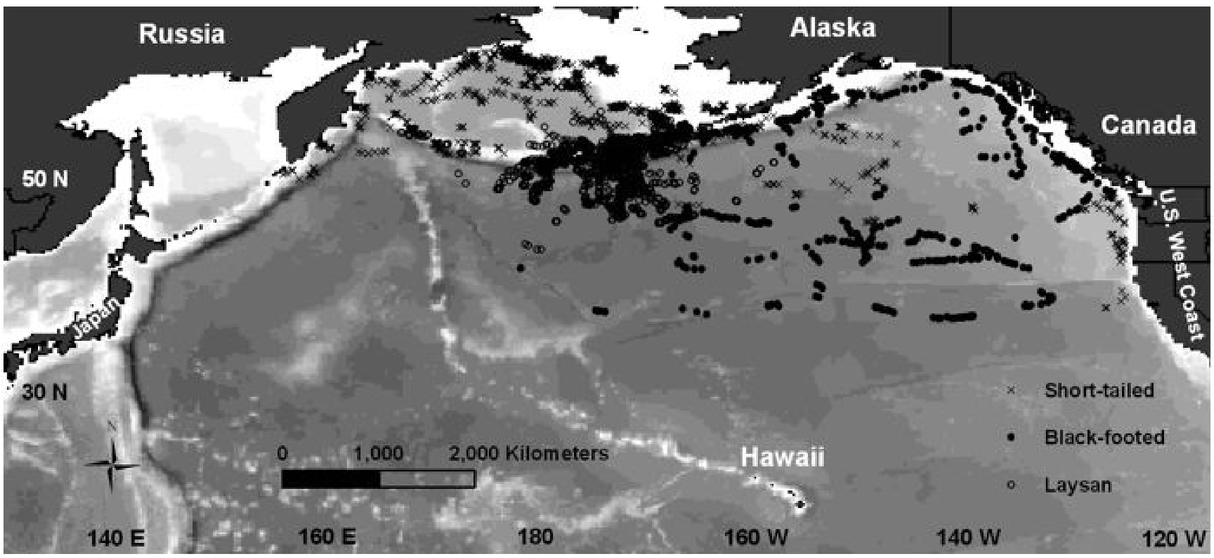

Figure 3. North Pacific Ocean, showing multiple fixes for three species of albatrosses (BFAL, n=10) tracked with satellite transmitters in summer 2005. Note that these birds were all captured near the Aleutian Islands rather than on their breeding colonies, which would bias the distribution of tracks shown. Map courtesy of R. Suryan and K. Fischer (unpubl. data), Oregon State University.

The marine range of the Black-footed Albatross is influenced by age and breeding status and enlarges and contracts with the breeding cycle. Adult birds are concentrated around the colonies during the egg-laying, incubation and chick brooding periods (November – February), while during chick rearing (March – July), breeding adults range at least 4,500 km from the colony to forage in more productive waters (McDermond and Morgan 1993; Cousins and Cooper 2000; Fernández *et al*. 2001; Hyrenbach *et al*. 2002). Post-breeding adults fly north or north-east across the Pacific Ocean, towards the west coast of North America, into the cool, productive waters of the transitional and sub-arctic zones (Robbins and Rice 1974; McDermond and Morgan 1993; Gould *et al*. 1998; Hyrenbach *et al*. 2002). All birds leave the colonies by the end of July, with breeders gradually returning to the vicinity of the Hawaiian Islands chain in October and November (McDermond and Morgan 1993). Most fledglings disperse west from the Hawaiian breeding colonies towards Japan and immature birds primarily spend summers and winters in the eastern North Pacific, likely using the same areas as adult birds. Non-breeders occur throughout sub-arctic waters in the North Pacific Ocean, from Japan to the west coast of North America (Brazil 1991; Whittow 1993; McDermond and Morgan 1993).

At smaller spatial scales, fishing vessel presence can influence albatross distribution. Wahl & Heineman (1979) suggested that commercial fishing operations in coastal Washington affected the distribution of the Black-footed Albatross on the continental shelf over an area of 100s of km^2, with birds significantly more abundant in their survey area on days when fishing vessels were present than when they were absent.

Canadian range

The Black-footed Albatross is the only albatross species seen regularly off Canada's Pacific coast (Campbell *et al*. 1990; Morgan 1997). At-sea observations are recorded for every month of the year from waters off south-western Vancouver Island to Dixon Entrance off the north coast of the Queen Charlotte Islands/Haida Gwaii; it is commonest from April through October (Figures 4 – 8; Campbell *et al*. 1999; Morgan *et al*. 1991; Morgan 1997). The Black-footed Albatross is considered an offshore species but it is "common" (Wahl *et al*. 1993) over waters within a few nautical miles of the British Columbia coast; during summer an estimated 2,500 birds occur within Canadian waters (Hunt *et al*. 2000).

In August 2005, 10 Black-footed Albatrosses were fitted with satellite tags at Seguam Pass, Alaska and three of these birds passed through Canadian waters between 19 August and 22 September (Figures 3, 9; Suryan pers. comm. 2005). In British Columbia, Black-footed Albatross numbers peak during the post-breeding dispersal in August and early September, particularly along the continental shelf break. In late September to October, numbers decline along the British Columbia coast when birds return to their breeding colonies in Hawaii or Japan (Morgan *et al*. 1991; McDermond and Morgan 1993; Morgan 1997; Gould *et al*. 1998). Black-footed Albatrosses encountered within the Canadian exclusive economic zone (EEZ) after this time (i.e., October to June) historically have been assumed to be non-breeders or failed breeders (McDermond and Morgan 1993), but more recent data (e.g., Hyrenbach *et al*. 2002) indicate that during the chick-rearing stage, i.e., from February to July, breeding birds forage in the California Current as far north as British Columbia.

Although Black-footed Albatrosses are commonly found within British Columbia's offshore waters in most months, sightings from shore are considered "unusual" from the Queen Charlotte Islands/Haida Gwaii (Johnston pers. comm. 2006) as well as the west coast of Vancouver Island (Hatler *et al*. 1978). Historically the species was also "rare" in the inshore, north coast waters (Kermode 1904; see also *Special Significance of the Species*, below). Canadian extralimital records include Nanaimo, BC (June 1900) and Satellite Channel near Victoria, BC (August 1957; Campbell *et al*. 1990).

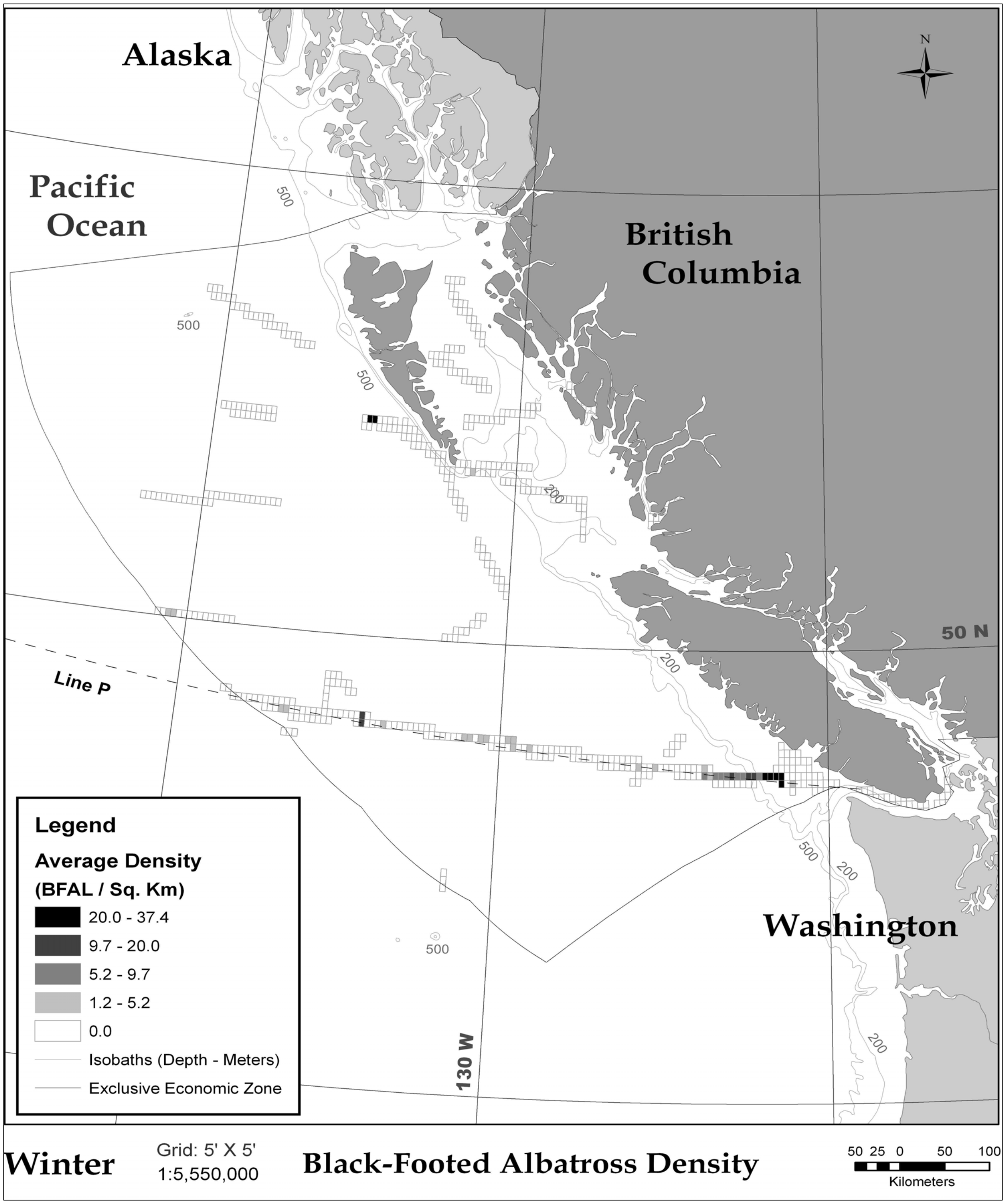

Figure 4. Black-footed Albatross density in Canadian waters, winter survey tracks (16 Dec – 15 Mar). Source: Environment Canada, Pacific and Yukon Region.

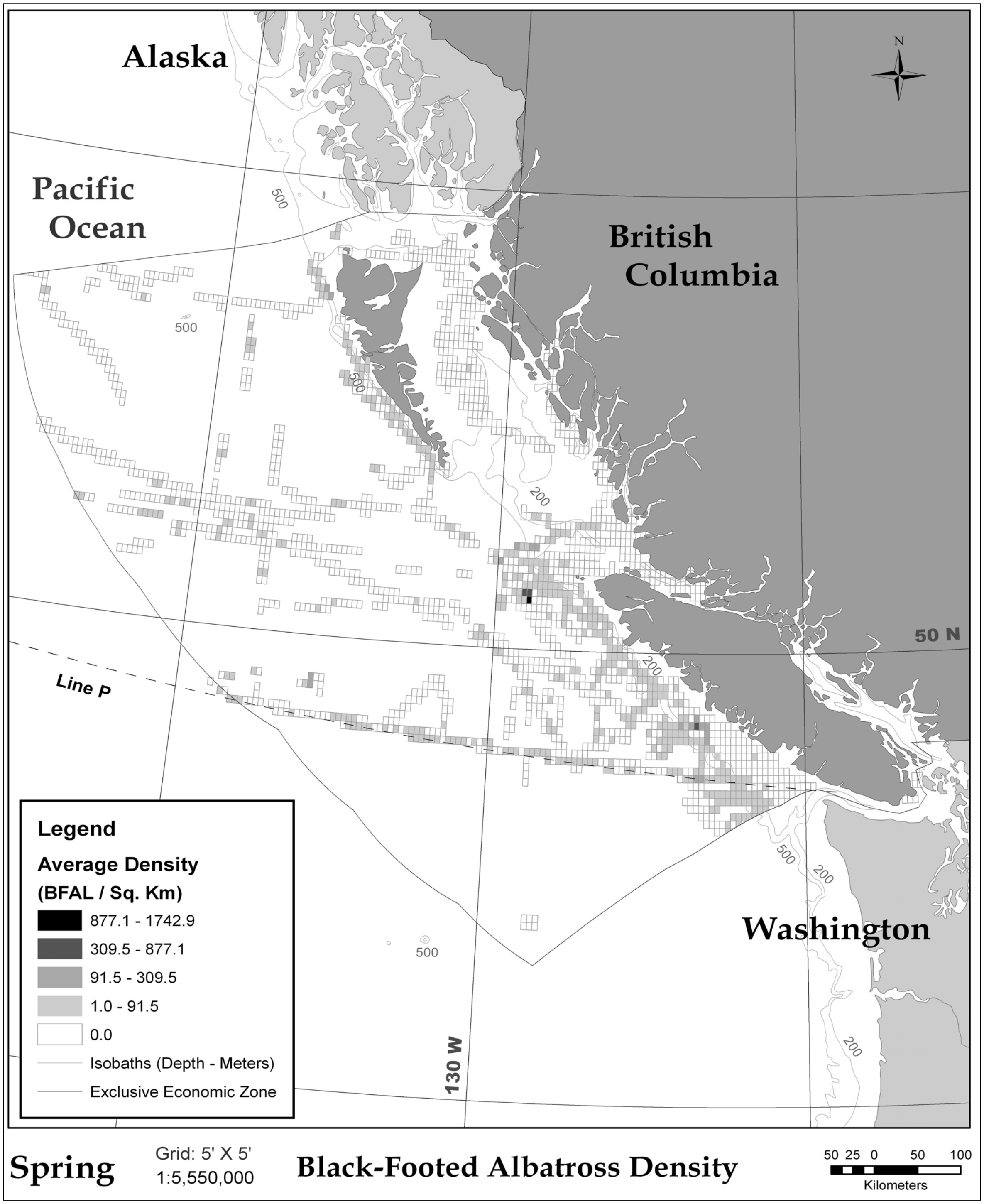

Figure 5. Black-footed Albatross density in Canadian waters, spring survey tracks (16 Mar – 15 Jun). Source: Environment Canada, Pacific and Yukon Region.

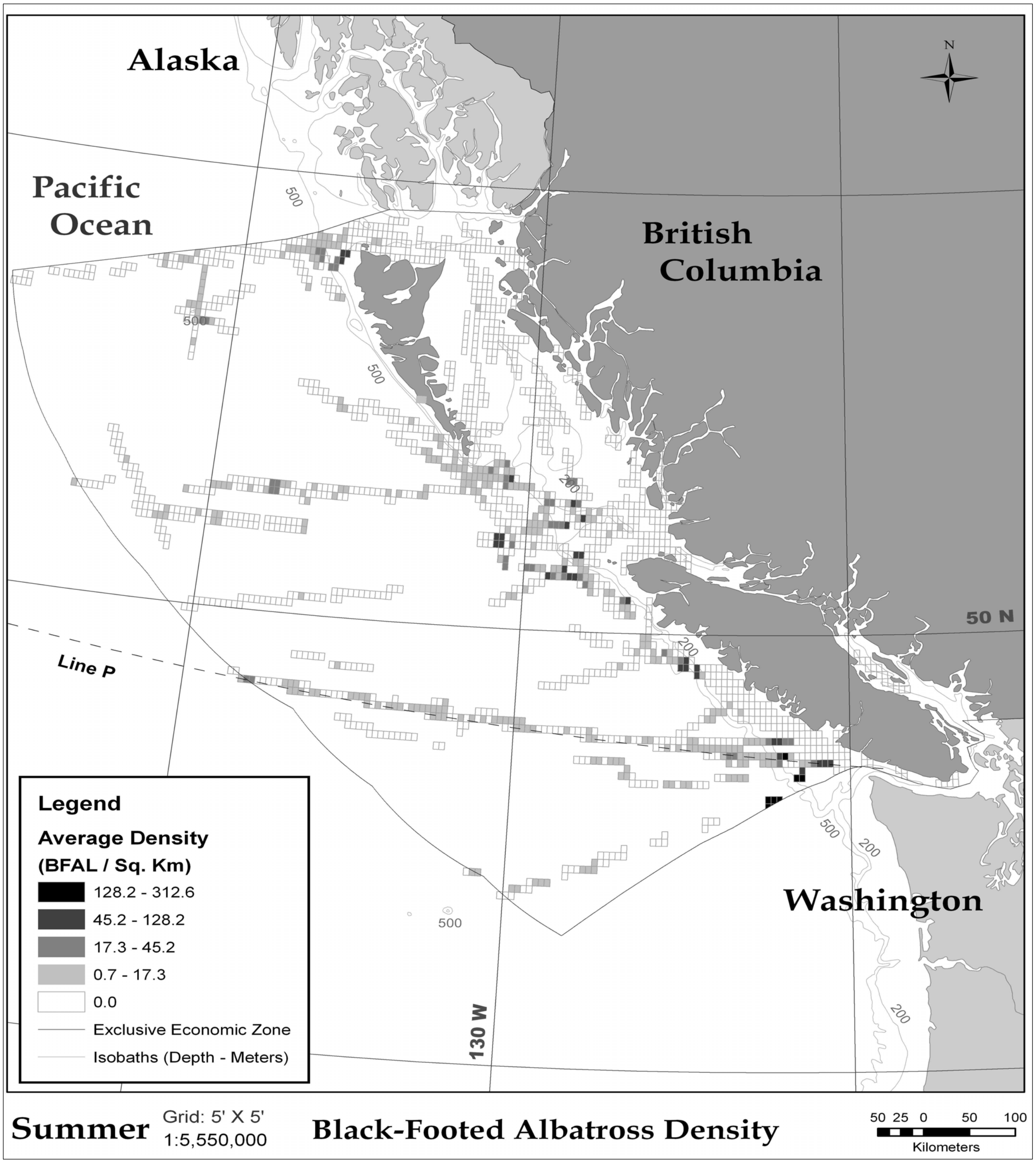

Figure 6. Black-footed Albatross density in Canadian waters, summer survey tracks (16 Jun – 15 Sep). Source: Environment Canada, Pacific and Yukon Region.

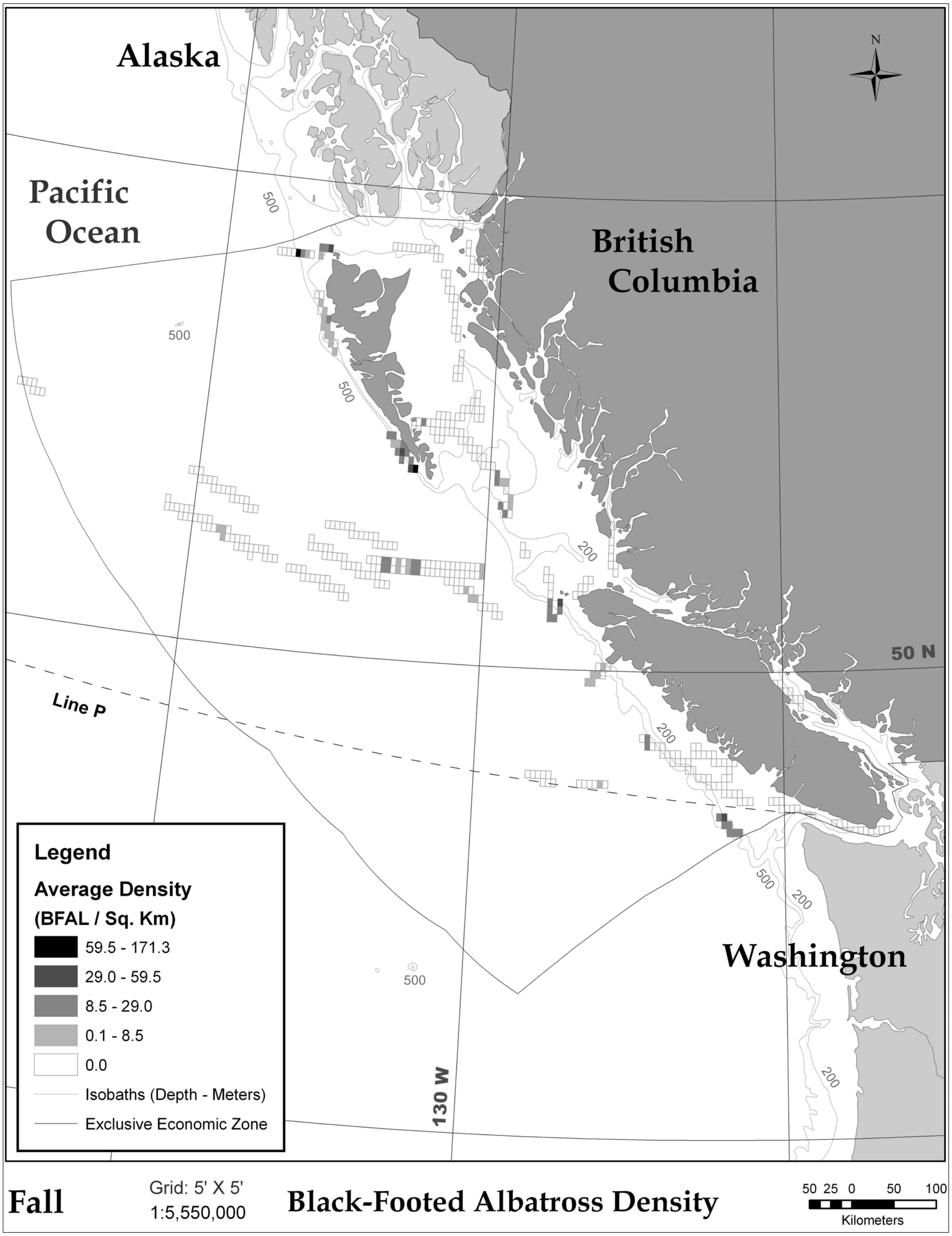

Figure 7. Black-footed Albatross density in Canadian waters, fall survey tracks (16 Sep – 15 Dec). Source: Environment Canada, Pacific and Yukon Region.

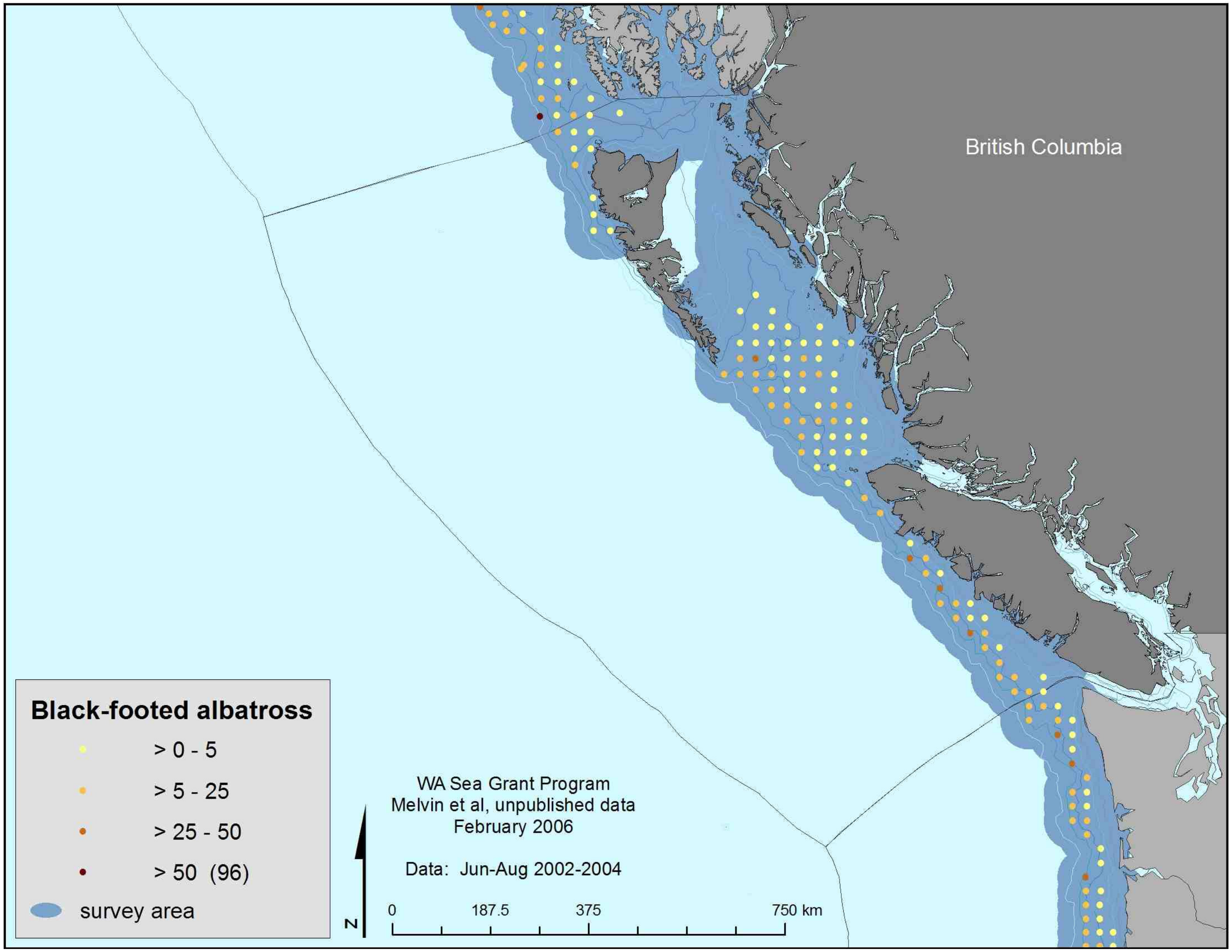

Figure 8. Black-footed Albatross density in Canadian waters within International Pacific Halibut Commission (IPHC) survey areas (surveys from June – August, 2002 – 2004). Source: Washington Sea Grant.

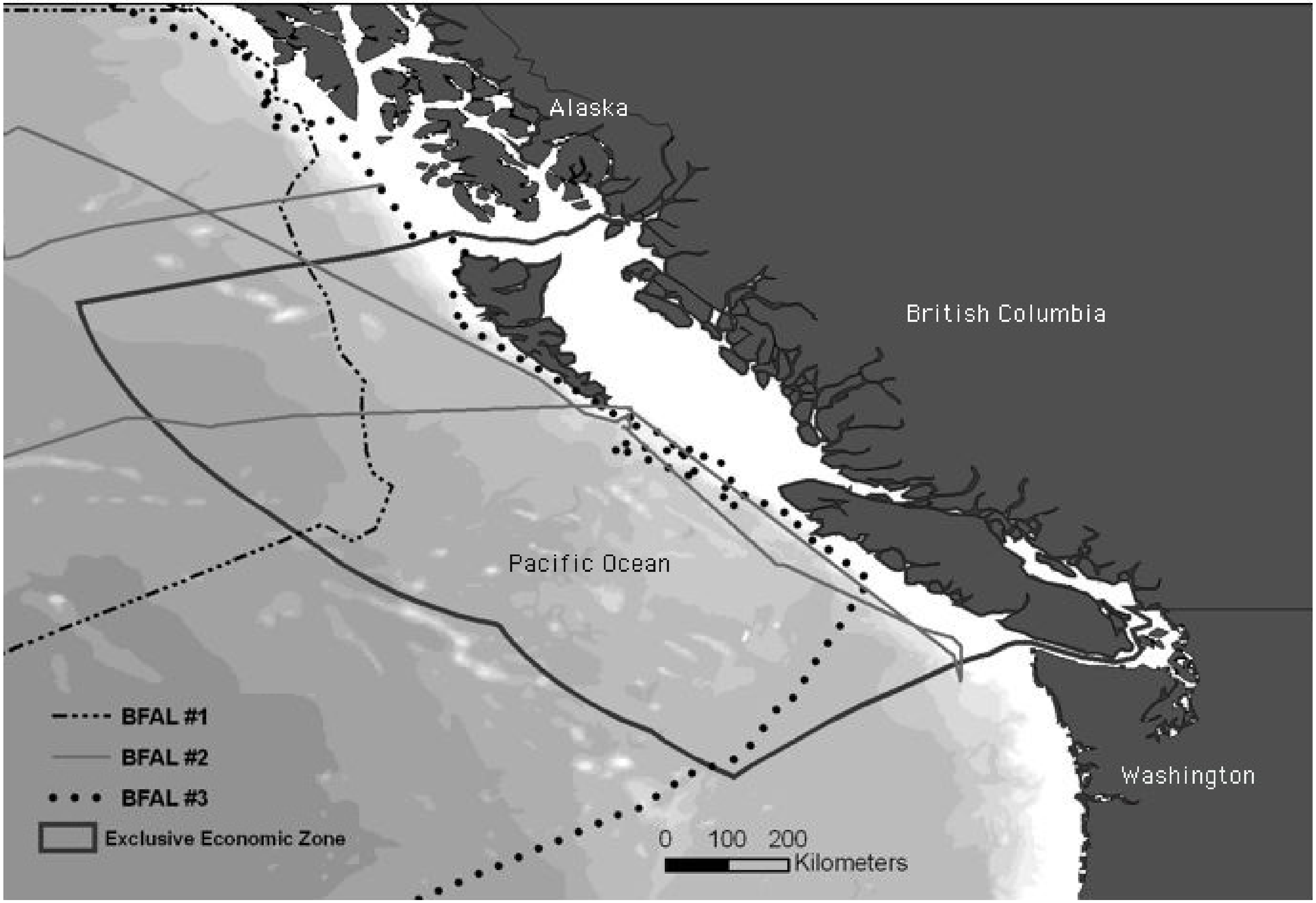

Figure 9. Presence within Canadian EEZ of three Black-footed Albatrosses tracked with satellite transmitters from August to early October 2005. Map courtesy of R. Suryan and K. Fischer, Oregon State University.

Where the shelf break (200 m contour interval) approaches the continent, birds can be seen relatively close to land. Black-footed Albatross occur in Dixon Entrance West and are “regularly encountered” (Morgan 1997) in Queen Charlotte Sound and Hecate Strait, primarily south of Juan Perez Sound in the vicinity of the shelf break (Harfenist *et al*. 2002). Nonetheless, this species is more common off the West Coast than in any nearshore or inshore waters (Morgan 1997; Harfenist *et al*. 2002).

HABITAT

Habitat requirements

Nesting habitat

Black-footed Albatrosses typically nest on exposed sandy beaches or on the adjacent, sparsely vegetated fringes of low-lying coral and sand islands in the low-latitude Pacific (Fisher 1972; Whittow 1993; Tickell 2000). Birds may also breed in altered habitat: for example, at Midway Island, Black-footed Albatrosses nest on the grassy borders of an aircraft runway, and in the open areas among introduced ironwood trees (*Casuarina equisetifolia*; Whittow 1993). In this species, a breeding territory is confined to the nest site and its immediate vicinity, and is active only during mating and nesting periods (Rice and Kenyon 1962a).

Marine habitat

Life history stage constrains and influences the marine habitats used by Black-footed Albatrosses. At Tern Island in the Central Pacific, birds brooding chicks made restricted foraging trips over the warm, pelagic, oligotrophic waters (>20°C sea surface temperature (SST); >3000 m depth; <0.3 mg/m^3 chlorophyll *a;* respectively) in the vicinity of the colony. After chicks reached 18 days old, breeding albatrosses expanded their foraging range to access the cold, coastal, productive coastal waters (<15°C SST, <200 m depth; >0.3 mg/m^3 chlorophyll *a*) along the continental shelf of North America, from central California to British Columbia (Fernández *et al*. 2001; Hyrenbach *et al*. 2002). With the onset of the post-breeding period, Black-footed Albatross dispersed across the North Pacific, where they used a broad range of oceanic domains (7.1° to 24.9°C SST) characteristic of tropical, sub-tropical, transition zone and sub-arctic waters (Wahl *et al*. 1989; McKinnell and Waddell 1993; Hyrenbach and Dotson 2001; Hyrenbach and Dotson 2003). Four female Black-footed Albatrosses tagged and tracked at sea during their post-breeding dispersal foraged largely along the transition zone between the California Current and the Central Pacific Gyre (Hyrenbach and Dotson 2003).

In general, albatross marine habitat use is mediated by wind patterns and food distribution (with the latter largely determined by bathymetric and hydrographic features; cf. Croxall *et al*. 2005). Different physical processes influence the marine distribution of seabirds at different scales (Hunt and Schneider 1987): over meso-scales of 10 to

100 km, processes that aggregate prey, e.g., convergence or frontal zones, likely influence the distribution of the Black-footed Albatross (Hyrenbach *et al*. 2002). At-sea survey data from Canadian and US pelagic studies show that Black-footed Albatrosses are most abundant over the outer continental shelf (in waters >100 m deep; Harfenist *et al*. 2002), particularly at the shelf break (Morgan *et al*. 1991; Whittow 1993; McDermond and Morgan 1993),. This species frequents boundaries between water masses and areas of strong and persistent upwelling (Wahl *et al*. 1989; McDermond and Morgan 1993; Whittow 1993; Hyrenbach and Dotson 2001). Telemetry-tracked birds travelled more slowly in the vicinity of the continental shelf and at hydrographic fronts, indicating that they were foraging in these areas (Hyrenbach *et al*. 2002). Seamounts may also be important oceanic features for albatrosses: two pelagic surveys found significantly higher densities of Black-footed Albatrosses over Cobb Seamount, BC than in waters beyond one seamount diameter away (K. Morgan, unpublished data). As well, the highest bycatch of Black-footed Albatross occurred at Bowie Seamount, indicating unusual densities at this location (Smith and Morgan 2005).

Habitat trends

Ironwood was introduced to Midway Atoll in the early 1900s, leading to ongoing loss of open nesting habitat through conversion to forested areas. In 1940 US preparations for WW II began and these resulted in substantial physical alteration to Midway and other islands in the Northwestern Hawaiian chain (McDermond and Morgan 1993; USFWS 2005a). More recently, introduced golden crown-beard (*Verbesina encelioides*) has significantly degraded breeding habitat at Midway, Pearl and Hermes and Kure Atolls, with areas of thick infestation uninhabitable by nesting birds (Shluker 2002). Active control programs now manage non-native plant species at albatross colonies but these are costly and much work remains to be done (USFWS 2005a). Midway Atoll National Wildlife Refuge (NWR) was established in 1988 as an overlay refuge of the Naval Air Station. In 1997, the Naval Air Station at Midway Atoll was decommissioned and operation of the atoll was transferred from the US Department of Defense to the Department of the Interior (i.e., the US Fish & Wildlife Service) for management as an NWR. Although the airstrip at Midway is still operational, airfield operations are now conducted to minimize and document albatross mortality via air strikes, and many obstacles such as overhead wires and traffic signs have been removed, reducing risk of bird collision (Cousins and Cooper 2000; USFWS 2005c). Military operations at Midway created as well as destroyed nesting habitat, e.g., dredged fill material substantially increased the area of Sand Island (Cousins and Cooper 2000).

Volcanic activity may lead to future habitat alteration or loss at some of the minor colonies, e.g., San Benedicto Island, Mexico (Pitman and Ballance 2002) and at Torishima Island, Japan (Whittow 1993; USFWS 2005c); an eruption at Torishima in 1939 reduced the population breeding there to just a few birds (Cousins and Cooper 2000). Longer-term habitat loss can be predicted to occur at low-lying atolls – some of which are a maximum elevation of only three or four metres above sea level (Herbst and Wagner 1992) – as a result of climate change and an associated rise in sea level (Baker *et al*. 2006). Climate change and related perturbations in marine ecosystems (e.g., intensification of El Niño events), in conjunction with natural longer-term cycles such as the Pacific Decadal Oscillation (PDO), are also affecting marine habitat through altering distribution, abundance and quality of prey (Robinson *et al*. 2005; USFWS 2005a). For example, a warm PDO regime since 1976 has resulted in prey declines and increased SST in the California Current system, a body of water that extends to the northern end of Vancouver Island. These factors have in turn been implicated in a 90% decline of Sooty Shearwaters (*Puffinus griseus*) in the region, and the number of Black-footed Albatrosses in the California Current also declined over the past 20 years. Sooty Shearwaters may have simply redistributed themselves in the Pacific basin by moving to the central North Pacific transition zone, where waters have been cooling and increasing in productivity (Ainley and Divoky 2001; Bertram *et al*. 2005; Robinson *et al*. 2005). It is not known whether the same pattern holds true for Black-footed Albatross, but a recent rapid increase in California Current Black-footed Albatross numbers in response to PDO-related SST cooling indicates that this may be the case (Ainley pers. comm. 2006). Sea surface temperatures off northern Mexico are now similar to those around the Hawaiian archipelago, and this change in SST may be involved in the establishment of new albatross colonies on Mexican offshore islands (Ainley and Divoky 2001).

Habitat protection/ownership

Approximately 35% of the global Black-footed Albatross population breeds at Midway Atoll, a US National Wildlife Refuge, while similar numbers of birds nest at Laysan Island in the Hawaiian Islands NWR. Most of the remaining US Black-footed Albatross colonies occur on other islands and atolls also within the Hawaiian Islands NWR or on Hawaii state seabird sanctuaries (Kure Atoll; Anon. 2004, USFWS 2005a,b). Over 95% of the total population breeds in the Hawaiian archipelago, and thus the vast majority of the world’s Black-footed Albatrosses nest at protected sites. Except for field stations on Tern and Laysan Islands, and USFWS workers at Midway Atoll, the Hawaiian Islands NWR is uninhabited by humans. Entry to the refuge is by USFWS Special Use Permit only and even scientific research is limited and reviewed in order to minimize unnecessary disturbance (USFWS 2005b).

San Benedicto and Guadalupe Islands fall under the jurisdiction of Mexico; the former is not protected, but is uninhabited and free of introduced predators. Military personnel are stationed at Guadalupe Island year round (Pitman and Ballance 2002). A Biosphere Preserve was proposed for Guadalupe in 2003 (Aguirre Muñoz *et al*. 2003), and was declared in April 2005 (Comisión Nacional de Áreas Naturales Protegidas, no date; Tershy pers. comm. 2006). Torishima Island is a Japanese National Monument, i.e., is under the ownership of the Japanese government, and is managed for wildlife conservation. Japan’s jurisdiction over the Senkaku Islands is in dispute, and the archipelago may be subject to future oil development (USFWS 2005c).

There is little protection in place for the marine habitat of the Black-footed Albatross, in part because birds use high seas waters outside of national jurisdictions. In Canada, Parks Canada Agency has proposed the Gwaii Haanas National Marine

Conservation Area (NMCA) for the waters around Gwaii Haanas National Park Reserve (Queen Charlotte Islands/Haida Gwaii). However, this proposal is in the consultation stage and although species at risk are already managed by Parks Canada within the proposed NMCA, the timelines for the establishment of this protected area are unknown (Shepherd pers. comm. 2005; Achuff pers. comm. 2006). In addition, Environment Canada is working towards the establishment of a Marine Wildlife Area (MWA) around the Scott Islands. If the boundary of the proposed study area becomes the boundary for the MWA, approximately 25,800 km^2 of marine habitat would be under some level of protection (Dunn pers. comm 2006). In 1991 a 50 nautical mile Protected Species Zone was established around the Northwestern Hawaiian Islands, largely to protect endangered Hawaiian monk seals (*Monachus schauinslandi*; BirdLife International 2004a). Three US National Marine Sanctuaries created in the California Current System off coastal California (Gulf of the Farallones, Cordell Bank, Monterey Bay; Ford *et al*. 2004) appear to encompass foraging areas important for Black-footed Albatross during the breeding season (Hyrenbach *et al*. 2006). In the eastern North Pacific Ocean Black-footed Albatrosses pass through the EEZs of Mexico, the USA and Canada (Figure 3). Hyrenbach and Dotson (2003) used satellite transmitters to track four female Black-footed Albatrosses off the coast of California during their post-breeding dispersal and found that these birds spent 25%, 24% and 51% of their time in the EEZs of the USA and Mexico and in international waters, respectively. Throughout their known range, Black-footed Albatrosses also occur within the territorial waters of China, Guam, Japan, the Republic of Korea, the Marshall Islands, the Federated States of Micronesia, New Zealand (as a vagrant), the Northern Mariana Islands, Russia, and Taiwan (BirdLife International 2004b).

BIOLOGY

Black-footed Albatrosses have been studied extensively at their nesting colonies in the Hawaiian archipelago since the first comprehensive population surveys took place in the 1950s, although intermittent censuses took place at certain colonies as early as the first decade of the 20th century (Rice and Kenyon 1962a,b) and banding efforts occurred from the 1940s (Yocum 1964; Cousins and Cooper 2000). Behaviour at sea is also relatively well-known as Black-footed Albatrosses have been included in numerous multi-species surveys and studies of seabirds and other marine predators in subsequent decades (e.g., Ainley *et al*. 1995; Hunt *et al*. 2000; Burger 2003). The species has also been the subject of a number of more recent projects using satellite telemetry and other remote monitoring technologies to determine marine habitat use (e.g., Fernández and Anderson 2000; Fernández *et al*. 2001; Hyrenbach and Dotson 2001; Hyrenbach *et al*. 2002; Shaffer *et al*. 2005; Suryan pers. comm. 2005). The Black-footed Albatross was the focus of several recent demographic modelling exercises to determine population status and trends in the context of fisheries-related mortality (Cousins and Cooper 2000, Lewison and Crowder 2003; Wiese and Smith 2003, Niel and Lebreton 2005; and cf. Tuck *et al*. 2001; Mills and Ryan 2005). Most information on the Black-footed Albatross is from studies conducted on birds from the Hawaiian Islands population or on birds tagged or observed at sea; the latter most likely come from the Hawaiian population.

Life cycle and reproduction

Adults usually breed at the age of seven or eight, with some birds breeding as early as five or six years of age. A very small number return to colonies at two to three years of age but individuals have not been observed on the colony at all during the first two years of life. Most (63%) breeding birds nest two years in a row but less than half do so for three consecutive years (Whittow 1993; USFWS 2005a). The nest is constructed by both adults and consists of a shallow hollow scraped in loose sand, often augmented with vegetation. Black-footed Albatrosses are monogamous, with a pair bond that remains intact until the death or disappearance of a mate. Breeding birds return to the colony in late October and lay a single egg between mid-November and early December. If an egg is lost, relaying does not occur that year (Whittow 1993; USFWS 2000). Like other Procellariiformes, incubation is prolonged, a life history feature related to the slow growth of the embryo (Warham 1990). Both sexes incubate the egg for approximately 66 days until hatching occurs between mid-January and early February. The chick is brooded or attended continuously for about 19 days, guarded intermittently for another 10 days and then visited only for provisioning (Whittow 1993).

During the brood stage (>18 days) adults begin extended foraging trips of up to 28 days in length, ranging over thousands of ocean kilometres, from Hawaii to the west coast of North America, and engaging in area-restricted food searching behaviours (Fernández *et al*. 2001; Hyrenbach *et al*. 2002). Chicks are fed a diet of flying fish (Exocoetidae) eggs and stomach oil derived from squid (USFWS 2000), reaching an asymptotic mass of about 3,600 g (Sievert and Sileo 1993). The nestling period lasts 140–150 d and in June, adults leave the colony and chicks fledge without assistance in June or July (Whittow 1993; USFWS 2005a). Although Black-footed Albatrosses are highly philopatric (USFWS 2005a), young birds do not return to their exact natal nest site to breed. Some individuals may later nest on nearby islands (Rice and Kenyon 1962a; Whittow 1993). Established breeders generally nest within four to six metres of a former nest site, but some individuals have been recovered on islands >1000 km away from their original colony (Whittow 1993). Historically, Black-footed Albatross colonies were more widespread than they are today (Rice and Kenyon 1962b; USFWS 2005a), so the current availability of nesting habitat is presumably not a limiting factor for these populations.

Although hybrids of Black-footed and Laysan albatrosses occur (Whittow 1993), “the amount of interbreeding is almost negligible” (Fisher 1972).

Physiology, foraging and nutrition

Both breeding and feather moult are energetically demanding, and like most bird species, Black-footed Albatross do not moult and breed at the same time (Tickell 2000). Instead adult and juvenile birds undergo moult at sea during the post-breeding dispersal, replacing 20–90% of their feathers each year (Langston and Rohwer 1995, Edwards and Rohwer 2005). At the same time, Black-footed Albatrosses also gain fat deposits in preparation for the upcoming breeding season (Fring and Fring 1961): foraging success and prey availability clearly have the ability to affect an individual bird's physiological readiness to breed in the upcoming season, and successful breeders are more likely to skip nesting in the subsequent year than are failed breeders (Langston and Rohwer 1995).

Total energy expenditure over the breeding season (250 d) for the colony of Black-footed Albatross at French Frigate Shoals was calculated to be 8.019×10^6 kj, and birds consumed an estimated total of 929 tonnes of food to meet this energy requirement. Hunt *et al*. 2000 estimated that as much as 16,730 tonnes of prey were consumed by Black-footed Albatrosses each summer within the Western and Eastern Tropical zones of the North Pacific.

Principal food items for Black-footed Albatrosses breeding in Hawaii consist of squid and flying fish eggs, followed by fish and deep-water crustaceans such as large mysids and isopods (Harrison *et al*. 1983; Whittow 1993; USFWS 2005a). Black-footed Albatrosses feed at one-third to one full trophic level higher than Laysan Albatross (Gould *et al*. 1997, J. Bisson, unpubl. data, 2005). This, along with a combination of ship-following behaviour, daytime foraging, and the presence of offal (fishing vessel discards as well as naturally occurring dead squid, fish, marine mammals and birds) in the diet indicate that scavenging represents an important mode of obtaining prey (Gould *et al*. 1997, 1998; Fernández and Anderson 2000; Harfenist *et al*. 2002). Birds primarily feed by seizing food items from the surface of the water; in one study, Black-footed Albatross fitted with immersion loggers spent an average of 90.8% of their time at sea flying. Most foraging, as indicated by immersion events, took place during the day (Fernández and Anderson 2000, Hyrenbach *et al*. 2002). Black-footed Albatross have low levels of rhodopsin in their eyes (4 density units/g, as opposed to 20 density units/g for Barn Owls *Tyto alba*) and it is assumed that their night vision is relatively poor (Fernández and Anderson 2000).

Behaviour

Black-footed Albatrosses are scavengers, feeding at the surface, and are well known ship-followers (summarized in Hyrenbach 2001) that are drawn to fishing vessels, where they scavenge for discarded fish, squid and offal. This behaviour makes them particularly vulnerable to drowning in demersal and pelagic longlining, and in high seas driftnet fisheries (see *Limiting Factors and Threats*, below).

Black-footed Albatrosses form small to large flocks at sea. Wahl and Heinemann (1979) recorded a maximum flock size of 250 birds foraging at a factory trawler. Morgan *et al*. (1991) reported that in spring, most observations of Black-footed Albatrosses were of single birds or of small flocks typically numbering less than 10 birds. During the summer months (July–August), the species was more gregarious, with flocks of 20 to 40 birds commonly seen and a maximum group size of 180 birds observed rafting on the water (Morgan *et al*. 1991).

Attraction to vessels as well as rafting behaviour could also make the Black-footed Albatross especially vulnerable to mortality from chronic or catastrophic oil spills, as has been suggested for rafting flocks of Pink-footed Shearwater (*Puffinus creatopus*; COSEWIC 2004).

Survival and recruitment

Black-footed Albatross are long-lived birds, with an average lifespan of 12–40 years (USFWS 2000). The oldest known Black-footed Albatross was at least 43 years in 2004 (USFWS 2005a), although the species undoubtedly attains a greater age: the age record for the sympatric and closely related Laysan Albatross is at least 51 years, and that bird was brooding a healthy chick at the time of band reading (Walker 2003; Robbins pers. comm. 2005). For the purposes of assessing species' status, generation time has been estimated from 18.67 (BirdLife International 2004a,b) to 20 years (Lewison and Crowder 2003; NatureServe 2006). Niel and Lebreton (2005) modelled the mean generation time for this species, under optimal conditions, as 17.09 years.

As a *K*-selected species (see *Limiting Factors and Threats*, below), the stability of the Black-footed Albatross population is highly vulnerable to factors that affect adult survivorship. There are no published estimates for adult survival in Black-footed Albatross but it is estimated at mean=0.923, ranging 0.81–0.994, based on data collected in the 1960s (Cousins and Cooper 2000, p. 49). Even under ideal conditions on the colony and at sea, it is estimated that the total Black-footed Albatross population cannot grow at a rate greater than 5.9% per annum so any additional source of mortality in excess of that amount (ca. 8,900 individuals/year, based on recent estimates of population size) will result in a population decline (Niel and Lebreton 2005). Cousins and Cooper (2000) estimated a similar maximum mortality threshold of 10,000 birds per year, including mortality from natural sources and without incorporating indirect mortality effects such as widowing and lower net reproduction.

Predation

In Hawaiian waters, tiger sharks (*Galeocerdo cuvier*) depredate juvenile Laysan and Black-footed albatrosses when they fledge from their natal colonies. These sharks take an estimated 10% of albatross fledglings each year (Wake Forest University 1999). Introduced rats (*Rattus* spp.) killed nestlings at Kure and Midway Atolls in the past but these rodents have now been eradicated. Polynesian rats (*R. exulans*) on Kure Atoll killed both adult and juvenile Laysan Albatross but they have only been documented as predators of Black-footed Albatross nestlings (Kepler 1967; Moors and Atkinson 1985; Whittow 1993). On Torishima (Izu Islands, Japan), Steller's Sea Eagles (*Haliaeetus pelagicus*) are occasionally seen taking Black-footed Albatross chicks (USFWS 2005c), and rats are present on the island.

Dispersal/migration

Adult Black-footed Albatrosses are concentrated around their colonies during the egg-laying, incubation and chick guard periods (November – February; Whittow 1993; Cousins and Cooper 2000). Non-breeders and failed breeders start to leave the nesting grounds in April, and between June and September the remaining adult birds disperse northeast across the Pacific Ocean into transitional and sub-arctic waters that are cooler and more productive than those adjacent to the colony. Fledglings disperse primarily west of 180 degrees, and subsequent summers and winters are spent mostly in the eastern temperate north Pacific (Robbins and Rice 1974; Whittow 1993; Gould *et al*. 1998; Hyrenbach *et al*. 2002). See also sections on *Distribution* and *Habitat Requirements – Marine habitat*, above.

Diseases and parasites

Avian pox (Avipoxvirus) has been found in Laysan Albatross chicks at Midway Atoll and it also occurs, albeit rarely, in Black-footed Albatross nestlings. In Laysan Albatross chicks the disease generally appears to be self-limiting, i.e., most chicks eventually recover if they continue to be fed (Fefer pers. comm. 2006; Sileo pers. comm. 2006). Mortality of Black-footed Albatross chicks has been documented from nocardiosis (infection with the soil bacterium *Nocardia asteroids*) and from chigger infestation (Whittow 1993): three species of chigger and one species of tick have been reported from Black-footed Albatross nests (Whittow 1993; Ushijima *et al*. 2003). Of the six species of chewing lice (Pthiraptera) recorded on Black-footed Albatross, three occur on no other host species.

POPULATION SIZES AND TRENDS

Search effort

The U.S. Fish and Wildlife Service generates estimates of the annual breeding population for Black-footed Albatross by using standardized techniques that include direct counts of active nests and estimates from chick production. The total world population of breeders does not include breeders that did not lay an egg, did not return to breed, or birds not yet of breeding age (USFWS unpubl. data 2005). A band-reading project underway at Tern Island, French Frigate Shoals since 1979 will be used to calculate the segment of the population not previously included in breeding bird counts (Flint pers. comm. 2005).

Since 1980, direct counts of active nests have been done at French Frigate Shoals and they have been done at Midway Atoll since the 1991/1992 breeding season (hatch year (HY) 1992). Estimates have been conducted at Laysan Island since 1992, but direct counts only began there in 1997/1998 (Naughton pers. comm. 2006).

In the years immediately following World War II, biologists working in the Hawaiian archipelago, and particularly on Midway Atoll, generated early population estimates for Black-Footed Albatross colonies (e.g., Fisher and Baldwin 1946; Rice and Kenyon 1962b; Robbins pers. comm. 2006). Methods used for these counts varied.

Abundance

The current global population size for Black-footed Albatross is estimated at 278,000 (BirdLife 2004a,b) to 300,000 individuals (Cousins and Cooper 2000). Over 95% of breeding birds nest in the Hawaiian Islands chain (Cousins and Cooper 2000; USFWS 2005a; Table 1) and the majority of Black-footed Albatrosses nest on two islands, Laysan Island and Midway Atoll.

In 2000, an estimated 62,000 pairs were breeding at 12 colonies (Cousins and Cooper 2000). In 2005, the total number was estimated at 61,141 pairs, with 21,006 and 21,829 pairs nesting at Laysan Island and Midway Atoll, respectively. The Japanese population consists of approximately 2,450 breeding pairs (Table 1).

Table 1. Best estimates of the number of breeding pairs of the Black-footed Albatross at all breeding sites to 2005/06 (USFWS unpubl. data; Tershy pers. comm. 2006 for Revillagigedo Is.; Hasegawa pers. comm. 2006 for Japanese populations). See text for details.

Breeding site	Number of pairs	Last census year
HAWAII		
Kure Atoll	2,020*	2000
Midway Atoll	21,829	2004
Pearl & Hermes Reef	6,116*	2003
Lisianski Island	3,737*	2002
Laysan Island	21,006	2004
French Frigate Shoals	4,259	2004
Necker Island	112*	1995
Nihoa Island	31	1994
Kauai	0	2004
Lehua Island	10*	2002
Niihau	?	
Kaula	0	1998
Oahu	0	2002
JAPAN		
Izu Island (Torishima)	1,900**	2005
Senkaku Islands	100¶	2002
Bonin Islands	450¶	2005
MEXICO		
Guadalupe Island	0	2003
Revillagigedo Islands	0	2002
TOTAL	61,570	

*Estimate is hindcast to total number of eggs based on the number of chicks later in the season, assuming 75% reproductive success (Flint pers. comm. 2005).

**As above, but assuming 65% reproductive success (Hasegawa pers. comm. 2006).

¶Estimate based on nest and chick counts (Hasegawa pers. comm. 2006).

In Mexico, a single nest was recorded on Guadalupe Island in 1998 and another on San Benedicto Island (Revillagigedo Group) in 2000 (Pitman and Ballance 2002). During the most recent survey (2002) of the Revillagigedos, no breeding Black-footed Albatross were recorded at San Benedicto but a prospecting bird was observed at Clarión Island. As pigs and sheep have recently been eradicated from the latter, Black-footed Albatross may now be breeding there (Tershy pers. comm. 2006). In January 2006 field crews recorded a pair of Black-footed Albatrosses exhibiting breeding behaviour at Guadalupe (Henry pers. comm. 2006). It is believed that these Mexican birds represent a new colonization event rather than re-colonization of an extirpated colony. In Japan, the small breeding population has increased in number and expanded in extent over the past 20–50 years (Hasegawa pers. comm. 2006).

Fluctuations and trends

The French Frigate Shoals colony, while only one quarter the size of the two largest colonies (Midway and Laysan) has the longest continuous time series of direct nest counts and is thus extraordinarily valuable when assessing long-term changes in this species with respect to concomitant anthropogenic factors, oceanographic conditions and changes in prey populations. The total number of breeding Black-footed Albatross on French Frigate Shoals has fluctuated annually from 2,760 to 5,067 pairs (Figure 10). Comparing annual counts to a 25-year average, anomaly values fluctuated from -1,195 to + 3,872 pairs/year, with 54% of years having positive anomalies. However, the number of active nests declined steadily from hatch years 1987 to 1996, following one of the lowest counts at this colony and ending with the second lowest count. In 1996, Whale-Skate – one of the islands at French Frigate Shoals – was lost to erosion; at its peak in 1984, 2,046 Black-footed Albatrosses nested at this site. After 1996, however, numbers at French Frigate Shoals steadily increased to reach pre-1985 values in 2005.

On Laysan Island, direct nest counts from hatch year 1998 to hatch year 2005 (n = 8 years) resulted in 19,900 to 23,297 breeding pairs (Figure 11; mean ± SD: 21,079 ± 1,382 pairs). The percent annual change (n = 7) varied from + 7.3 percent to - 17.1 percent. On Midway Atoll the number of breeding pairs from 1998 to 2005 was 17,617 to 21,829 (19,709 ± 1,346) (Figure 11). The percent annual change on Midway Island (n=7) varied from + 6.6 percent to -16.4 percent. Both colonies show the greatest annual decline from HY 1999 to HY 2000.

The number of breeding pairs on Laysan Island prior to HY 1998 was estimated using the density of eggs in quadrats (representing 5% of the total area) and multiplied by the total nesting area. The number of pairs by egg density estimates is not comparable to direct count methods adopted in 1998. On Laysan Island, where both techniques are still employed, the egg density method always produced a higher number of pairs than direct counts (Table 1).

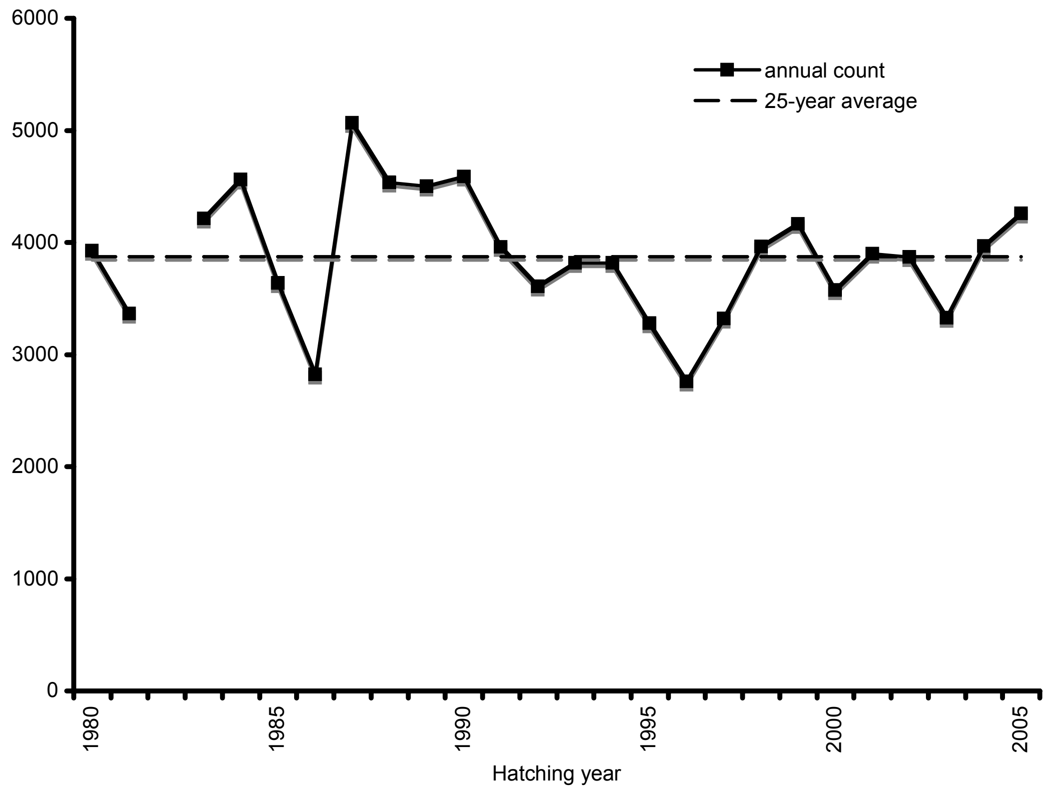

Figure 10. Total count of active nests on French Frigate Shoals with 25-year average to examine inter-annual variation (USFWS unpubl. data 2005).

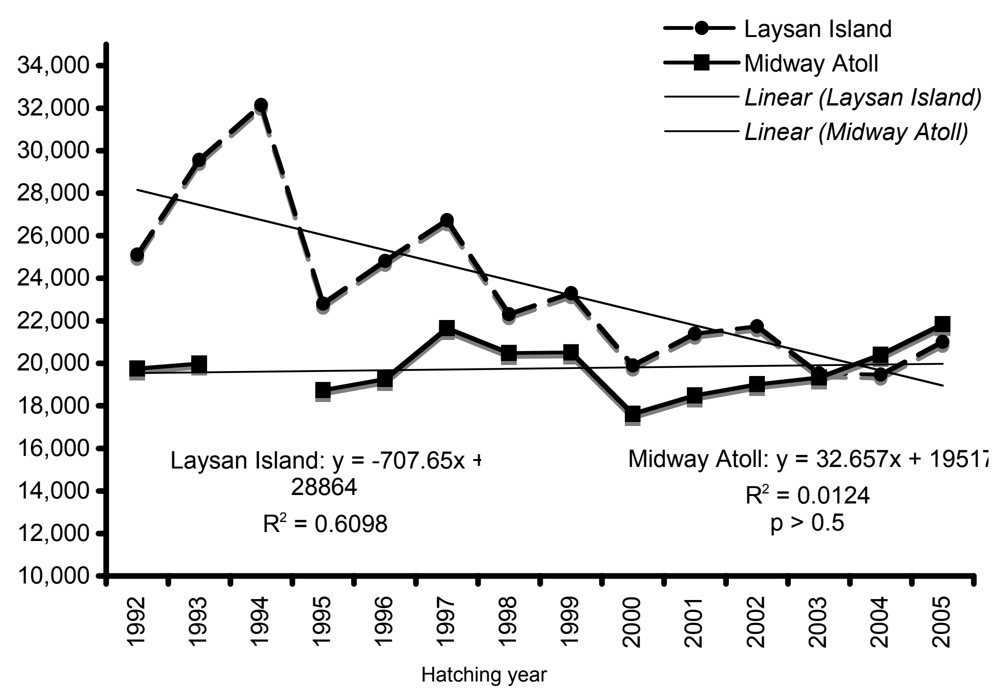

Figure 11. Black-footed Albatross population trends on Laysan Island (indirect active nest counts HY 1992–1997, direct counts 1998–2005) and Midway Atoll (direct counts HY 1992 – present; USFWS unpubl. data).

Decades-long data gaps preclude an analysis of trends at the two largest Black-footed Albatross colonies over a period of three generations (60 years). A 1945 survey estimated 26,500 nesting pairs based on transect counts of surviving chicks (Fisher and Baldwin 1946). This yields a count of 35,333 pairs when the USFWS assumption of 75% nesting success is applied. Subsequent counts between 1954 and 1967 show a dramatic drop in number of pairs breeding at Midway, presumably due to post-war military operations (Rice and Kenyon 1962b; Robbins pers. comm. 2006). In contrast, birds on Laysan Island were less disturbed; in their 1956-57 survey of albatrosses in the Hawaiian archipelago, Rice and Kenyon (1962b) estimated that 34,000 pairs were nesting there (Figure 12).

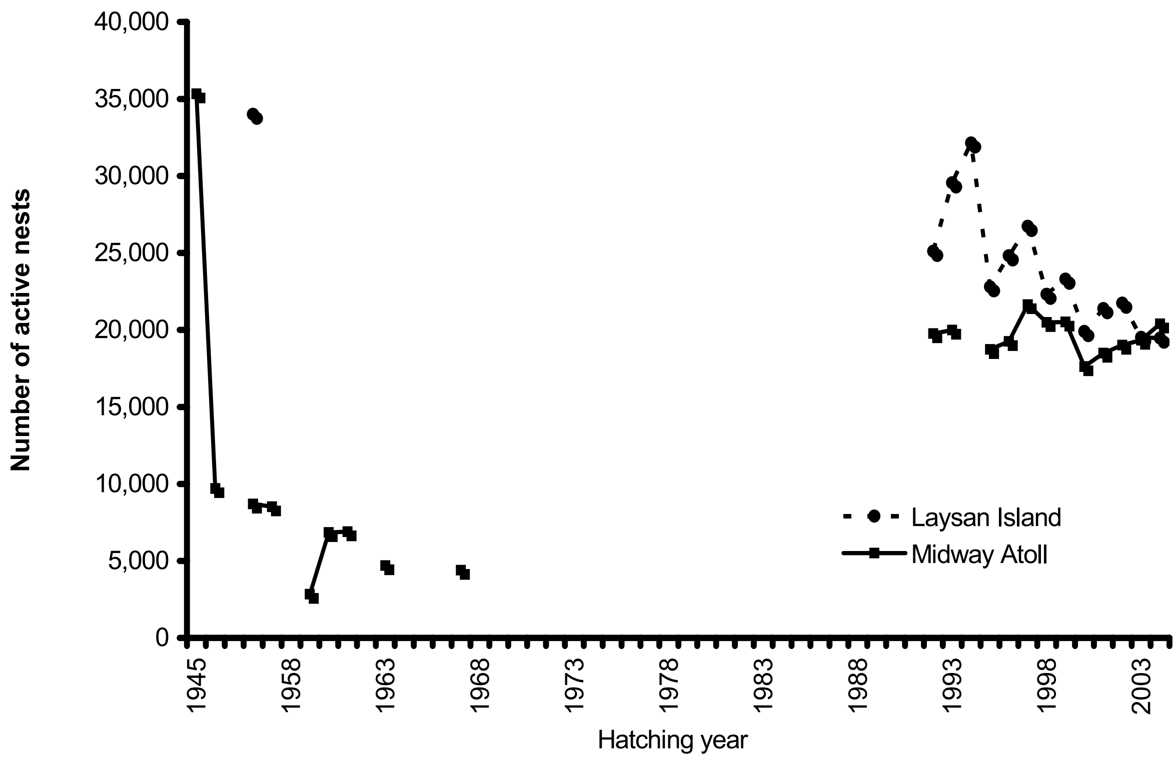

Figure 12. Black-footed Albatross pairs at Laysan Island and Midway Atoll, 1945–2005 (Fisher and Baldwin 1946; Rice and Kenyon 1962b; Robbins pers. comm. 2006; USFWS unpubl. data).

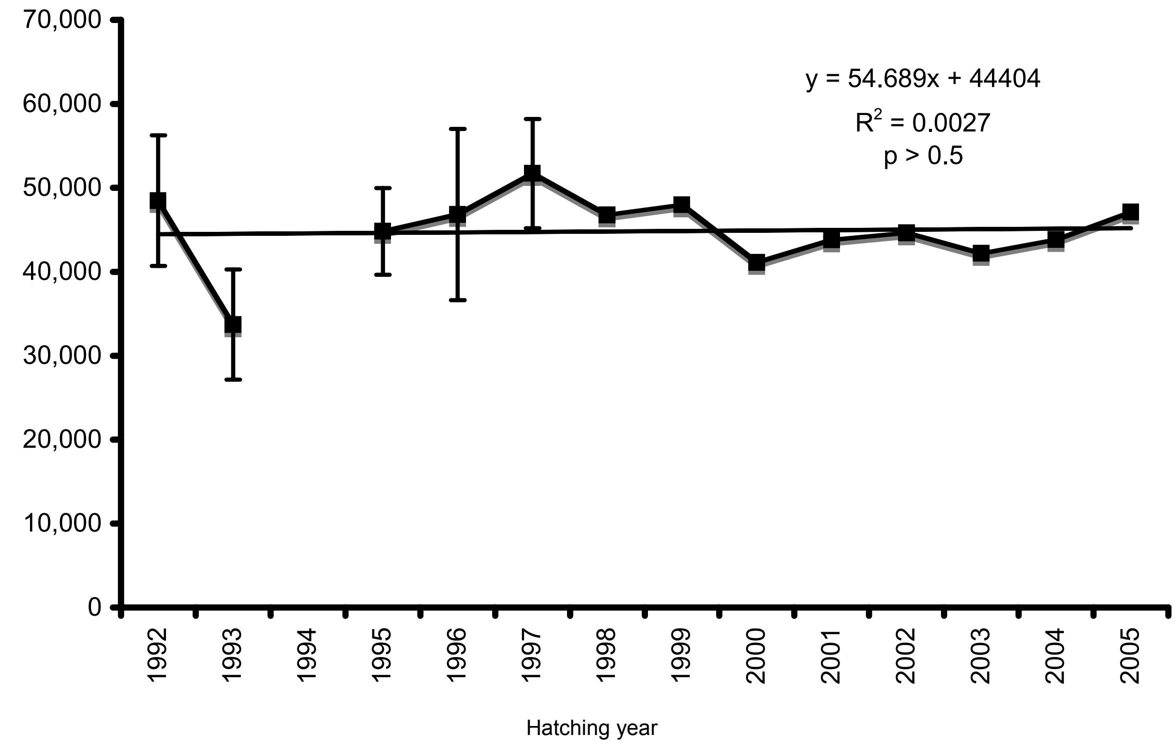

Figure 13. The total number of breeding pairs on the three monitored Black-footed Albatross colonies: French Frigate Shoals, Midway Atoll and Laysan Island, 1992–2005. Prior to 1998, active nests on the latter colony were estimated by indirect methods and 95% confidence intervals indicate uncertainty in those years (USFWS unpubl. data).

Apparent declines in the number of Black-footed Albatrosses at their major colonies during the late 1990s, coupled with increasing awareness of the bycatch of albatross in longline fisheries, highlighted a conservation concern for this species (Naughton pers. comm. 2006). However, in 2000, when the number of breeders attending the colony was at its lowest, Pyle (2000) reasoned in a non-peer reviewed article that the cause for the decline was unclear and could be the result of changes in ocean productivity, an increase in adult mortality, a change in the breeding interval, or a combination of all three.

Concern for the low returning number of breeders in the late 1990s triggered several population projection estimates to evaluate the potential future status of the species. In 2000, a workshop was held to estimate the total mortality of Black-footed Albatross in longline fishing and participants calculated a 20% decline in three generations using demographic data from Laysan Albatross (because demographic data for the Black-footed Albatross were not available) (Cousins and Cooper 2000). In 2003, Lewison and Crowder published a similar population projection of the Black-footed Albatross based on bycatch rates for the observed portion of the US fisheries, and an unpublished estimate of the total annual fishing effort by international pelagic longline vessels. Lewison and Crowder (2003) used a basic age-structured matrix model and the same demographic parameters as Cousins and Cooper (2000), that is, those for Laysan Albatross. Both of the population projection estimates assumed unaffected demographics, i.e., that adult survival rates of (Laysan) albatross were not currently affected by incidental mortality in longline fisheries. The publication of the model by Lewison and Crowder (2003) and the workshop report by Cousins and Cooper (2000), in concert with the uncertainties surrounding total bycatch in the North Pacific, were the primary basis for listing the Black-footed Albatross as Endangered by the World Conservation Union (IUCN; BirdLife International 2004a,b; see *Status designations*, below).

In an attempt to understand the potential effect of the current estimates of fisheries mortality on future populations of the Black-footed Albatross, Wiese and Smith (2003), in an unpublished report, estimated growth rates using an age-structured matrix model based on the same demographic parameters (because these are still the only values available) but assumed that the demographic data were affected, that is, incidental mortality was already incorporated in the observed adult survival rates since longline fishing has occurred in the North Pacific since the mid-1900s. The result of the Wiese and Smith (2003) model showed population growth rates of 0.98-1.04 in the next 20 years, or in other words, no substantial decline. When they used their model to hindcast to population levels in 1998, the model successfully bound real data.

Since 2004, there has been growing controversy around the reliability of the published population projection estimates (and the IUCN listing) because current demographic data for the Black-footed Albatross were not used, the total fishing effort in the North Pacific, by all countries, was not known, and the bycatch rates for all foreign and US fisheries were not known because of the lack of adequate observer coverage and reporting. As well, mark/recapture information for banded birds was generally not sufficient to generate precise estimates of annual survival (Naughton pers. comm. 2006).

Early in 2006, the Patuxent Wildlife Research Center of the US Geological Survey (USGS) calculated demographic parameters for the Black-footed Albatross breeding in US territories (results not yet publicly available). A new USFWS monitoring program for Black-footed Albatross was initiated in 2005 as a result of the USGS research, which should provide survival estimates in the future (Naughton pers. comm. 2006).

In January 2006, a draft status assessment for Laysan and Black-footed albatrosses was submitted to the USFWS, and will be available for public review sometime in the future (Arata *et al*. 2006; Sievert pers. comm. 2006). J. Arata and others constructed a population projection estimate using an age-structured matrix model with the not-yet-available USGS Patuxent demographic data, all historical and current pelagic and longline fishing effort data available, spatially explicit bycatch rates based on observer coverage in the US and Canada, and estimated bycatch rates for foreign vessels based on FAO data (Sievert pers. comm. 2005). After acceptance and release by the USFWS, it will provide the most up-to-date assessment of population trends for both Laysan and Black-footed albatrosses.

In summary, the long-term population trends for this species are unclear despite a published estimate of a 60% decline in three generations (Lewison and Crowder 2003; also see *Limiting Factors and Threats – Cumulative effects* section, below). There is no doubt that Black-footed Albatross are caught in high numbers in North Pacific longline fisheries, but the recent expansion of breeding adults to Mexican islands and Wake Atoll is not necessarily in accordance with the behaviour of a dramatically declining population. Current data suggest that the interannual variability in counts of active nests is extremely high in this species and thus an assessment of the status of the population would vary depending on what time period was examined. BirdLife International based their recent listing on population models using data from the 1990s but since that assessment, the number of breeders has increased at all colonies. Some population projection model results showed weak to dramatic declines (Cousins and Cooper 2000 (non-peer-reviewed workshop proceedings); Lewison and Crowder 2003 (published, peer-reviewed paper)) while others show a relatively stable population (Wiese and Smith 2003 (non-peer-reviewed report, currently being revised for publication)). Inadequate demographic parameters, as well as limited information on fisheries effort and bycatch rates in domestic and international fisheries, are serious problems for all population projection models.

There is no specific trends analysis available for the Black-footed Albatross in Canadian waters.

Rescue effect

The concept of rescue effect does not apply to this species in Canada since it does not breed in this country.

LIMITING FACTORS AND THREATS

Like most pelagic seabirds, Black-footed Albatross are a long-lived, *K*-selected species with small clutch size and low fecundity (typically < 0.5 chicks reared per breeding pair per year; Whittow 1993; Furness 2003), slow chick growth and lengthy parental care period, delayed age of first breeding, and high adult survival rates (often > 90% per annum for most species) and are thus highly vulnerable to adult mortality. In contrast, a change in reproductive output will likely have a much smaller impact on population dynamics and will require a considerable time lag to become apparent (Tasker *et al*. 2000; Furness 2003).

Historically, the greatest threats to Black-footed Albatross consisted of poaching by feather and egg hunters, with the loss of as many as 300,000 birds per year between the late 1800s and early 1900s (reported in Lewison and Crowder (2003) based on Rice and Kenyon (1962b), Spennemann (1998), and Cousins and Cooper (2000)). Other important historical threats included alteration of habitat through military occupation and the introduction of domestic rabbits and non-native vegetation, and population control of nesting birds during wartime preparations and subsequent military operations

(McDermond and Morgan 1993; Cousins and Cooper 2000). In the 1950s and 1960s control programs to protect aircraft at Midway, as well as collisions with buildings, antennae and other infrastructure, resulted in the death of tens of thousands of Black-footed and Laysan albatrosses (USFWS 2005a).

Approximately 90% of the world's Black-footed Albatross population breeds at only four sites (Laysan Island, Midway Atoll, Pearl and Hermes Reef and French Frigate Shoals; USFWS 2005a), so the species is particularly vulnerable to localized threats during the breeding season (e.g., oil leaking from vessels sunk in WW II; USFWS 2005a). However, non-breeding adults and immature birds remaining at sea year-round serve as a potential "extirpation buffer" to local stochastic events.

Bycatch in longline and driftnet fisheries

Fisheries bycatch is a global concern for many species of wildlife and fish because of the incidental take of non-commercial species while fishing for commercially valuable species (Hall *et al*. 2000; Tasker *et al*. 2000; Furness 2003; Gilman and Freifeld 2003; Lewison *et al*. 2004). Incidental catch in longline fisheries has been an international conservation concern for seabirds for over two decades, especially in the Southern Ocean where 17 albatross taxa have been affected (e.g., Weimerskirch and Jouventin 1987; Brothers *et al*. 1999; Gilman *et al*. 2005). Today, longlining is one of the most common fishing methods used worldwide, and comprises the greatest industrial fishing effort in the North Pacific (USFWS 2005a).

In the North Pacific, industrial longline fishing has increased steadily since World War II, and occurs in both national and international waters. On the west coast of the U.S. and Canada, six commercial longline fisheries overlap with Black-footed Albatross populations during and after the breeding season: the pelagic tuna (*Thunnus* spp.) and swordfish (*Xiphias gladius*) fisheries near their colonies in Hawaii; the demersal groundfish fishery in the Bering Sea/Gulf of Alaska; the demersal Pacific halibut (*Hippoglossus stenolepis*) fishery in Alaska; and the demersal rockfish (*Sebastes* spp.) and halibut fisheries in British Columbia (Melvin *et al*. 2001; Smith and Morgan 2005). At least six seabird species have been reported caught in these fisheries, including all three North Pacific Albatross species, with Northern Fulmars (*Fulmarus glacialis*) and Laysan Albatross the most common in Alaska, and the Black-footed Albatross the most common in British Columbia (Melvin *et al* 2001; Smith and Morgan 2005). Observer coverage in these fisheries ranges from 0% of hooks hauled (US halibut) to 19% (Canadian halibut; Smith and Morgan 2005).

In the Hawaiian-based fishery, at least 23,000 Black-footed Albatrosses were killed from 1990–1994 (USFWS 2005a). In the five years following, 1994–1998, a further 6,827–11,622 birds were caught (Cousins and Cooper 2000). In the Bering Sea/Gulf of Alaska, the groundfish fishery caught an estimated 310–600 Black-footed Albatross annually during 1993–1997 (Stehn *et al*. 2001; Melvin *et al*. 2001). These data suggest that 1% of the global Black-footed Albatross population was taken annually in the 1990s (Cousins and Cooper 2000). Lewison and Crowder (2003) calculated that between

5,200 and 13,800 Black-footed Albatross per annum were caught in the 1990s over the entire North Pacific Ocean based on fisheries observer data for the US pelagic longline fleet and estimates of Japanese, Taiwanese and Korean fishing effort. This estimate is controversial because there are no observers on US halibut or international vessels, and < 5% observer coverage in the US groundfish fishery. Satellite tracking of four Black-footed Albatrosses captured off California found a high degree of spatial overlap between albatross distributions and reported fishing effort in the 1980s but no co-occurrence with effort in the 1990s (Hyrenbach and Dotson 2003). These results might suggest that Black-footed Albatross mortality was higher in the 1980s than the 1990s.

In Canada, the Black-footed Albatross is the seabird species most at risk of bycatch due to a high degree of spatial and temporal overlap with longline fishing effort (Wiese and Smith 2003; Smith and Morgan 2005). A spatially and temporally explicit analysis of the halibut and rockfish fishery from 2000–2002 estimated an annual mortality of 55–253 Black-footed Albatross, accounting for uneven observer effort and coverage (Wiese and Smith 2003). This estimate represents 2–4% of the Canadian maximum annual summer population of 2,500–4,000 individuals, as identified by Morgan *et al*. (2000). Bycatch rates for the Black-footed Albatross in B.C. (2000–2002), ranged from 0.0007–0.0054 (halibut) to 0–0.316 (rockfish) birds killed per thousand hooks (Wiese and Smith 2003). The estimated bycatch rates in Canada are lower than the US swordfish fishery (0.16–0.59), comparable to the US tuna fishery (0.005–0.024) but twice as high as the Alaskan groundfish fishery (0.0002–0.015; Melvin *et al*. 2001; Lewison and Crowder 2003). The difference in total annual mortality of the Black-footed Albatross between the US and Canada is due to a smaller fishing area and fewer licensed vessels.

Longline fishery effort, target areas, and regulations related to bycatch are often in flux, at least in terms of Canadian- and US-based fisheries. For example, in response to seabird bycatch, British Columbia, Alaska and Hawaii have all implemented mandatory mitigation measures since the late 1990s. In 2001, primarily due to the mortality of marine turtles, the Hawaiian-based longline fishery for swordfish was closed and subsequent estimates of Black-footed Albatross bycatch dropped to under 100 birds per year. However, much of the Hawaiian swordfish fleet then moved to California, since mitigation measures were not yet required for California-based vessels despite considerable overlap in fishing areas, and Black-footed Albatrosses were caught in that fishery (72 birds caught during 469 net sets; US National Marine Fisheries Service 2004). Californian boats were regulated in 2004 and effort shifted back to Hawaii when the swordfish fishery was re-opened (USFWS 2005a). In Alaska, regulations adopted to prevent the accidental take of Short-tailed Albatross have reduced total bycatch significantly (Melvin pers. comm. 2006). In Canada, regulations for the mandatory use of seabird avoidance measures in longline fisheries were adopted in 2002; however, there have been no studies to assess the effectiveness of the regulation.

Until a moratorium in 1992, the high seas squid driftnet fishery in the North Pacific caught an estimated 3,500–4,500 Black-footed Albatrosses per year (Johnson *et al*. 1993). Legal North Pacific drift gill net fisheries still occur for salmon, and illegal driftnet fisheries target squid. The incidental take of shearwaters and alcids has been documented in the legal fisheries in the literature (e.g., Uhlmann *et al*. 2005). The legal fisheries occur west of 180° and may affect post-breeding Black-footed Albatross during dispersal from Hawaii and breeding birds foraging from colonies in Japan. There are no data for the illegal fisheries except reports from US Coast Guard personnel monitoring the area with aircraft surveillance: Laysan Albatross have been reported as bycatch (D. Hyrenbach pers. comm. 2006).

Competition with commercial fleets is another possible fisheries interaction for Black-footed Albatross. As squid forms up to 30% of their diet, Black-footed Albatross compete for food with pelagic squid fisheries. As is likely the case with Short-tailed Albatross (USFWS 2005c), the effect of commercial fisheries on the Black-footed Albatross food base is probably discountable. Scavenging is an important foraging strategy for Black-footed Albatross and any competition is likely offset by access to fisheries discards (cf. Tasker *et al*. 2000; Furness 2003).

Entanglement in "ghost" (lost or discarded) fishing gear such as monofilament nets has been documented for other marine birds (Tasker *et al*. 2000) and is a possible cause of mortality for Black-footed Albatross, although there are no data on this risk factor for the species.

There are few demographic data from dead Black-footed Albatrosses with which to estimate the population level effects of fisheries bycatch. However, a salvage bird program in British Columbia that retained thirteen Black-footed Albatrosses from 2002-2003 found that of 13 birds (7 males, 6 females), 12 were juveniles or immatures based on bursa and plumage (Environment Canada unpubl. data). Fisheries mortality can compound other demographic effects including mate loss. In the Black-footed Albatross, mate loss can cause adults to miss up to five breeding seasons prior to forming a new pair, decreasing lifetime reproductive success (Lewison and Crowder 2003; Mills and Ryan 2005).

Oil spills

Seabirds in British Columbia waters are vulnerable to both smaller chronic and larger catastrophic oil spills (Burger *et al* 1997). In general, seabirds are more at risk from smaller chronic spills (including deliberate discharge of oily waste) than from large, catastrophic ones as timing, frequency and location of spills are better predictors of impact than is spill size alone (Burger 1993; Wiese and Robertson 2004). Black-footed Albatrosses are susceptible to oiling as they often congregate on the water when foraging, especially around fishing vessels (see *Behaviour* section, above). Oiling of Black-footed Albatrosses does occur, even with this highly pelagic species – for example, oiled adult birds have been observed at the Tern Island colony (Chisholm pers. comm. 2006). Oil spills or discharges in or near key foraging areas (e.g., upwelling in the vicinity of shelf breaks) could pose a particularly high risk to Black-footed Albatrosses and other offshore seabirds.

Areas potentially involved in any future offshore oil and gas exploration in Canada's Pacific coastal waters include Queen Charlotte Sound and areas within Hecate Strait and off the north coast of Vancouver Island (COSEWIC 2004; Reid pers. comm. 2006). These areas overlap with marine habitat use of Black-footed Albatross in Canada (Figures 4 – 9); if offshore exploration for oil and gas leads to any petroleum spills or discharges, the potential for these affecting seabirds such as the Black-footed Albatross is substantial (COSEWIC 2004). Certain levels of hydrocarbon discharges are permissible during offshore oil and gas production and these can often lead to light sheens around offshore rigs. Black-footed Albatrosses innately investigate everything on the ocean from flotsam to ships, so will certainly be attracted to oil derricks as other seabirds are known to be (O'Hara pers. comm. 2006).

Existing commercial vessel traffic (tanker, cargo/passenger, fishing vessels) poses an ongoing oil spill risk for coastal BC waters through collision, grounding, or illegal disposal of oily bilge waste. A study by the Pacific States/British Columbia Oil Spill Task Force (2002) found areas of higher grounding or collision risk 25 nautical miles from land along the entire West Coast, except (for Canadian waters) off northwestern BC, where the high risk area extended to 100 NM offshore. Most west coast tanker traffic remains well offshore as a result of a voluntary tanker exclusion zone; however, non-tanker traffic uses shipping lanes that parallel the shelfbreak off the west coast of Vancouver Island and the Queen Charlottes (O'Hara pers. comm. 2006).

Coastal shipping in British Columbia waters – including vessels transporting oil and condensate – is projected to increase dramatically within the next decade. For example, the proposed Kitimat pipeline (projected completion date 2010) would transport heavy oil across BC from Alberta's oil sands to the West Coast for export by oil tankers to Asian (China) and US southern markets (California). Projected volume would require a 125,000 DWT oil tanker every second day. The pipeline proposal also includes the importation (from offshore sources to Kitimat) of up to 25,000 barrels of condensate per day, and transport by existing CN railway to Alberta. The proponent expects to start importing by 2006. Similar proposals for new or expanded port facilities exist for coastal communities such as Prince Rupert and Stewart (Reid pers. comm. 2006).

Climate change and natural climate cycles

Climate change is primarily likely to affect albatrosses and other marine birds through intensification of El Niño Southern Oscillation (ENSO) events, leading to less productive marine foraging habitat (Robinson *et al*. 2005; see also *Habitat trends*, above). Mass adult mortality due to climate-induced food shortages has been documented in pelagic waters for Short-tailed Shearwater (*Puffinus tenuirostris*; Baduini *et al*. 2001), but decreased food availability and/or quality can also decrease reproductive success of breeding seabird adults or survivorship of fledged offspring (Crick 2004; Kitaysky *et al*. 2006). Black-footed Albatrosses may conceivably choose to increase intervals between breeding years due to depleted food resources (Gilman and Freifeld 2003). Climate change effects have not yet been documented for breeding

Black-footed Albatrosses, although there has been a decrease in the number of this species recorded in the California Current system, concurrent with an apparently minor PDO-linked increase (0.7 ºC) in average sea surface temperature (Ainley and Divoky 2001; Crick 2004; see *Habitat trends* section, above).

Sea level rises associated with climate change may ultimately decrease the availability of nesting habitat at the low-lying atolls where a high proportion of the global population of Black-footed Albatrosses breed. The low elevation islands of the tropical Pacific are among the world's most vulnerable sites to climate-induced inundation (USFWS 2005a; Baker *et al*. 2006).

Contaminants

As a long-lived top predator, Black-footed Albatrosses are susceptible to the bioaccumulation of environmental pollutants that are ingested via prey items. Black-footed Albatross appear to feed at a higher trophic level than Laysan Albatross (Gould *et al*. 1997, 1998; though see Finkelstein *et al*. 2006), and contain correspondingly higher concentrations of organochlorines and heavy metals (e.g., PCBs, DDE, mercury; Auman *et al*. 1997; Guruge *et al*. 2001; Shinsuke *et al*. 2003; Finkelstein *et al*. 2006). Black-footed Albatrosses are also likely to accumulate organochlorines such as PCBs via consumption of floating plastic items, which they ingest frequently (see *Plastic ingestion* section, below). Using samples collected in 1992–1993, Auman *et al*. (1997) found that concentrations of DDE in the eggs of Black-footed Albatross from Midway were at about half of the threshold required for eggshell thinning, although population-level thinning effects had not been observed. Concentrations of PCBs, DDE and dioxins in Black-footed Albatrosses were similar to those for certain terrestrial and coastal bird species at contaminated sites in industrial nations, e.g., the Great Lakes, with PCB concentrations being at the threshold of where subtle population-level effects on productivity could be expected to occur (Auman *et al*. 1997; Tanabe *et al*. 2004). However, samples collected at Midway in 2000 showed a marked increase in blood plasma concentrations of contaminants over those reported by Auman *et al*. (1997), with DDE concentrations 360% higher than in 1992–1993 samples (Finkelstein *et al*. 2006). The US Fish and Wildlife Service (2005a) presently reports a "small but measurable reduction in productivity" at Midway Atoll as a result of organochlorine contamination in combination with fisheries bycatch.

Birds at Midway Atoll are also locally exposed to lead in paint chips around old buildings. Chicks ingest contaminated soil and the resulting lead poisoning results in poor fledging success since poisoned birds are unable to fly, although to date this has only been documented in Laysan Albatross (Finkelstein *et al*. 2003; USFWS 2005a).

Plastic ingestion

Far-ranging surface feeding seabirds such as Black-footed Albatrosses are known to consume substantial amounts of floating plastic waste, to the extent that pelagic tubenoses such as albatrosses and Northern Fulmars have been suggested as biological indicators of marine plastic pollution in the world's oceans (Nevins *et al*. 2005; van Franeker and Meijboom 2002). Susceptibility to plastic consumption has been ranked "high" for Black-footed Albatross (Nevins *et al*. 2005), with 100% of birds examined in two studies containing plastic in the gizzard and/or proventriculus (Blight and Burger 1997; Kinan and Cousins 2000). Of 13 Black-footed Albatross sampled off the British Columbia coast, 8 had plastic in their stomach (Environment Canada, unpublished data). Adult birds can regurgitate plastic items and thus offload them while provisioning offspring, but young chicks do not possess the musculature to do so and therefore retain plastic loads until near to fledging. Items ingested by albatrosses include cigarette lighters, bottle tops, rubber gloves, plastic toys, broken plastic fragments, industrial plastic pellets and chemical light sticks (Blight and Burger 1997; Auman *et al*. 1998; Nevins *et al*. 2005). Although it has proven difficult to determine whether there are population-level impacts of plastic ingestion by seabirds, individual effects documented for North Pacific albatross species include lower fledging masses, reduced fat indices, satiation and subsequent starvation or dehydration, and mechanical blockage of the gut (Sievert and Sileo 1993; Auman *et al*. 1998; Nevins *et al*. 2005). Plastic in the ocean adsorbs organochlorines such as PCBs, and dietary plastic likely increases albatross exposure to these and other toxic compounds (Auman *et al*. 1998; Tanabe *et al*. 2004). Available research shows an increasing trend in plastic ingestion by seabirds worldwide (Nevins *et al*. 2005).

Invasive species

Introduced vertebrate predators pose a globally serious conservation threat to island-nesting birds. Rats are known to depredate Black-footed Albatross nestlings (see *Predation* section, above), but have been eradicated from most islands where the species is nesting. Feral cats (*Felis catus*) and rats are still present at islands that were historically occupied by Black-footed Albatross (e.g., Wake and Johnston Atolls and the Mariana Islands), and may prevent or limit re-colonization of these sites. Cat eradication is underway for Wake Island (USFWS 2005a). Mosquitoes (*Culex quinquifasciatus*) were introduced at Midway Atoll during WW II. These insects are a vector for avian pox and Midway is the only albatross colony where outbreaks of this disease occur (Tickell 2000; USFWS 2005a; see *Diseases and parasites*, above). As albatrosses have had little exposure to mosquito-borne viruses they may be particularly vulnerable to the emerging threat of West Nile virus (USFWS 2005a), although there are no data to support this supposition.

Invasive alien plants can eliminate or degrade habitat for ground-nesting seabirds. Ironwood and golden crown-beard form dense forests or stands at Midway, limiting the open sandy areas favoured by Black-footed Albatrosses (see *Habitat trends*, above). Golden crown-beard also has displaced large areas of native vegetation at Kure Atoll and Pearl and Hermes Reef, and threatens to spread further in the Northwestern Hawaiian Islands. Management of these species by the USFWS is ongoing (USFWS 2005a).

Other threats

Other threats to the Black-footed Albatross are more localized in nature, e.g., birds nesting on volcanic Torishima and San Benedicto Islands are at risk from future volcanic eruptions (Whittow 1993; Pitman and Balance 2002). Air strikes continue to be a source of mortality for albatrosses at Midway Atoll, but strict mitigation measures are in place and birds are escorted or physically removed from the runway prior to aircraft landing or taking off; mortality numbers in the 10s of birds per year (numbers for Laysan and Black-footed Albatross combined; USFWS 2005c).

Offshore wind farms are being planned along the coast of British Columbia. One facility, the Nai Kun Wind Farm, is well into the planning phase and can provide a general perspective on the scope of similar projects. This wind farm will be built in Hecate Strait along the northeast coast of Graham Island. The Nai Kun Wind Farm is expected to contain 200 (and perhaps as many as 300-500) turbines and occupy many km^2 of marine habitat. Although technology continues to evolve rapidly, turbines will stand over 100 m tall with three blades and a rotor-swept diameter of up to 120 m (http://www.naikun.ca/). Turbine blades tend to not reach closer than 20 m above the ocean surface.

Two potential threats of wind farms to Black-footed Albatrosses are mortality from collisions or habitat displacement. Based on studies of other migrating waterbirds at wind farms in Denmark (e.g., loons, seaducks and geese), collision risk is believed to be very low for all birds. Birds detect turbines at distances greater than several hundred metres and either fly around or between the wind turbines (e.g., Christensen and Hounisen 2005; Desholm and Kahlert 2005). One risk assessment for procellariiform birds concluded that Northern Fulmars had the lowest risk of collision compared to all other marine bird species studied (Garthe and Hüppop 2004). Albatrosses and petrels tend to fly very close to the water's surface (i.e., less than 30 m height of blade edge) and generally tend not to fly at night when visibility is reduced.

Habitat displacement could occur if albatrosses avoided marine habitats used by wind farms. However, marine wind farms are generally constructed in shallow waters and Black-footed Albatrosses normally frequent deep or shelf break waters (see *Habitat*, above); thus, relatively few albatross are expected to occur where wind farms are built.

Cumulative effects

The IUCN lists the Black-footed Albatross as Endangered because of a projected population decline of more than 60 percent over three generations (BirdLife International 2004a,b). While the validity of the worst-case scenario (i.e., the 60% decline in three generations, or a decline from 60,000 to 24,000 pairs) published by Lewison and Crowder (2003) is still unclear as new assessments (e.g., Arata *et al*. in review) were not available at the time of this draft, several facts make it clear that there is justifiable concern for this species: there is a high degree of interannual variability within the number of breeders returning to the colony each year even though long-term averages appear relatively stable; there are multiple documented threats that affect annual adult and chick survival; they are the third-most commonly reported seabird species caught as fisheries bycatch in the North Pacific (and the most commonly reported species caught in Canadian fisheries); and there is near-unanimous agreement among scientists in the US and Canada that there is a large amount of uncertainty surrounding estimates of mortality in foreign pelagic longline fisheries. We recommend a precautionary approach because of the multiple threats, the degree of uncertainty surrounding total mortality, and the high variability in the number of adults returning to breed each year. There is no doubt that sustained adult mortality from human activities can cause severe population declines in long-lived seabirds (Moloney *et al*. 1994; Weimerskirch *et al*. 1997; Tasker *et al*. 2000; Tuck *et al*. 2001; Ainley and Divoky 2001). As shown by examples in Hawaii (Cousins and Cooper 2000), and South America (Duffy 1983), the coincidence of unfavourable environmental conditions, and sustained, negative anthropogenic effects can cause population declines even when species are abundant. At the very least, decreased population growth (even when no declines are present) increases the vulnerability of these species and populations to changes in their environment and other pulse perturbations (Dunnet 1982; Takekawa *et al*. 1990; Wiese *et al*. 2004).

SPECIAL SIGNIFICANCE OF THE SPECIES

Importance to people

Albatrosses have featured in folk tales and classic literary works about the sea for centuries (e.g., Coleridge's *The rime of the ancient mariner* in 1798, Baudelaire's *L'Albatros* in 1857; Yocum 1947; Tickell 2000) and have long been viewed by sailors as kindred spirits or the reincarnated souls of lost shipmates.[1] Indeed, several early scientific accounts of Black-footed and other albatrosses were written by natural historians or biologists serving as naval officers (e.g., Richards 1909; Yocum 1947; Thompson 1951; Jameson 1961). Sailors today still feel an affinity for these birds that follow in the wake of their vessel. As the most common albatross in the eastern North Pacific, the Black-footed Albatross is of special significance to the recreational sailors and professional mariners who transit these waters.

Albatrosses played a role in the early diet of coastal First Nations people. In British Columbia, Short-tailed Albatross bones have been found at archaeological excavations that include Maple Bank, Esquimalt; Yuquot, West Coast Vancouver Island; and Kunghit

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1Robert Cushman Murphy (1959) reports a verse written by an anonymous old salt about a pair of albatrosses: "*And as them birds went sailing by,*
something about them caught my eye,
and as I gazed I grew surprised, for both of them I reckonized [sic]*.*
I knew by a certain peculiar mark
that one of them was old Bill Clark.
And, by its graceful movements and rapid turns,
I knew that the other was Brocky Burns."

Island, Gwaii Haanas, Queen Charlotte Islands/Haida Gwaii (Crockford *et al*. 1997; Harfenist *et al*. 2002; Wigen 2005). Based on the archaeological evidence of middens from Northern California to the Aleutian Islands, the Short-tailed Albatross was hunted by a number of coastal tribes (Crockford *et al*. 1997, Crockford 2003). However, the bones of Black-footed Albatross are conspicuously absent from these midden sites (Crockford 2003; Eda *et al*. 2002). This archaeological evidence indicates that coastal First Nations did not regularly hunt Black-footed Albatrosses, presumably due to the species' preference for offshore habitats – prior to its decimation by the feather trade the Short-tailed Albatross was likely the common inshore albatross species in British Columbia (cf. Kermode 1904; Crockford 2003; Crockford pers. comm. 2005; Keddie pers. comm. 2005). The Black-footed Albatross was nonetheless known to coastal First Nations, as evidenced by the presence of a name for this species in the Haida lexicon (see *Name and classification* section, above).

Ecological role

The Black-footed Albatross is a top trophic level predator in the marine food web of the North Pacific Ocean. Loss or reduction of upper trophic levels may have profound cascading effects on pelagic food webs (Pauly *et al*. 1998; Springer *et al*. 2003; Scheffer *et al*. 2005). Although the Black-footed Albatross is not a particularly abundant seabird in comparison to other top trophic level species such as the Sooty Shearwater (*Puffinus griseus*), which has a global population numbering in the millions (as did Short-tailed Albatross historically), maintaining albatross populations at or returning them to historical levels is nonetheless part of maintaining a healthy and functioning marine ecosystem in the North Pacific Ocean.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

International conventions and agreements

Migratory Birds Convention Act, 1994

The *Migratory Birds Convention Act, 1994* (MBCA) is the updated statute that implements the 1916 Migratory Birds Convention between Canada and the United States. The Family Diomedeidae is not listed in Article I of the Convention, but well-established policy dictates that albatrosses are protected under the MBCA by virtue of their inclusion in the Environment Canada document entitled *Birds Protected in Canada under the Migratory Birds Convention Act* (CWS 1991; Grigg pers. comm. 2006).

Convention on International Trade in Endangered Species (CITES).

This species is not listed by CITES (CITES 2006).

Convention on Migratory Species (CMS)

Black-footed Albatross is listed under Appendix II of the CMS or Bonn Convention (ARKive 2004). The Agreement on the Conservation of Albatrosses and Petrels (ACAP) is a daughter agreement of the Bonn Convention. ACAP is currently considering ways in which it would be able to evaluate proposals for the addition of new species to its Annex that might be received in the future. As part of this exercise a preliminary assessment of all the procellariiform species has been undertaken (Cooper and Baker 2006) and will be developed further (ACAP Secretariat 2006). The Black-footed Albatross was one of the species that was considered in this evaluation process, along with the other two North Pacific albatrosses.

Federal and provincial legislation

British Columbia Wildlife Act

As a species of bird protected under the *Migratory Birds Convention Act*, the Black-footed Albatross also receives protection via the *British Columbia Wildlife Act.*

Canadian national legislation

Black-footed Albatross is protected under the *Migratory Birds Convention Act, 1994* (see *International agreements*, above). As the Black-footed Albatross is protected under this Act, it is illegal to capture or kill the species without a permit.

US Endangered Species Act

The Secretary of the U.S. Department of the Interior, through the United States Fish and Wildlife Service, received a petition on 28 September 2004 from Earthjustice, on behalf of the Center for Biological Diversity and Turtle Island Restoration Network, to list the Black-footed Albatross as a threatened or endangered species and to designate critical habitat to ensure its recovery under Section 4(b) the US Endangered Species Act and Section 553(3) of the Administrative Procedures Act (Earthjustice 2004). This petition is now under review by the USFWS and a finding is expected later in 2006 (Freifeld pers. comm. 2006).

Status designations

National and sub-national designations

The Black-footed Albatross is Yellow-listed by the British Columbia Conservation Data Centre (BC CDC 2005) and is provincially ranked as SNA (i.e., Sub-national rank Not Applicable). NatureServe ranks the taxon as G3G4 with a US national rank of N4N5B and sub-national ranks as follows: Alaska – S5N, Hawaii – S3S4, Oregon – SNA, Washington – S3N (last reviewed November 2002; NatureServe 2006).

In the State of Hawaii, the species is listed as Threatened under state legislation, while in Mexico the Black-footed Albatross is listed as *Amenazada* (Threatened) by the Mexican Instituto Nacional de Ecología (INE 2005), a branch of Mexico's environmental protection agency.

IUCN Red List

In 2003, the IUCN uplisted the Black-footed Albatross from Vulnerable to Endangered (EN A3bd) on the basis of a projected future population decline >60% over the next three generations (i.e., 56 years), based on the estimated rate of incidental mortality from demersal and pelagic North Pacific longline fisheries (BirdLife International 2004a,b).

TECHNICAL SUMMARY

Phoebastria nigripes

Black-footed Albatross — Albatros à pieds noirs

Range of Occurrence in Canada: Canadian territorial waters off British Columbia

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* **Area of Canadian territorial waters on Pacific Coast**	Approx 70,000 km²
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* **Area of Canadian territorial waters on Pacific Coast and total terrestrial area of breeding colonies (outside Canadian waters)**	Approx 70,000 km² (ca. 22 km² on breeding colonies; BirdLife International 2004a)
• *Specify trend in AO*	Unknown
• *Are there extreme fluctuations in AO?*	No, though there may be seasonal and annual distributional shifts within the EO, based on changing oceanographic conditions
• *Number of known or inferred current locations*	Not applicable in Canadian waters; 12 established breeding locations worldwide (see *Distribution* section, above)
• *Specify trend in #*	Not applicable in Canada; stable or increasing worldwide with four new breeding localities (see *Distribution* section, above)
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Breeding habitat stable
Population Information	
• *Generation time (average age of parents in the population)* **See text for discussion of generation time estimates**	17-20 years (Niel and Lebreton 2005, Lewison and Crowder 2003; NatureServe 2006); 18.67 years (following IUCN calculation; BirdLife International 2004a,b)
• *Number of mature individuals* **Estimated number of breeding pairs x 2**	123,140 (see Table 1)
• *Total population trend:*	Unknown. Published sources: declining (See *Population Sizes and Trends* section, above)
• *% decline over the last/next 10 years or 3 generations.* **Limited historical data precludes an analysis of % decline over 3 generations (ca. 60 years)**	Laysan Island, 1992-2005, decline ($p < 0.002$); Midway Atoll, 1992-2005, no trend ($p > 0.5$; Fig. 11). Three of four largest colonies summed (French Frigate Shoals, Laysan Island, Midway Atoll), 1992-2005, no trend ($p > 0.5$; Fig. 13)
• *Are there extreme fluctuations in number of mature individuals?*	No, though pronounced interannual fluctuation in number of adults returning to breed
• *Is the total population severely fragmented?*	No – island colonies isolated, but genetic exchange possible

• *Specify trend in number of populations*	Stable: although incipient Mexican colonies are geographically isolated, they will not be genetically isolated from NWHI population (see *Distribution* section, above) and are not considered a separate population for this report
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: Northwestern Hawaiian Islands – 118,240; Japan – 4,900 (see Table 1)	
Threats (actual or imminent threats to populations or habitats)	
Incidental mortality in longline and driftnet fisheries; mortality from oil spills; loss of breeding habitat from climate change and associated sea level changes; climate-change induced changes in marine productivity; habitat alteration and depredation by invasive species (plants, rabbits, cats, rats); pollution, including plastic ingestion and bioaccumulation of organochlorines; volcanic eruption at Torishima and Revillagigedo Is. (see *Limiting Factors and Threats* section, above).	
Rescue Effect (immigration from an outside source)	Not applicable
• *Status of outside population(s)?*	
• *Is immigration known or possible?*	
• *Would immigrants be adapted to survive in Canada?*	
• *Is there sufficient habitat for immigrants in Canada?*	
• *Is rescue from outside populations likely?*	Not applicable
Quantitative Analysis See discussion of competing models. Also see Arata *et al*. (in review). Niel and Lebreton (2005) modelled the mortality level that would result in a population decline; estimates of fisheries bycatch mortality approximate this number.	Some models predict 60% decline in 3 generations, others predict stable population
Current Status COSEWIC: Special Concern(2007) IUCN: Endangered (A3bd)	

Status and Reason for Designation

Status: Special Concern	**Alpha-numeric code**: not applicable

Reasons for Designation:

This long-winged, long-lived (up to 40 years) seabird breeds on remote islands in the Hawaiian chain, but significant numbers feed off the coast of British Columbia each year, including adults making long foraging trips to feed their young. Black-footed Albatross numbers declined at one of the two major colonies in the 1990s, but the population seems generally stable. Many are caught as bycatch in longline fisheries; most suffer from ingestion of plastic and accumulate high levels of pollutants. The long-term effects of these threats are unclear.

Applicability of Criteria

Criterion A: (Declining Total Population): No significant declining trend.

Criterion B: (Small Distribution, and Decline or Fluctuation): No significant declining trend.

Criterion C (Small Total Population Size and Decline): Population too large.

Criterion D: (Very Small Population or Restricted Distribution): Comes close to meeting restricted distribution category (22 km^2 area of 12 colonies).

Criterion E: (Quantitative Analysis): conflicting results; some predict 60% decline over 3 generations, others predict a more or less stable population.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

Louise Blight has an MSc in Biology from Simon Fraser University and is the sole proprietor of Procellaria Research and Consulting. As a wildlife biologist she is particularly interested in the breeding and foraging ecology of marine birds. Louise's Master's thesis was on the breeding ecology of Rhinoceros Auklets at Triangle Island, British Columbia, and she has worked on seabird research and inventory projects on breeding colonies and at sea in Canada, the US, Antarctica and the Southern Ocean. Louise is currently employed as a species at risk specialist for Parks Canada; prior to that she worked and consulted for other government and non-governmental organizations on the conservation and management of a diverse range of threatened and endangered species and ecosystems. Her recent projects include developing an oil spill response plan for sea otters in British Columbia and collaborating on recovery strategies for several species; she is also presently working with John Cooper (see below) on recovery planning efforts for rare birds in Garry oak ecosystems.

Joanna Smith has an MSc in Biology from the University of Victoria and is currently a PhD candidate at the University of Washington, Seattle, USA. She owns Birdsmith Ecological Research, a private consulting company that specializes in the research and conservation of marine birds and island ecosystems. Since 1999, she has worked with the Canadian Wildlife Service to assess seabird bycatch in Canada's west coast longline and gillnet fisheries. Joanna was one of the founding members of the Pacific Seabird Bycatch Working Group, a government initiative to establish bycatch rates, assess species at risk, advise fisheries observer programs and reduce incidental catch. Joanna contributed to the Canadian Status Report to lead towards a National Plan of Action and co-wrote the initial regulations for mandatory use of seabird avoidance measures in BC. She is a member of the North Pacific Albatross Working Group, an international group of scientists and non-scientists that meet annually to discuss advances and gaps in our understanding of these species. Joanna studies temperate seabirds and island ecosystems in both the north and south Pacific Ocean, and is currently studying the foraging ecology of Juan Fernández Petrels in Chile.

John Cooper is a leading ornithologist in British Columbia and has authored over 150 books, academic papers, technical reports, and popular articles on birds and other wildlife. John is a founding partner of Manning, Cooper and Associates Ltd, a consulting company with three offices in British Columbia. MCA specializes in biodiversity studies, forest biodiversity management and policy development, and environmental impact assessments. John is regularly consulted on the status and conservation of birds in British Columbia by the provincial and federal governments, industry, and NGOs. He is co-author of the reference books *The Birds of British Columbia* and has contributed to COSEWIC and conservation of species at risk as co-author of COSEWIC status reports for Northern (Queen Charlotte) Goshawk, Streaked Horned Lark, Spotted Owl and Band-tailed Pigeon. He has developed SARA Management Plans for Peale's Peregrine Falcon, Lewis's Woodpecker and Flammulated Owl. John has also been the lead or sole author of 12 BC provincial status reports on birds at risk. John is an active volunteer on the Garry Oak Ecosystems Recovery Team, which is leading recovery efforts for several extirpated or rare birds in southwestern British Columbia.

COLLECTIONS EXAMINED

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