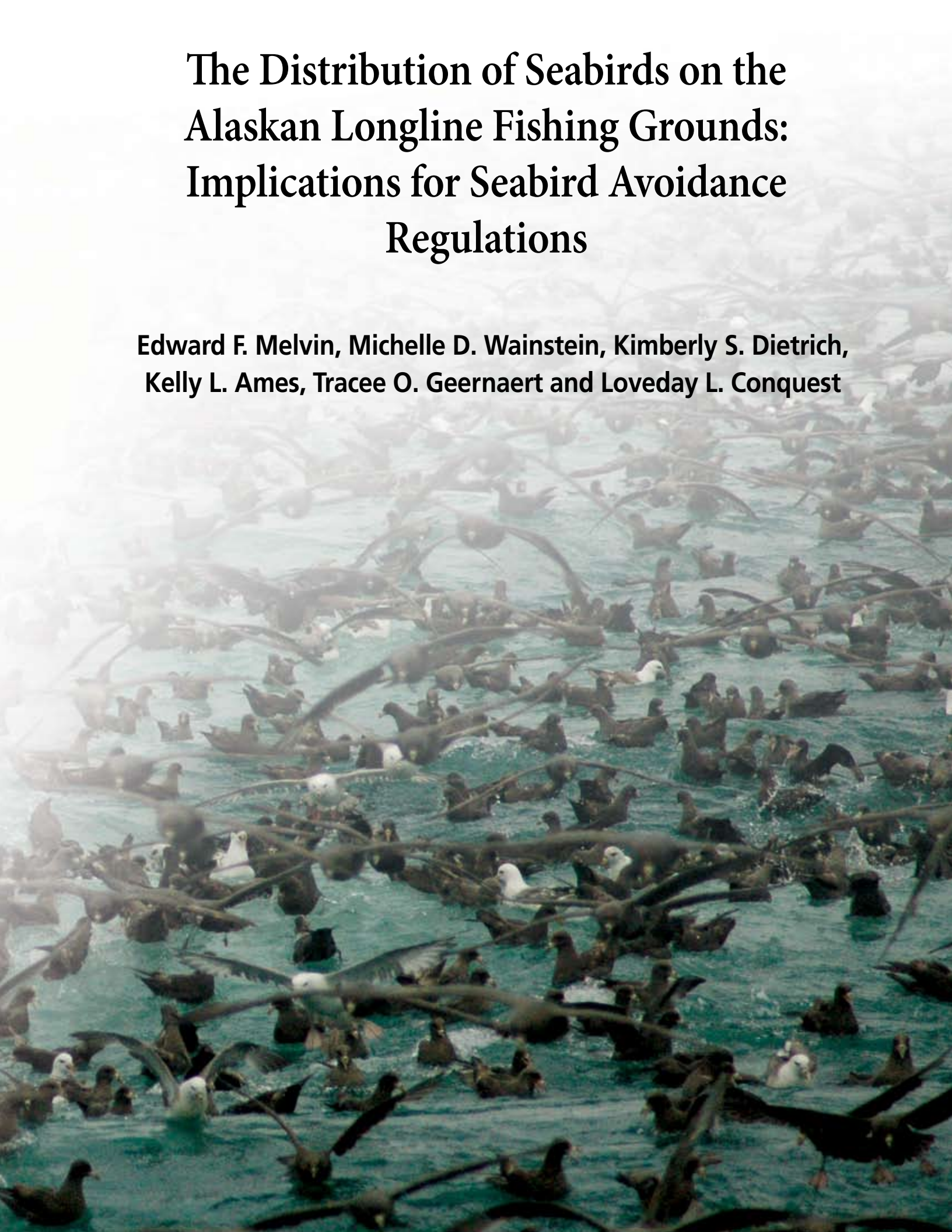
The Distribution of Seabirds on the Alaskan Longline Fishing Grounds: Implications for Seabird Avoidance Regulations

Edward F. Melvin, Michelle D. Wainstein, Kimberly S. Dietrich, Kelly L. Ames, Tracee O. Geernaert and Loveday L. Conquest



The Distribution of Seabirds on the Alaskan Longline Fishing Grounds: Implications for Seabird Avoidance Regulations

Edward F. Melvin[1], Michelle D. Wainstein[1], Kimberly S. Dietrich[1], Kelly L. Ames[2], Tracee O. Geernaert[2] and Loveday L. Conquest[3]

[1] Washington Sea Grant Program, University of Washington
[2] International Pacific Halibut Commission
[3] School of Aquatic and Fishery Sciences, University of Washington

Sea Grant Washington

Washington Sea Grant Program
University of Washington
3716 Brooklyn Avenue N.E.
Seattle, WA 98105-6716
Campus Mail: Box 355060
206.543.6600
Fax: 206.685.0380

seagrant@u.washington.edu

wsg.washington.edu

International Pacific Halibut Commission

NOAA Fisheries Service

Suggested citation: Melvin, E.F., M.D. Wainstein, K.S. Dietrich, K.L. Ames, T.O. Geernaert, and L.L. Conquest, 2006.
The Distribution of Seabirds on the Alaskan Longline Fishing Grounds: Implications for Seabird Avoidance Regulations.
Washington Sea Grant Program. Project A/FP-7.

Available on loan from the National Sea Grant Library, and from the publisher.
WSG-AS 06-01

This publication is a final report of findings to the funding agencies.

This research was funded by the U.S. Fish and Wildlife Service,
Endangered Species and Migratory Bird Management Programs, Award 70181-9-J194
and Washington Sea Grant Program NOAA Grant No. NA04OAR4170032, Project A/FP-7.

Contents

List of Figures

List of Tables

Executive Summary

Seabird mortality in longline fisheries is a worldwide marine conservation problem. In the Alaska groundfish longline fisheries, incidental seabird mortality averaged 13,144 birds per year from 1993 to 2004, peaking at 26,269 seabirds in 1998. Procellariiform (or "tubenose") seabirds, which include albatross species, were the most frequently caught.

The short-tailed albatross, an endangered species under the U.S. Endangered Species Act, is the focus of regulatory and conservation attention in the Alaska longline fisheries. The U.S. Fish and Wildlife Service's (USFWS) Biological Opinion specifies that short-tailed albatross takes exceeding six within a two-year period (four in the groundfish fishery and two in the Pacific halibut fishery) would trigger re-initiation of a Section 7 consultation in these respective fisheries and consequently, could interrupt or close Alaska's $320 million (ex-vessel value) groundfish and halibut longline fisheries.

In December 2001, the North Pacific Fishery Management Council took final action on seabird avoidance measures required in the Alaska longline fisheries for groundfish and Pacific halibut. These revised seabird avoidance requirements were based on the results of a study done in collaboration with industry on vessels fishing exclusively in open waters of the Bering Sea and Gulf of Alaska (GOA). During Council deliberations, the need for seabird avoidance devices for vessels fishing Alaskan inside waters — defined as Prince William Sound (PWS), Southeast Alaska (SEAK), and state waters of Cook Inlet (CI) for the purposes of seabird avoidance regulations — was strongly questioned. The Council acknowledged that albatrosses and other pelagic seabirds are unlikely to occur within these areas but that data on the distribution of these seabirds were insufficient to rule out the need for seabird mitigation in these inside waters. Ultimately, a less stringent set of regulations was adopted for vessels fishing inside waters as compared to vessels fishing all other waters of Alaska.

Given the paucity of data on seabird distribution in Alaskan waters and the need to manage Alaska's longline fisheries based on the best available science, Washington Sea Grant Program (WSGP) developed a three-year collaborative program with the International Pacific Halibut Commission (IPHC), the National Marine Fisheries Service (NMFS) Alaska Fisheries Science Center Auke Bay Laboratory, and the Alaska Department of Fish and Game (ADFG) to collect seabird distribution data in the course of Pacific halibut and sablefish stock assessment surveys on longline vessels. In this report, we provide the most current and comprehensive data on the distribution patterns of seabirds on the Alaskan longline fishing grounds and recommend regulatory changes based on analyses of this unique data set.

Seabird data were collected from 2002-2004 during four summer longline stock assessment surveys: IPHC halibut surveys, NMFS sablefish surveys, ADFG Southeast Inside sablefish surveys, and ADFG Prince William Sound sablefish surveys. The number of seabirds by species or species group was recorded within a 50-m radius of each survey vessel's stern immediately after each set was retrieved, providing a snapshot of presence and absence of species and their relative abundance. Seabird sightings at each survey station across all three years were compared among eight geographic regions, comprised of two inside waters areas (PWS and SEAK) and six outside waters areas (all other Alaskan waters). Because only one survey station was located within the inside waters of CI, this area was not included in quantitative analyses of inside waters.

An average of 1,456 stations were surveyed each year, and a total of 230,452 birds were observed over three years. Most birds seen were tubenose seabirds (85% of all birds sighted), and of these, most were northern fulmars (71% of all birds sighted) or albatrosses (13% of all birds sighted). Albatrosses occurred throughout the fishing grounds in outside waters. Short-tailed albatrosses were extremely rare (0.03% of all sightings) and had a similar distribution to Laysan albatrosses — rare or absent east and south of the Western GOA and most abundant in the Aleutian Islands. Black-footed albatrosses were more ubiquitous, occurring in all outside waters.

Albatrosses and other tubenose species (fulmars and shearwaters) were absent in our observations of PWS, and extremely rare in SEAK. When sighted in SEAK, tubenose birds were geographically limited to the mouth of Chatham Strait and Dixon Entrance, making area management very tractable. Our survey data were insufficient to evaluate seabird distributions in CI.

Seabird data from the North Pacific Pelagic Seabird Database (NPPSD) and US Fish and Wildlife Service (USFWS) provided an expanded temporal and spatial assessment of seabird distribution in inside waters, spanning up to 26 years and including Cook Inlet. These data corroborated our findings, demonstrating that albatrosses were exceedingly rare or absent, and shearwaters and fulmars uncommon to absent, in all inside waters.

Collectively, data from our surveys and all other available sources strongly suggest that longline fishing poses little to no risk to albatrosses and other tubenose seabirds in Alaskan inside waters. Although longline fishing may pose some small degree of risk to seabird species that were sighted in inside waters (northern fulmars and shearwaters in highly localized areas of PWS and CI, black-legged kittiwakes in PWS, and gulls in all inside waters), none of these species are USFWS-identified birds of conservation concern. In addition, less than 5% of the longline takes of these species occurs in the GOA, strongly suggesting that the relative risk to these species is low in this region. Finally, the characteristics of most vessels fishing inside waters (considerably fewer hooks set, hooks set at slower speeds so they sink quickly, and little or no offal production) make them generally unattractive to seabirds, reducing the risk of incidental mortality even further.

Recommendations

Inside Waters

- We recommend that seabird avoidance requirements be eliminated for longline vessels fishing in the inside waters of Prince William Sound (NMFS Area 649), Southeast Alaska (NMFS Area 659), and state waters of Cook Inlet. Currently, in inside waters, these regulations require vessels 26-32 ft and 32-55 ft (without masts, poles, or rigging) to tow one buoy bag line, and vessels 32-55 ft (with masts, poles, or rigging) and > 55 ft to tow a single streamer line. If implemented, this action would affect 42% of the Alaska longline fleet, which lands 10% of the Alaska longline catch. Of this affected segment of the fleet, 85% are small vessels (≤ 55 ft) and over half fish with snap-on gear.
- The presence of black-footed albatrosses, northern fulmars, and shearwaters in southern Chatham Strait and Dixon Entrance of the Southeast Alaska region suggests increased risk to seabirds from longline fishing in these small areas. If this risk is deemed significant, the definition of inside waters (for the purpose of seabird avoidance regulations) could be amended to exclude these areas. Specifically, ADFG statistical areas 345603 and 345534 in Chatham Strait, and 325431 and 325401 in Dixon Entrance could be reclassified as "outside waters", where seabird avoidance regulations would continue to be required.

Outside Waters

- Based on these data, we recommend that existing seabird avoidance requirements be maintained in all outside waters. For recommendations on small vessels fishing fixed gear in outside waters, see also *Seabird Avoidance Measures for Small Alaskan Longline Vessels* by Melvin and Wainstein (WSGP 2006, p.19).

Research

- Our seabird sighting data have proven extremely valuable with regard to ecosystem-based fisheries management. We strongly support efforts to institutionalize the collection and management of seabird observation data from fish stock assessment surveys at NMFS and IPHC. We also strongly support making these data available through the NPPSD.
- We strongly encourage efforts to expand this seabird survey protocol to all Alaska and Northwest Fisheries Science Center surveys to broaden the temporal and spatial scope of this data set for application to other fisheries. Incorporating this protocol into North Pacific Groundfish Observer Program data collection should also be explored to expand temporal and spatial coverage.

Introduction

Seabird mortality in longline fisheries is a worldwide marine conservation problem (Robertson and Gales 1998). Seabirds aggregate in response to fishing operations and can become hooked and drown as they attack sinking baited hooks. Because many seabirds are long-lived with delayed maturity and limited reproductive capability, their populations are highly vulnerable to adult mortality. Even low levels of adult mortality can halt population growth or cause decline (Croxall et al. 1990; Weimerskirch et al. 1997).

In the Alaska groundfish longline fisheries, incidental seabird mortality averaged 13,144 birds per year from 1993 to 2004, ranging from a high of 26,269 seabirds in 1998 to a low of 4,106 in 2002 (Table 1). Procellariiform seabirds (referred to as tubenose seabirds) — northern fulmars, albatrosses, and shearwaters — were, as a group, the most frequently caught (68.7%). Tubenose seabirds are the most oceanic of avian species, since most return to land only to breed or seek refuge from storms. The remaining takes included gull species (20%), unidentified seabirds (10.9%), and other seabird species (0.4%, including kittiwakes).

Among the tubenose seabirds, most takes were of northern fulmars (57.6%; Table 1). Laysan and black-footed albatrosses accounted for 4% and 1.4% of all birds taken, respectively. Although no short-tailed albatrosses have been observed taken since 1998, the US Fish and Wildlife Service (USFWS) estimates that two short-tailed albatrosses are taken each year in the Alaska groundfish longline fisheries (USFWS 2003). The extent of seabird mortality in the Pacific halibut (*Hippoglossus stenolepis*) longline fishery is poorly understood due to the lack of systematic at-sea catch monitoring in this fishery.

Regulatory and conservation attention in the Alaska longline fisheries is focused on the incidental mortality of the short-tailed albatross, an endangered species under the US Endangered Species Act (ESA). The USFWS' Biological Opinion specifies that short-tailed albatross takes exceeding six within a two-year period (four in the groundfish fishery and two in the Pacific halibut fishery) would trigger re-initiation of a Section 7 consultation in these respective fisheries (USFWS 2003) and consequently, could interrupt or close Alaska's $320 million (ex-vessel value) groundfish and halibut longline fisheries. The Biological Opinion requires that mitigation devices be used in these fisheries and that research be conducted to test their effectiveness.

Conservation concern for black-footed and Laysan albatross populations has increased recently. In 2003, the World Conserva-

Table 1. NMFS estimates of incidental seabird take in Alaska demersal groundfish longline fisheries, 1993-2004 (excluding the halibut fishery; data from NMFS, *www.afsc.noaa.gov/refm/reem/doc/Seabird%20bycatch%20tables%201993-2004_13April2006.pdf*). STAL = short-tailed albatross, LAAL = Laysan albatross, BFAL = black-footed albatross, Unid tubenose = identified as albatross or other tubenose, Other = all other identified seabird species (including kittiwakes, comprising less than 0.24% of total). For scientific names, see Table 4. Mean % by location = 12-year mean percentage caught in Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA).

Year	STAL	LAAL	BFAL	Fulmar	Shearwater	Unid tubenose	Gull	Other	Unid seabird	TOTAL
1993	0	748	41	5,012	124	358	876	21	1,991	9,171
1994	0	480	44	5,247	709	435	1,772	8	2,669	11,364
1995	0	532	305	10,346	370	906	4,096	53	4,411	21,019
1996	4	391	685	6,405	504	77	1,628	96	464	10,254
1997	0	426	109	16,067	382	191	3,486	9	949	21,619
1998	8	1,672	330	16,544	1,156	29	4,476	102	1,952	26,269
1999	0	758	201	8,243	551	422	2,521	60	926	13,682
2000	0	552	171	11,345	560	101	4,744	21	1,608	19,102
2001	0	476	78	5,724	479	118	2,570	41	1,026	10,512
2002	0	52	33	812	154	25	2,621	27	382	4,106
2003	0	194	166	3,180	289	14	1,414	118	273	5,648
2004	0	120	35	1,962	726	100	1,363	62	611	4,979
12-year mean	**1**	**533**	**183**	**7,574**	**500**	**231**	**2,631**	**52**	**1,439**	**13,144**
% of total birds	**0.01**	**4.1**	**1.4**	**57.6**	**3.8**	**1.8**	**20.0**	**0.4**	**10.9**	**100**
mean % in BS	100.0	37.2	3.8	86.4	85.8	65.7	93.9	85.3	87.9	84.5
mean % in AI	0.0	43.8	6.0	8.5	10.3	19.3	2.5	4.5	8.9	9.0
mean % in GOA	0.0	19.0	90.2	5.1	3.8	15.0	3.6	10.2	3.2	6.5

tion Union (IUCN), an international conservation consortium, changed the conservation status of the black-footed albatross from vulnerable to endangered and Laysan albatross from least concern to vulnerable (IUCN 2003). In addition, in September 2004, the Turtle Island Restoration Network, Center for Biological Diversity, and Earth Justice filed a petition to list the black-footed albatross, a USFWS bird of conservation concern (USFWS 2002), as threatened or endangered under the ESA. USFWS will conduct a formal review of the petition to list the black-footed albatross and is in the process of completing population assessments of both albatross species (M. Naughton, USFWS, pers. comm.). These events reflect an increasing need for fishery managers to address the mortality of all three North Pacific albatross species. Of the other seabird species taken with any frequency in Alaska longline fisheries (i.e., more than 1% of total incidental catch: northern fulmars, gull species, and shearwaters; Table 1), none is listed as a bird of conservation concern by the USFWS (USFWS 2002) or as threatened by the IUCN (IUCN 2003). Red-legged kittiwakes are a USFWS bird of conservation concern; however, takes of red-legged kittiwakes are extremely rare in Alaska longline fisheries (estimated at 1 individual per year) and have been recorded exclusively in the Bering Sea (S. Fitzgerald, National Marine Fisheries Service [NMFS], pers. comm.).

In December 2001, the North Pacific Fishery Management Council (Council) took final action on seabird avoidance measures required in the Alaska longline fisheries for groundfish and Pacific halibut (NMFS 2001). These revised seabird avoidance requirements (NMFS 2004), which went into effect in February 2004, were based on the results of a 2-year study done in collaboration with industry on vessels 65 ft length overall (LOA) and longer (Melvin et al. 2001). Streamer lines, sometimes called tori lines or bird scaring lines, were found to reduce the incidental mortality of surface foraging seabirds such as northern fulmars and albatrosses by nearly 100%, and they were adopted as required seabird avoidance measures for most vessels over 55 ft. Recognizing that the majority of the Alaska fleet is composed of vessels less than 55 ft LOA (with some unknown mix of rigging, gear type, and crew size), and that research was not conducted on this size class of vessels, the Council adopted more flexible requirements for smaller vessels.

In these same Council deliberations, the need for seabird avoidance devices for vessels fishing Alaskan inside waters (defined as Prince William Sound, Southeast Alaska, and state waters of Cook Inlet for the purposes of seabird avoidance regulations) was strongly questioned. The Council's Scientific and Statistical Committee (SSC) acknowledged that albatrosses and other pelagic (i.e., tubenose) seabirds are unlikely to occur within these waters; however, they also acknowledged that data on the distribution of albatrosses and other tubenose seabirds were insufficient to rule out the need for seabird mitigation in these inside waters. Based on this discussion, the Council adopted less stringent requirements for vessels fishing these inside waters (vessels fishing outside waters are required to use a second seabird avoidance measure). The absolute number of vessels fishing inside waters was not well established, but many were thought to be small vessels with limited capability to deploy seabird avoidance gear. Additionally, these small vessels generally set considerably fewer hooks, set gear at slower speeds, land fewer fish, and have no or less offal discharge compared to larger vessels fishing outside waters. It is highly likely that these characteristics minimize seabird interactions with longline fishing operations within inside waters regardless of seabird species present.

Given the paucity of data on seabird distribution in Alaskan waters and the need to manage Alaska's longline fisheries based on the best available science, Washington Sea Grant Program (WSGP) developed a three-year collaborative program with the International Pacific Halibut Commission (IPHC), NMFS Alaska Fisheries Science Center Auke Bay Laboratory, and the Alaska Department of Fish and Game (ADFG) to collect seabird data in the course of Pacific halibut and sablefish (*Anoplopoma fimbria*) stock assessment surveys on longline vessels. Preliminary data from 2002, the first year of seabird surveys, suggested that tubenoses were rare or absent in inside waters (Melvin et al. 2004). In this report, we provide the most current and comprehensive data on the distribution patterns of seabirds on the Alaskan longline fishing grounds and recommend regulatory changes based on analyses of this unique data set. In addition, we provide a characterization of the Alaska longline fishing fleet and quantify the number and size class of fishing vessels potentially affected by suggested regulatory changes.

Methods

Seabird Surveys

Seabird data were collected from 2002-2004 during four summer longline stock assessment surveys (Figure 1, Table 2):

1. IPHC coastwide halibut survey (IPHC 2002; IPHC 2003; IPHC 2004);
2. NMFS sablefish survey (Rutecki 2004a; Rutecki 2004b; Rutecki 2005);
3. ADFG Northern and Southern Southeast Inside (NSEI and SSEI) sablefish surveys (Holum 2003; Holum 2004; Holum 2005; Richardson 2003a; Richardson 2003b); and
4. ADFG Prince William Sound (PWS) sablefish survey (2004 only; no cruise report available).

At-sea fish samplers were trained to identify and quantify North Pacific seabirds. They recorded the number of seabirds by species or species group, both on the water and in the air within a 50-m radius of the vessel's stern immediately after each set was retrieved (Figure 2). This snapshot methodology provides data on the presence and absence of species and their relative abundance. All albatrosses (short-tailed, Laysan, and black-footed) and northern fulmars were identified to species. When possible, kittiwakes were identified to species (red- versus black-legged); however, if this was not possible, birds were identified to the species group level of kittiwake. Gulls, terns, shearwaters, storm-petrels, jaegers, alcids, and cormorants were identified to the species group level. Unidentified birds were recorded as such. All sets were monitored during gear retrieval for incidental seabird mortality.

IPHC Stock Assessment Survey

The IPHC stock assessment survey encompasses offshore waters from Oregon to the island of Attu in the Aleutian Islands (IPHC 2002; IPHC 2003; IPHC 2004). Survey results, which are independent of the commercial fishery, provide standardized catch statistics and biological data for the halibut stock assessment. The survey consists of predetermined stations located on a 10 by 10 nautical mile (nm) grid and divided into 27 survey regions. Approximately 80% of the commercial halibut catch is taken inside or within 20 nm of the IPHC survey area.

During 2002, 2003, and 2004, seabird observations were conducted at 1,228, 1,218, and 1,227 stations, respectively (an average of 99% of all stock assessment stations surveyed by IPHC) yielding a total of 3,673 observations. Twelve to thirteen vessels (LOA range: 55-122 ft) participated in the survey each year, which occurred from May 26 to September 5 over the three years (Table 2). The sequence in which stations were fished each

Table 2. Seabird survey descriptions for all agencies and all years. IPHC = International Pacific Halibut Commission, NMFS = National Marine Fisheries Service, ADFG = Alaska Department of Fish and Game. SSEI = South Southeast Inside, NSEI = North Southeast Inside, PWS = Prince William Sound.

Agency	Survey	Year	Observation Dates	Stations
IPHC	Coast-wide halibut	2002	June 2 – September 2	1,228
IPHC	Coast-wide halibut	2003	May 26 – September 5	1,218
IPHC	Coast-wide halibut	2004	May 30 – August 28	1,227
NMFS	Coast-wide sablefish	2002	June 4 – September 3	144
NMFS	Coast-wide sablefish	2003	June 2 – August 30	141
NMFS	Coast-wide sablefish	2004	June 5 – August 30	144
ADFG	Southeast Inside sablefish	2002	May 21 – May 26 (SSEI); August 13 – August 18 (NSEI)	80
ADFG	Southeast Inside sablefish	2003	May 20 – May 25 (SSEI); August 3 – August 7 (NSEI)	76
ADFG	Southeast Inside sablefish	2004	May 21 – May 26 (SSEI); August 5 – August 9 (NSEI)	81
ADFG	PWS sablefish	2004	August 31 – September 14	29
Total				4,368

year within each of the 27 survey regions was based on skipper's preference, generating a non-sequential spatial fishing pattern, although the underlying systematic grid pattern of the surveys remained constant. At each station, five to eight 550-m skates, consisting of 100 size 16/0 circle hooks on gangions spaced 5.5 m apart, were deployed. Each hook was baited with #2 semi-bright chum salmon. All vessels processed fish intermittently during surveys and discarded offal primarily in the form of fish guts (non-macerated). The survey depth range was 27 to 823 m. Vessels fishing outside waters deployed two streamer lines during gear deployment, while vessels fishing inside waters deployed one streamer line (average streamer line aerial extent was 41 m, 36 m, and 40 m in 2002, 2003, and 2004, respectively).

NMFS Sablefish Survey

The NMFS sablefish survey collects data to estimate the relative abundance and size composition of sablefish on the upper continental shelf (Rutecki 2004a; Rutecki 2004b; Rutecki 2005). All of the major fishing grounds are sampled with the exception of the western Aleutians (west of the international date line).

During 2002, 2003, and 2004, seabird observations were conducted at 144, 141, and 144 survey stations, respectively (an average of 98% of all stock assessment stations surveyed by NMFS), yielding a total of 429 observations. A single vessel (150 or 155 ft LOA) conducted the surveys each year from June 2 to September 3 (Table 2). Survey stations were fished at the same time and place year to year, from west to east ending in Kodiak, and from south to north starting in Ketchikan. Survey gear consists of 160 100-meter skates, each with 45 size 13/0 hooks spaced 2 m apart. Each hook was baited with *Illex* spp. squid. All vessels processed fish intermittently during surveys and discarded offal primarily in the form of fish heads and guts (non-macerated). Survey depths ranged from 200 m to 1,000 m. Paired streamer lines were deployed during gear deployment operations (average streamer line aerial extent was 38 m, 19 m, and 50 m in 2002, 2003, and 2004, respectively).

ADFG Southeast Alaska Sablefish Surveys

The Northern and Southern Southeast Inside Alaska (NSEI and SSEI or collectively SEAK) sablefish surveys are designed to estimate the relative abundance of sablefish and to provide biological data on sablefish and rockfish (*Sebastes* and *Sebastolobus* spp.; Holum 2003; Holum 2004; Holum 2005; Richardson 2003a; Richardson 2003b). Designed in 1988, the survey stations were randomly chosen from statistical areas where the majority of commercial fishing occurred and where depths were greater than 200 fathoms (366 m). Surveys sample approximately 80% of the SEAK fishing grounds, and approximately 90% of the catch is from within the surveyed area.

During 2002, 2003, and 2004, seabird observations were conducted at 80, 76, and 81 survey stations, respectively (an average of 98% of all Southeast stock assessment stations surveyed by ADFG), yielding a total of 237 observations. Five vessels (LOA range: 52-70 ft) conducted the two surveys each year from May 20 to August 18 (Table 2). In NSEI, stations were typically fished from south to north in each of three sections (south, central, and north Southeast Alaska), with some variation due to weather and logistics. In SSEI, station sequence was variable between years and highly dependent on weather. Twenty-five 90-m standard skates, each consisting of 45 size 13/0 circle hooks spaced two meters apart, were set at each station. Each hook was baited with *Illex* spp. squid. All vessels processed fish intermittently during surveys and discarded offal primarily in the form of fish heads and guts (non-macerated). Survey depths ranged from 187 to 732 m. Most of the survey vessels deployed a single streamer line during setting; one vessel deployed two (average streamer line aerial extent was 26 m and 40 m in 2003 and 2004, respectively; no data were available for 2002).

ADFG Prince William Sound Groundfish Survey

The ADFG Prince William Sound (PWS) groundfish survey is conducted to determine the relative abundance and composition of groundfish caught on longline gear within PWS sablefish habitat (Bechtol and VanSant 1997). Designed in 1996, the survey covers inside waters of western PWS at depths greater than 183 m. PWS was divided into quadrants, and sampling effort among quadrants was based on catch harvested in the commercial fishery as indicated by ADFG commercial fish ticket data. Eastern PWS was not included in the groundfish survey because it has yielded only seven percent of the commercial harvest since 1987 and the minimum number of stations could not be sampled in the time available. Prior to the survey, stations within a quadrant were randomly selected from a pool of stations having at least some habitat deeper than 183 m. Because the stations are randomly assigned over the area, they sample approximately 50% of the commercial fishing grounds.

Seabird data were collected only in 2004. A total of 29 seabird observations were completed at the 29 unique survey stations by a single vessel (58 ft LOA) fishing from August 31 to September 14, 2004 (Table 2). The sequence of stations was dependent on weather and logistics. At each station, fifteen 100-m skates, each consisting of 45 size 13/0 circle hooks on gangions spaced two m apart, were deployed. Each hook was baited with *Illex* spp. squid. The survey vessel processed fish intermittently during surveys and discarded offal primarily in the form of fish heads and guts (non-macerated). Survey depths in 2004 ranged from 190 to 760 m. While the gear was being set, a single buoy was towed as a seabird avoidance device.

Survey Data Analyses

WSGP and IPHC entered, edited, and managed the seabird observation data, which were later imported into a central database at IPHC. We calculated the mean number of seabirds observed over the three-year period at each individual survey station using ArcGIS (ESRI, Redlands, CA). Surveys were not necessarily conducted at precisely the same location each year; however, deviations were slight and stations were subsequently assigned intended station coordinates for mapping purposes. Maps were

generated of the distribution of all species or species groups using averaged data for each station.

For quantitative analyses, we used two-factor analysis of variance (ANOVA) to compare mean seabird counts by region, year (2002-2004), and their interaction (S-Plus 6.2; Anon. 2001). We identified eight regions based on regulatory designations and preliminary analysis, including six regions categorized as outside waters and two as inside waters. For analyses of Alaskan outside waters (3-200 nm), NMFS regulatory areas (see *www.fakr.noaa.gov/rr/ figures/fig1.pdf* and *www.fakr.noaa.gov/rr/figures/fig3.pdf*) were grouped into the following regions: Bering Sea (BS; NMFS Areas 509-530), Aleutian Islands (AI; NMFS Areas 541-543), Western Gulf of Alaska (W-GOA; NMFS Areas 610, 620, and 630), and Eastern Gulf of Alaska (E-GOA; NMFS Areas 640 and 650). The two remaining outside waters were British Columbia (BC) and Washington/Oregon (WA/OR). Inside waters were defined as Prince William Sound (NMFS Area 649, 5 AAC [Alaska Administrative Code] 28.205(a), Inside District only, Figure 3a) and Southeast Alaska (NMFS Area 659, 5 AAC 28.105(a)(1) and (2), Inside Subdistricts only, Figure 3b). As only one survey station occurred within the inside waters of Cook Inlet District (5 AAC 28.305(a), Figure 3c), Cook Inlet was excluded from quantitative comparisons.

ANOVAs were run for each species or species group. Although our data did not meet the assumptions of normality or independence, error variances generated by standard ANOVA from highly skewed data such as these tend to be inflated (thus decreasing the power of any ANOVA F-test), yielding p-values that are conservative estimates of statistical significance. Species included short-tailed albatross, Laysan albatross, black-footed albatross, and northern fulmar. Species groups included shearwater species, gull species, kittiwakes, all tubenoses combined, and total seabirds. Kittiwakes (black- and red-legged) were not analyzed by species because the proportion of kittiwakes that were not identified to the species level varied dramatically among years. Although storm-petrels are tubenose seabirds, they are not included in our analyses because the likelihood of their interacting with longline fishing gear is extremely low (North Pacific Groundfish Observer Program data, 1993-2004).

Post-hoc tests (e.g., Tukey's HSD) comparing mean observation rates between individual regions based on the standard ANOVAs, as well as Poisson, quasi-Poisson, binomial and negative binomial Generalized Linear Models, led to some cases of spurious, nonsensical results due to overdispersion of the data. This phenomenon was due to extremely unbalanced sample sizes (with Prince William Sound particularly low and Western Gulf of Alaska particularly high; Table 3), and infrequent sightings (many zero counts) of rare species (short-tailed albatross, shearwaters, and kittiwakes in particular). Consequently, we used bootstrap techniques (Efron and Tibshirani 1993) to compare mean observation rates between individual regions.

Bootstrapping generates standard error terms for estimated parameters based on the probability distribution of the data as opposed to a specified probability model. One thousand samples, each the size of the original data set, were taken using sampling with replacement, yielding a probability distribution for each statistic of interest. For each pair-wise comparison between areas, bootstrap coefficients were divided by their standard error to generate Z-values, which were used to calculate p-values. Those p-values were Bonferroni-corrected to account for multiple (28) pair-wise comparisons between analysis areas for each species or group. The models for post-hoc comparisons contained terms for region and year, but not their interaction. Due to small sample sizes in certain combinations of years and regions, including the interaction term led to unstable estimated coefficients and nonsensical results. We did not use bootstrap techniques for the full model, because S-Plus does not allow for extraction of F-ratios from bootstrap models.

We also present data summaries from the North Pacific Pelagic Seabird Database (NPPSD), including the multi-species transect/stationary sightings database (Drew and Piatt 2005) and the USFWS short-tailed albatross opportunistic sightings database (NPPSD 2005). Some conclusions contained in this document are based in part on information obtained from these sources. The author(s) have complied with published guidelines for the ethical use of such data.

Fleet Characterization

To identify vessels potentially affected by changes to seabird mitigation regulations, we attempted to characterize the longline fishing fleet through queries of agency databases of commercial effort in 2004. Both fish ticket (landings) and logbook data were queried in the IPHC commercial halibut database, while fish ticket data were queried in the Alaska Commercial Fisheries Entry Commission (CFEC) groundfish database (the ADFG groundfish database was structured such that identifying groundfish data complementary to IPHC results was not possible).

The number of unique vessels and pounds landed (whole weight) were summarized by area fished, vessel length, and gear type. Gear types were available only from halibut vessel logbooks and included snap-on gear (individual gangions are clipped on or off with snaps as the gear is deployed or retrieved) and fixed gear (individual gangions are permanently attached to the groundline). Melvin and Wainstein (2006) discuss the implications of gear type for seabird-fishery interactions in more detail.

Because a proportion of groundfish catcher-processor landings are not represented in CFEC records, we also incorporated hook-and-line landings data from Council reports made available through the Pacific Coast Fisheries Information Network (*www.psmfc.org/pacfin/pub_npfmc/r009.n04*).

Final results represent a synthesis of query results and provide estimated values for the entire Alaskan longline fishing fleet. Thirty-six halibut vessels (2.4% of fleet) were missing length information in the CFEC licensing database; consequently, the number of unique vessels and halibut pounds landed were slightly underestimated in queries by vessel length. In addition, only 58% of halibut vessels less than 55 ft LOA turned in logbooks; results by gear type are therefore presented as percentages, but are considered representative.

Results

Seabird Surveys

A total of 230,452 birds were observed over three years (Table 4). Most birds seen were tubenose seabirds (85% of all birds sighted), and of these, most were northern fulmars (71% of all birds sighted) or albatrosses (13% of all birds sighted). Gulls comprised 11% of all birds sighted while shearwaters comprised less than 1%.

For all seabirds combined and for tubenose seabirds, mean observation rates varied significantly by region and the interaction between region and year, but not by year (Table 5; for post-hoc comparison results see Table 6). Densities of both groups were significantly highest in the W-GOA, BS, and AI, and significantly lowest in the inside waters of SEAK and PWS (Table 3 and Figure 4). Although the density of northern fulmars — the most abundant tubenose seabird — drove these patterns, dominant domains were apparent for several species or species groups.

All species except the black-footed albatross were most abundant in one or more of the W-GOA, AI, and BS regions, and uncommon or absent from the E-GOA south to WA/OR (Table 3 and Figure 4). In addition, all species with the exception of gulls were extremely rare or absent in SEAK and PWS (see also *Inside versus Outside Waters* below). An inverse pattern was apparent in the number of surveys conducted in which no seabirds were sighted (Table 3). Few or no "zero bird" observations occurred in the W-GOA, AI, BS, and E-GOA, a moderate number occurred in BC and WA/OR, and no birds were seen in over half of the observations conducted in SEAK and PWS.

ANOVA and post-hoc comparison results for the remaining individual species and groups are presented in Tables 5 and 6. For all three albatross species, northern fulmars, and gulls, mean observation rates varied significantly by region, year, and the interaction between region and year. Mean shearwater and kittiwake observation rates varied significantly by region and the interaction between region and year, but not by year. Regional patterns for each species and species group are presented below.

Short-tailed albatrosses were rare relative to other seabirds (Table 3 and Figure 4) and were observed only in the W-GOA, AI, and BS (Figure 5). Short-tailed albatross observation rates were significantly higher in the W-GOA and the AI; however, rates in the BS were not statistically distinct from all other areas where no short-tailed albatrosses were observed. None were observed in inside waters. Sightings were consistent with opportunistic observations of short-tailed albatrosses reported year-round to the USFWS for 2002-2004 (NPPSD 2005; Figure 5).

Like short-tailed albatrosses, virtually all (99.8%) Laysan albatrosses were observed in the W-GOA, AI, and BS, and were exceedingly rare east and south of the W-GOA (Figure 6). Observation rates peaked significantly in the AI (14.5 birds per observation; Table 3 and Figure 4). No Laysan albatrosses were observed in inside waters.

Black-footed were the most ubiquitous albatross, observed in all outside waters (Table 3; Figures 4 and 7). Their distribution was nearly opposite to that of short-tailed and Laysan albatrosses; black-footed albatross concentrations were significantly greater from the W-GOA through WA/OR compared to the AI, BS, SEAK, and PWS. Black-footed albatrosses were absent in inside waters, with the exception of 28 individuals observed near the entrance of Chatham Strait (4 in 2002, 20 in 2003, and 4 in 2004) and a single individual sighted in 2003 in Dixon Entrance (Figures 8a and 8b). Consequently, black-footed albatross densities in SEAK (0.07 birds per observation) were statistically similar to the AI and BS (0.10 and 0.54 birds per observation, respectively). No black-footed albatrosses were observed in the inside waters of PWS (Figures 9a and 9b).

Northern fulmars were also observed in all outside waters (Figure 10) and were significantly more abundant in the W-GOA, AI, and BS (Figure 4, Tables 3 and 6). Northern fulmars were absent from PWS and most of SEAK. In 2003, 6 northern fulmars were sighted in the Chatham Strait area of SEAK on the same surveys during which black-footed albatrosses were observed. In addition, over the three survey years, 30 northern fulmars were observed in Dixon Entrance.

Shearwaters were relatively uncommon and, like black-footed albatrosses and fulmars, were observed in all outside waters (Figure 11). They were most abundant in the BS and AI, but these densities were not significantly different than those in the W-GOA or WA/OR (Figure 4, Tables 3 and 6). Shearwaters were absent in inside waters with the exception of 12 individuals observed in SEAK. Five shearwaters were sighted in 2002 near the entrance of Chatham Strait on a survey during which black-footed albatrosses were also observed. In addition, 7 other shearwaters were observed during two separate surveys in the Dixon Entrance area. No shearwaters were observed in the inside waters of PWS.

Unlike all other seabird species/groups, gulls were sighted in all outside and inside waters in all three years (Figure 12), with densities significantly highest in the AI at 16.0 birds per observation (Figure 4, Tables 3 and 6). Gulls were present in both SEAK and PWS (3.0 and 4.3 birds/obs, respectively).

Kittiwakes were uncommon overall compared to most other seabirds (Table 3). Both black-legged and red-legged kittiwakes peaked in abundance in the Bering Sea (Figure 13 and Table 3); however, black-legged kittiwakes were 10 times more abundant. Note that these results represent underestimates, as a mean of 30% of kittiwakes (across all three years) were not identified to species.

Inside versus Outside Waters

In Prince William Sound, no tubenose seabirds (albatrosses, northern fulmars or shearwaters) were sighted across all three years (Table 3). Gulls were the most abundant seabird in PWS, occurring at densities similar to those in all areas except the AI.

Table 3. Mean observation rates (seabirds per observation) within several large geographic regions and NMFS Alaska management areas (indicated in parentheses). WA/OR = Washington and Oregon, BC = British Columbia, GOA = Gulf of Alaska, SEAK = Southeast Alaska, and PWS = Prince William Sound. STAL = short-tailed albatross, LAAL = Laysan albatross, BFAL = black-footed albatross, BLKI = black-legged kittiwake, and RLKI = red-legged kittiwake. Zero birds indicates the percent of sets in which seabirds were absent in the observation zone.

	WA/OR	BC	Eastern GOA (640,650)	Western GOA (610,620,630)	Aleutian Islands (541-543)	Bering Sea (509-530)	SEAK Inside (659)	PWS Inside (649)
N sets	249	510	695	1753	331	340	425	65
STAL	0	0	0	0.02	0.07	0.02	0	0
LAAL	0.03	0.002	0.004	0.80	14.48	1.41	0	0
BFAL	10.02	3.70	11.47	5.64	0.54	0.10	0.07	0
Albatrosses total	**10.05**	**3.70**	**11.48**	**6.46**	**15.09**	**1.53**	**0.07**	**0**
Fulmar	2.84	3.04	17.08	60.58	58.44	70.55	0.08	0
Shearwater	0.37	0.29	0.13	0.53	1.18	1.45	0.03	0
Tubenoses total	**13.25**	**7.03**	**28.69**	**67.58**	**74.71**	**73.53**	**0.18**	**0**
Gulls	2.00	1.72	8.17	6.41	15.96	0.64	2.95	4.26
BLKI	0	0	0.10	0.12	0.11	1.09	0.02	1.00
RLKI	0	0	0	0.01	0.01	0.08	0	0
Kittiwakes total	0	0	0.11	0.13	0.16	2.03	0.02	1.00
Other	0.22	2.46	2.78	2.79	1.50	1.61	0.11	0.08
Grand totals	**15.5**	**11.2**	**39.7**	**76.9**	**92.3**	**76.9**	**3.3**	**5.3**
Zero birds	24%	28%	7%	2%	0%	0%	60%	52%

Table 4. Bird species sighted in the observation zone (Figure 2) during 2002-2004 IPHC, NMFS and ADFG fish stock assessment surveys.

Common name	Scientific Name	Number sighted	Relative Abundance (%)
Albatross species			
Short-tailed albatross	*Phoebastria albatrus*	69	0.03
Laysan albatross	*Phoebastria immutabilis*	6,682	2.90
Black-footed albatross	*Phoebastria nigripes*	22,487	9.76
Northern fulmar	*Fulmarus glacialis*	163,697	71.03
Shearwater species			
Short-tailed shearwater	*Puffinus tenuirostris*	526	0.23
Sooty shearwater	*Puffinus griseus*	277	0.12
Pink-footed shearwater	*Puffinus creatopus*	85	0.04
Unidentified shearwater	*Puffinus spp.*	1,270	0.55
Gull species			
Glaucous-winged gull	*Larus glaucescens*	3,989	1.73
Herring gull	*Larus argentatus*	306	0.13
Mew gull	*Larus canus*	100	0.04
Sabine's gull	*Xema sabini*	3	0.001
Unidentified gull	*primarily Larus spp.*	20,930	9.08
Kittiwake species			
Black-legged kittiwake	*Rissa tridactyla*	752	0.33
Red-legged kittiwake	*Rissa brevirostris*	41	0.02
Unidentified kittiwake	*Rissa spp.*	327	0.14
Other species			
Fork-tailed storm petrel	*Oceanodroma furcata*	6,306	2.74
Leach's storm petrel	*Oceanodroma leucorhoa*	27	0.01
Unidentified storm petrel	*Oceanodroma spp.*	2,271	0.99
Unidentified tern	*Sterna spp.*	25	0.01
Parasitic jaeger	*Stercorarius parasiticus*	11	0.005
Pomarine jaeger	*Stercorarius pomarinus*	4	0.002
Unidentified jaeger	*Stercorarius spp.*	30	0.01
Tufted puffin	*Fratercula cirrhata*	10	0.004
Horned puffin	*Fratercula corniculata*	1	0.0004
Unidentified puffin	*Fratercula spp.*	32	0.01
Rhinoceros auklet	*Cerorhinca moncerata*	1	0.0004
Unidentified alcid	*(various)*	111	0.03
Unidentified cormorant	*Phalacrocorax spp.*	1	0.0004
Unidentified marine bird	*(unknown)*	76	0.03
Bald eagle	*Haliaeetus leucocephalus*	5	0.002
Grand Total		230,452	100

Table 5. F- and p-value results of analysis of variance by species. Full model includes analysis area (df = 7), year (df = 2), and the analysis area by year interaction (df = 14). * = interaction, ns = not significant.

Species	Factor	F-value	p-value
Short-tailed albatross	analysis area	6.353	< 0.001
	year	3.490	0.031
	analysis area* year	2.773	< 0.001
Laysan albatross	analysis area	128.488	< 0.001
	year	8.631	< 0.001
	analysis area* year	9.601	< 0.001
Black-footed albatross	analysis area	33.473	< 0.001
	year	24.024	< 0.001
	analysis area* year	2.523	0.001
Albatrosses total	analysis area	31.967	< 0.001
	year	22.416	< 0.001
	analysis area* year	3.913	< 0.001
Northern fulmar	analysis area	189.695	< 0.001
	year	7.291	< 0.001
	analysis area* year	9.555	< 0.001
Shearwater species	analysis area	7.340	< 0.001
	year	0.544	ns
	analysis area* year	2.870	< 0.001
Tubenoses total	analysis area	151.833	< 0.001
	year	2.340	ns
	analysis area* year	7.792	< 0.001
Gull species	analysis area	54.821	< 0.001
	year	13.576	< 0.001
	analysis area* year	2.867	< 0.001
Kittiwake species	analysis area	82.487	< 0.001
	year	0.713	ns
	analysis area* year	5.005	< 0.001
Total birds	analysis area	171.827	< 0.001
	year	0.888	ns
	analysis area* year	7.249	< 0.001

Table 6. Results for bootstrapped post-hoc pairwise comparisons between analysis areas for all species and all areas. P-values are Bonferonni corrected, ns = not significant. AI = Aleutian Islands, BC = British Columbia, BS = Bering Sea, EGOA = Eastern Gulf of Alaska, PWS = Prince William Sound, SEAK = Southeast Alaska, WA/OR = Washington and Oregon, WGOA = Western Gulf of Alaska. STAL = short-tailed albatross, LAAL = Laysan albatross, BFAL = black-footed albatross, Alb Tot = albatrosses combined, NOFU = northern fulmar, SH = shearwater species, KI = kittiwake species (combined).

Area comparison	STAL	LAAL	BFAL	Alb Tot	NOFU	SH	Tubenoses	Gulls	KI	Total Birds
AI - BC	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001	ns	< 0.001
AI - BS	ns	< 0.001	ns	< 0.001	ns	ns	ns	< 0.001	< 0.001	ns
AI - EGOA	< 0.01	< 0.001	< 0.001	ns	< 0.001	< 0.001	< 0.001	< 0.001	ns	< 0.001
AI - PWS	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	ns	< 0.001
AI - SEAK	< 0.01	< 0.001	ns	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	ns	< 0.001
AI - WA/OR	< 0.01	< 0.001	< 0.001	ns	< 0.001	ns	< 0.001	< 0.001	ns	< 0.001
AI - WGOA	ns	< 0.001	< 0.001	< 0.001	ns	ns	ns	< 0.001	ns	ns
BC - BS	ns	< 0.001	< 0.001	< 0.001	< 0.001	< 0.05	< 0.001	< 0.01	< 0.001	< 0.001
BC - EGOA	ns	ns	< 0.001	< 0.001	< 0.001	ns	< 0.001	< 0.001	< 0.01	< 0.001
BC - PWS	ns	ns	< 0.001	< 0.001	ns	ns	< 0.001	ns	< 0.05	< 0.05
BC - SEAK	ns	ns	< 0.001	< 0.001	< 0.001	ns	< 0.001	< 0.05	ns	< 0.01
BC - WA/OR	ns	ns	< 0.001	< 0.001	ns	ns	< 0.01	ns	ns	ns
BC - WGOA	< 0.01	< 0.001	< 0.05	< 0.001	< 0.001	ns	< 0.001	< 0.001	< 0.001	< 0.001
BS - EGOA	ns	< 0.001	< 0.001	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
BS - PWS	ns	< 0.001	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	ns	ns	< 0.001
BS - SEAK	ns	< 0.001	ns	< 0.001	< 0.001	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001
BS - WA/OR	ns	< 0.001	< 0.001	< 0.001	< 0.001	ns	< 0.001	< 0.05	< 0.001	< 0.001
BS - WGOA	ns	< 0.05	< 0.001	< 0.001	ns	ns	ns	< 0.001	< 0.001	ns
EGOA - PWS	ns	ns	< 0.001	< 0.001	< 0.001	ns	< 0.001	ns	ns	< 0.001
EGOA - SEAK	ns	ns	< 0.001	< 0.001	< 0.001	ns	< 0.001	< 0.001	ns	< 0.001
EGOA - WA/OR	ns	ns	ns	ns	< 0.001	ns	< 0.001	< 0.001	< 0.01	< 0.001
EGOA - WGOA	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.05	< 0.001	ns	ns	< 0.001
PWS - SEAK	ns	ns	< 0.01	< 0.05	ns	ns	ns	ns	< 0.05	ns
PWS - WA/OR	ns	ns	< 0.001	< 0.001	ns	ns	< 0.001	ns	< 0.05	< 0.001
PWS - WGOA	< 0.05	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	ns	ns	< 0.001
SEAK - WA/OR	ns	ns	< 0.001	< 0.001	< 0.05	ns	< 0.001	ns	ns	< 0.001
SEAK - WGOA	< 0.01	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
WA/OR - WGOA	< 0.01	< 0.001	< 0.01	< 0.05	< 0.001	ns	< 0.001	< 0.001	< 0.001	< 0.001

In SEAK, no short-tailed or Laysan albatrosses were sighted across all three years (Table 3). Of those birds that did occur in SEAK, fulmar densities were significantly lower than in all outside areas. Mean densities of black-footed albatrosses and shearwaters were lowest in SEAK, but these were not statistically different than other areas where these species were also uncommon (the AI and BS in the case of black-footed albatrosses and WA/OR, BC, and the E-GOA in the case of shearwaters; Table 6 and Figure 4). Because shearwaters and kittiwakes were relatively rare, post-hoc comparisons detected few significant differences between inside and outside regions or among individual regions. Like in PWS, gulls were the most abundant seabird in SEAK, occurring at rates statistically similar to PWS, WA/OR, BC, and BS.

Over 50% of the stations surveyed in the inside waters of SEAK and PWS had no birds (63% and 52%, respectively; Table 3). In contrast, the highest percentage of "zero bird" observations from any outside waters region was nearly half that (28% in BC; Table 3).

Incidental Catch

Twenty-six seabirds were caught in the course of these surveys. No seabirds were killed in the course of IPHC surveys in 2002 and 2003; however, two unidentified gulls were caught outside of PWS (1 each in the W- and E-GOA) on two separate sets in 2004. Twenty-four birds were caught in the NMFS sablefish surveys over the three years. In 2002, incidental mortality included 2 Laysan albatrosses caught in the Aleutian Islands, and 1 black-footed albatross caught in outside waters of the E-GOA. In 2003 and 2004, 18 and 3 black-footed albatrosses were caught, respectively. Albatrosses were caught by NMFS in outside waters near Kodiak (W-GOA) and in the outside waters of SEAK (E-GOA). No seabirds were caught during ADFG cruises.

Incidental catch of seabirds was too rare for meaningful statistical comparisons; however, there were no apparent anomalous environmental conditions (wind direction, wind speed, swell, sea state) associated with these catch events. Seventy-five percent (18) of the birds were caught by NMFS in 2003, when streamer lines on NMFS survey vessels were maintained with an average aerial extent of 19 m — approximately one third the aerial distance now required as of 2004 under the revised NMFS seabird avoidance regulations.

Fleet Characterization

In 2004, longline vessels fishing *exclusively* in inside waters comprised 25% of the longline fleet (390 of 1,579 vessels), and were responsible for landing 2% (6 million pounds) of the longline catch (Table 7). Of these vessels fishing exclusively in inside waters, 91% were small (≤ 55 feet LOA) and an estimated 58% fished exclusively with snap-on gear (based only on halibut logbook data).

Longline vessels fishing in inside waters to some degree (i.e., a combination of vessels fishing inside waters exclusively and vessels which fish both inside and outside waters; 'Total inside' in Table 7) comprise 42% (666 vessels) of the longline fleet, and were responsible for landing 10% (40 million lbs) of the 2004 longline catch. Of these vessels fishing inside waters to some extent, 85% were small and an estimated 55% fished exclusively with snap-on gear (based only on halibut logbook data).

Table 7. Characterization of the Alaska longline fleet (halibut and groundfish) by vessel size and area fished in 2004. Inside only = number of unique vessels fishing exclusively in Prince William Sound, Southeast Alaska, and/or Cook Inlet (see text for precise definitions of these waters). Inside + Outside = number of unique vessels fishing both inside and outside (all other) waters. Total inside = number of unique vessels utilizing inside waters to some degree (sum of Inside only and [Inside + Outside]). Outside only = number of unique vessels fishing exclusively in outside waters (all federal and state waters of Alaska except those defined in Inside only). Landed weights are whole pounds. Percent boats and pounds are of grand total boats and pounds. Small boats = ≤ 55 ft LOA. Small landings = landings by small boats. Percent small boats and percent small landings are of boats and landings within each area. Gear characterization is from halibut logbook data only.

Area fished	Boats	Pounds	% boats	% pounds	Small boats	Small pounds	% small boats	% small landings
Inside only	390	6,048,988	24.7	1.5	356	5,304,530	91.3	87.7
Inside + Outside	276	33,526,131	17.5	8.3	212	17,401,986	76.8	51.9
Total inside	666	39,575,119	42.2	9.8	568	22,706,515	85.3	57.4
Outside only	913	365,599,545	57.8	90.2	664	45,285,216	72.7	12.4
Grand total	1,579	405,174,664	100.0	100.0	1232	67,991,732	78.0	16.8

Discussion

Seabird Surveys

Three years of seabird observations on IPHC, NMFS, and ADFG stock assessment surveys have generated an extensive and robust at-sea seabird sighting database for the longline fishing grounds, creating the opportunity to incorporate seabird distribution data into fishery management decisions. With regard to the potential for seabird-fishery interactions, these data demonstrate that as a group, albatrosses occurred throughout the fishing grounds in outside waters (i.e., 3-200 nm EEZ; with < 3% of stations in coastal state waters, our data do not broadly address 0-3 nm). Of the nearly 30,000 albatrosses sighted, only 69 (0.2%) were short-tailed albatrosses. Short-tailed and Laysan albatrosses had similar distributions; they were rare or absent east and south of the Western GOA, and most abundant in the Aleutian Islands. Black-footed albatrosses were more ubiquitous, occurring in all outside waters. Northern fulmars, gulls, and shearwaters were also present in all outside waters, with fulmars comprising the majority of all seabirds sighted (71%). Kittiwakes were present in outside waters from the Eastern GOA and northward, though they were relatively uncommon.

In our surveys of Prince William Sound, albatrosses were absent, though this area had the fewest survey stations. We also examined data from the North Pacific Pelagic Seabird Database (NPPSD; Drew and Piatt 2005) which represent both stationary sightings and transect surveys. These records were derived from systematic surveys conducted by biologists from 1975-1999 and include over 200 additional sighting records in PWS (Figure 9c). In these surveys, no albatrosses were seen, with the exception of a single black-footed albatross in PWS in 1975 (Figure 9d). Long-term survey data (1989-2004) from USFWS further confirm the absence of albatrosses in PWS (Sullivan et al. 2005). While no other tubenoses where sighted on our 2002-2004 surveys, both NPPSD and USFWS data indicate that fulmars and shearwaters do enter PWS, though their presence appears to be inconsistent across years (Sullivan et al. 2005) and localized primarily near the entrances to the sound (Alger and Kendall 1997, Drew and Piatt 2005).

In our surveys of Southeast Alaska, black-footed albatrosses, northern fulmars, and shearwaters were sighted at rates that were an order of magnitude lower than those in most other areas, and all were concentrated in the mouth of Chatham Strait and Dixon Entrance. Similarly, albatross species were absent from SEAK in over 350 NPPSD sighting records (Drew and Piatt 2005; Figures 8c and 8d), or in surveys conducted by USFWS in 1994 (Agler et al. 1995b). In addition, both these sources report occasional observations of fulmars and shearwaters in inside waters of SEAK, but primarily limited to the Chatham Strait and Dixon Entrance regions.

With only one survey station from the inside waters of Cook Inlet (CI), we were unable to directly address with our data the distribution of seabirds in CI as it relates to seabird-fishery interactions (though no albatrosses were sighted in outside waters of CI). However, NPPSD records (Drew and Piatt 2005) include over 600 sighting events in CI (with over 200 within the restricted definition of inside waters; Figure 9c). Despite considerable survey effort, no albatrosses were sighted in the inside waters of CI (Figure 9d), while northern fulmars and shearwaters were uncommon and found primarily in the central region of Lower Cook Inlet (an area that is outside the definition of CI inside waters). This same pattern was apparent from a second dataset available for CI from surveys conducted in the 1990s (Speckman 2002). In the inside waters of Cook Inlet, no albatrosses were sighted and northern fulmars were rare. While shearwaters were more abundant in greater Cook Inlet, they were not common in inside waters, and observations were almost exclusive to Kachemak Bay (Speckman 2002). Likewise, extensive USFWS surveys of Lower CI in 1993-1994 documented the absence of albatrosses and the presence of fulmars and shearwaters (Agler et al. 1995a). The relative abundances of the latter species were low compared to outside waters, and in inside waters of CI, their distributions were concentrated near the mouth of Kachemak Bay and Augustine Island.

Collectively, data from our surveys and all available sources strongly suggest that longline fishing poses little to no risk to albatrosses and other tubenose seabirds in Alaskan inside waters. In PWS and CI, a low level of risk of incidental take may exist for fulmars and shearwaters. In Alaska, fulmars and shearwaters are not birds of conservation concern (USFWS 2002), although fulmars and sooty shearwaters have been indicated as species of "moderate concern" in North America (Kushlan et al. 2002). However, of the entire Alaska longline incidental take of fulmars and shearwaters, only 5% are taken in the GOA, indicating that relative risk is low in this region in general (Table 1; see also discussion of gulls below). In SEAK, the locations where tubenoses were encountered in our study (and in other databases) were small, adjacent to outside waters, and similar for all tubenose species (including black-footed albatrosses), making area management very tractable (Figure 14).

Gulls were the only abundant species group consistently observed in all inside waters during our surveys and those of other agencies (NPPSD, Drew and Piatt 2005; Agler et al. 1995a, 1995b; Sullivan et al. 2005). If seabird avoidance regulations are relaxed or eliminated in inside waters as we recommend (see Recommendations), this spatial overlap with fisheries may suggest an increased risk to gull species; however, several factors counter this perception. Most vessels fishing in these waters are small (see Fleet Characterization sections in this report) and generally attract few seabirds. Typically, these small vessels set considerably fewer hooks, set gear at slower speeds so hooks sink more quickly below the reach of surface-feeding seabirds (Melvin and Wainstein 2006), and produce less offal or no offal at all. For example, during research trials to develop seabird mitigation measures for small vessels, conducted in the summer of 2002 on eight different vessels, no seabirds were observed interacting with longline gear (Melvin and Wainstein 2006).

While the spatial overlap of fisheries and species common in inside waters may lead to some incidental take, we note that no gull species nor black-legged kittiwakes are listed as a bird of

conservation concern by the USFWS, either nationally or in the Alaska Regions (USFWS 2002). This list represents species that, without additional conservation action, are likely to become candidates for listing under the ESA. Not only have management agencies not identified gulls as species of conservation concern, permitted lethal control programs in Alaska took an estimated 770 gulls statewide at airfields, landfills, and military bases in 2005 alone (K. Blejwas, ADFG, pers. comm.).

We also note that from 1993-2004, both before and after streamer lines were required, a small percentage (3.6%) of gulls taken in Alaskan waters were caught in the GOA (Table 1). While gull observation rates in PWS were not significantly different from those in the E- and W-GOA as per our data, effort in this small geographic area is most certainly a fraction of overall GOA longline fishing activity. Small vessel effort in the inside waters of SEAK is also expected to be low relative to all GOA longline activity; in addition, gull observation rates in SEAK are significantly lower than in the E- and W-GOA.

Similarly, while black-legged kittiwakes were sighted in PWS, and very rarely in SEAK, exceedingly few are caught in Alaska longline fisheries, even in the Bering Sea (Table 1) where they are most abundant (NMFS 2005). Additionally, black-legged kittiwakes are not listed as a bird of conservation concern (USFWS 2002), and the North Pacific population estimate is 2.6 million breeding individuals (Hatch and Nettleship 1998). While red-legged kittiwakes are identified as a bird of conservation concern (USFWS 2002), they were not sighted in our study in inside waters, are generally rare, and are observed taken only in the Bering Sea and at extremely low rates (3 observed takes in the longline fishery, 1993-2004; S. Fitzgerald, NMFS, pers. comm.).

Although limited temporally to a 3-month time period from roughly June through August each year, the survey period included the two peak months of mean incidental catch rates for black-footed albatrosses (June and August) and two of the four highest months of mean incidental catch rates (June and July) for Laysan albatrosses (North Pacific Groundfish Observer Program data, 1995-2003). Given these trends, our data clearly encompass a period when the risk of interactions between albatrosses and fishing vessels is high. In addition, with the exception of a handful of short-tailed albatrosses observed east of the W-GOA, our short-tailed albatross sightings fairly represented their range throughout the year during 2002-2004 (Drew and Piatt 2005).

Opportunistic data of short-tailed albatross sightings since 1940, reported by individuals to the USFWS (NPPSD 2005), include one additional sighting of an immature short-tailed albatross in SEAK (in the mouth of Chatham Strait) and none in PWS or CI. While these data were collected by individuals of unknown skill and are not verified, the area in which this short-tailed albatross was sighted is consistent with our black-footed albatross sightings in SEAK.

Across years, there were significant differences in observation rates for most individual species or species groups. This result is to be expected, given the natural variability of species migrations and distributions (e.g., see high interannual variability in fulmars and shearwaters, Lower CI; Table 4 in Agler et al. 1995a), and related biological and environmental factors. For example, during the same 3-year time period, sea surface temperature (a commonly used index related to ocean productivity) off the coast of AK, BC, WA, and OR, went from well below to well above the 50+ year average (Kalnay et al. 1996). The interaction term between region and year was significant for all species and species groups. This result is also to be expected given that the boundaries of each region are based on regulatory imperatives as opposed to seabird biology, and given that pelagic environments are by definition highly dynamic.

Although our dataset detected significant variability in seabird distribution between years and the interaction between region and year, we also found a consistent pattern: there were significantly fewer or no tubenose seabirds in inside waters. With the corroboration of all available data, we are confident of our conclusion that tubenose seabirds are rare in inside waters, regardless of broader annual changes in the environment and in seabird abundance and distribution. Given that these data represent the best information currently available on at-sea seabird distributions on the longline fishing grounds, we believe they are a sound basis on which to modify seabird avoidance regulations.

In 2004, the seabird monitoring protocol designed for this study was adapted to the Alaska Fisheries Science Center (AFSC) triennial groundfish trawl survey and, in 2005, to all AFSC groundfish surveys. Expansion of temporal and spatial coverage of this seabird monitoring tool will allow fishery managers to reliably determine risk posed to seabirds by the Bering Sea longline fishery for Pacific cod (*Gadus macrocephalus*), which minimally overlaps with the longline stock assessment surveys described here, and by trawl fisheries throughout Alaska.

Incidental Catch

Seabirds were caught incidentally by IPHC and NMFS during their stock assessment surveys. In particular, both black-footed and Laysan albatross mortalities were recorded by NMFS. The majority of these albatross captures occurred when streamer lines were not extended to the current (2004) performance standard distance (60 m), anecdotally demonstrating that adherence to performance standards is critical to the successful deterrence of seabirds.

Fleet Characterization

Using fleet data from IPHC and CFEC, we estimate that almost half of the fleet operates in inside waters to some degree. Over 85% of these vessels are small (≤ 55 feet LOA). Smaller vessels often have limited crew and limited infrastructure to effectively deploy streamer lines according to performance standards. Eliminating seabird mitigation regulations in inside waters, where albatrosses and other tubenose species are extremely rare or do not occur, and where incidental catch of gulls and black-legged kittiwakes is likely to be low and benign at the population level, would therefore provide significant relief to a considerable proportion of fishing vessels and to a size class in which deploying proven seabird avoidance gear may be difficult.

Recommendations

Inside Waters

- We recommend that seabird avoidance requirements be eliminated for longline vessels fishing in the inside waters of Prince William Sound (NMFS Area 649), Southeast Alaska (NMFS Area 659), and state waters of Cook Inlet. Currently, in inside waters, these regulations require vessels 26-32 ft and 32-55 ft (without masts, poles, or rigging) to tow one buoy bag line, and vessels 32-55 ft (with masts, poles, or rigging) and > 55 ft to tow a single streamer line. If implemented this action would affect 42% of the Alaskan longline fleet, which lands 10% of the Alaskan longline catch. Of this affected segment of the fleet, 85% are small vessels (≤ 55 ft) and over half fish with snap-on gear.
- The presence of black-footed albatrosses, northern fulmars, and shearwaters in southern Chatham Strait and Dixon Entrance of the SEAK region suggests increased risk to seabirds from longline fishing in these small areas. If this risk is deemed significant, the definition of inside waters (for the purpose of seabird avoidance regulations) could be amended to exclude these areas. Specifically, ADFG statistical areas 345603 and 345534 in Chatham Strait, and 325431 and 325401 in Dixon Entrance could be reclassified as "outside waters" (Figure 14), where seabird avoidance regulations would continue to be required.

Outside Waters

- Based on these data, we recommend that existing seabird avoidance requirements be maintained in all outside waters. For recommendations on small vessels fishing fixed gear in outside waters, see also Melvin and Wainstein (2006; p.19).

Research

- Our seabird sighting data have proven extremely valuable with regard to ecosystem-based fisheries management. We strongly support efforts to institutionalize the collection and management of seabird observation data from fish stock assessment surveys at NMFS and IPHC. We also strongly support making these data available through the NPPSD.
- We strongly encourage efforts to expand this seabird survey protocol to all Alaska and Northwest Fisheries Science Center surveys to broaden the temporal and spatial scope of this data set for application to other fisheries. Incorporating this protocol into North Pacific Groundfish Observer Program data collection should also be explored to expand temporal and spatial coverage.

References

Agler BA, Kendall SJ, Seiser PE and Irons DB, 1995a. Estimates of marine bird and sea otter abundance in Lower Cook Inlet, Alaska, during summer 1993 and winter 1994 U.S. Fish and Wildlife Service. OCS Study, MMS 94-0063. Anchorage, AK.

Agler BA, Kendall SJ, Seiser PE and Lindell JR, 1995b. Estimates of marine bird and sea otter abundance in Southeast Alaska, during summer 1994. U.S. Fish and Wildlife Service. Final Report. Anchorage, AK.

Anon., 2001. S-Plus 6 for Windows User's Guide. Seattle, WA: Insightful Corporation.

Bechtol WR and VanSant J, 1997. Relative abundance of sablefish and other groundfish caught on longline gear in Prince William Sound, Alaska, 1996. Division of Commercial Fisheries. 2A97-29. Anchorage, AK.

Croxall JP, Rothery P, Pickering SP and Prince PA, 1990. Reproductive performance, recruitment, and survival of wandering albatross Diomedea exulans at Bird Island, South Georgia. Journal of Animal Ecology 59:775-796.

Drew GS and Piatt JF, 2005. North Pacific Pelagic Database Version 1.0. U.S. Geological Survey, Alaska Science Center. Anchorage, AK. *www.usgs.gov/research/NPPSD/*

Efron B and Tibshirani RJ, 1993. An introduction to the bootstrap. New York, NY: Chapman & Hall.

Hatch SA and Nettleship DN, 1998. Northern Fulmar (*Fulmarus glacialis*). In (A. Poole and F. Gill, eds) Birds of North America. Washington, D.C.: The Academy of Natural Sciences, Philadelphia and American Ornithologists' Union.

Holum D, 2003. Southern Southeast Inside (Clarence Strait and Dixon Entrance) relative abundance sablefish longline survey cruise report May 20-May 26, 2002. Alaska Dept of Fish and Game. Regional Info Report No 1J03-13. Juneau, AK. *www.cf.adfg.state.ak.us/region1/pdfs/1rir/1j03-13.pdf*

Holum D, 2004. Southern Southeast Inside (Clarence Strait and Dixon Entrance) relative abundance sablefish longline survey report for 2003. Alaska Dept of Fish and Game. Regional Info Report No 1J04-09. Juneau, AK. *www.cf.adfg.state.ak.us/region1/finfish/grndfish/sablefish/1j04-09_2003_ssei_longline_survey.pdf*

Holum D, 2005. Southern Southeast Inside (Clarence Strait and Dixon Entrance) relative abundance sablefish longline survey report for 2004. Alaska Dept of Fish and Game. Fishery Data Series No 05-17. Juneau, AK. *www.cf.adfg.state.ak.us/region1/pdfs/groundfish/fds05-17.pdf*

IPHC (International Pacific Halibut Commission), 2002. Report of Assessment and Research Activities, 2002: 2002 standardized stock assessment survey. *www.iphc.washington.edu/halcom/pubs/rara/2002rara/2k2RARA10.pdf*

IPHC (International Pacific Halibut Commission), 2003. Report of Assessment and Research Activities, 2003: 2003 standardized stock assessment survey. *www.iphc.washington.edu/halcom/pubs/rara/2003rara/2k310RARA.pdf*

IPHC (International Pacific Halibut Commission), 2004. Report of Assessment and Research Activities, 2004: 2004 standardized stock assessment survey. *www.iphc.washington.edu/halcom/pubs/rara/2004rara/2k4RARA10.pdf*

IUCN (World Conservation Union), 2003. The 2003 IUCN Redlist of Threatened Species. The World Conservation Union. Gland, Switzerland. *www.redlist.org/search/search-basic.html*

Kalnay E, Kanamitsu M, Kistler R, Collins W, Deaven D, Gandin L, Iredell M, Saha S, White G, Woollen J, Zhu Y, Chelliah M, Ebisuzaki W, Higgins W, Janowiak J, Mo KC, Ropelewski C, Wang J, Leetmaa A, Reynolds R, Jenne R and Joseph D, 1996. The NCEP/NCAR 40-Year Reanalysis Project. Bulletin of the American Meteorological Society 77:437-471.

Kushlan JA, Steinkamp MJ, Parsons KC, Capp J, Cruz MA, Doulter M, Davidson I, Dickson L, Edelson N, Elliot R, Erwin RM, Hatch S, Kress S, Milko R, Miller S, Mills K, Paul R, Phillips R, Saliva JE, Sydeman B, Trapp J, Wheeler J and Wohl K, 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, version 1. Washington, DC.

Melvin E, Dietrich K, Van Wormer K and Geernaert T, 2004. The distribution of seabirds on Alaskan Longline fishing grounds: 2002 Data Report. Washington Sea Grant Program. WSG-TA 04-02.

Melvin EF, Parrish JK, Dietrich KS and Hamel OS, 2001. Solutions to seabird bycatch in Alaska's demersal longline fisheries. Washington Sea Grant Program. Project A/FP-7.

Melvin EF and Wainstein MD, 2006. Seabird avoidance measures for small Alaskan longline vessels. Washington Sea Grant Program. Project A/FP-7.

NMFS (National Marine Fisheries Service), 2001. Draft - Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for a regulatory amendment to revise regulations for seabird avoidance measures in the hook-and-line fisheries off Alaska to reduce the incidental catch of the short-tailed albatross and other seabird species. NMFS Alaska Region. Juneau, AK.

NMFS (National Marine Fisheries Service), 2004. Management measures to reduce seabird incidental take in the hook-and-line halibut and groundfish fisheries. Federal Register 69:1930-1951.

NMFS (National Marine Fisheries Service), 2005. Ecosystem Considerations for 2006. Ecosystem Considerations for the Stock Assessment and Fishery Evaluation (SAFE) prepared for the North Pacific Fishery Management Council. Anchorage, AK.

NPPSD (North Pacific Pelagic Seabird Database), 2005. North Pacific Pelagic Seabird Database, Short-tailed Albatross, Version 2005.06.07. US Geological Survey, Alaska Science Center & U.S. Fish and Wildlife Service. Anchorage, AK. *www.absc.usgs.gov/research/NPPSD/*

Richardson BJ, 2003a. 2002 NSEI (Chatham) sablefish longline survey report. Alaska Dept of Fish and Game. Regional Info Report No 1J03-35. Juneau, AK. *www.cf.adfg.state.ak.us/region1/finfish/grndfish/sablefish/RIR1J03-35.pdf*

Richardson BJ, 2003b. 2003 NSEI (Chatham) sablefish longline survey report. Alaska Dept of Fish and Game. Regional Info Report No 1J03-40. Juneau, AK. *www.cf.adfg.state.ak.us/region1/finfish/grndfish/sablefish/RIR1J03-40.pdf*

Robertson G and Gales R, 1998. Albatross: Biology and conservation. NSW Australia: Surrey Beatty & Sons.

Rutecki TL, 2004a. Longline survey of the Gulf of Alaska and Eastern Aleutian Islands June 3 – September 5, 2002. National Marine Fisheries Service. Juneau, AK. *www.afsc.noaa.gov/abl/MarFish/pdfs/202revisedtexttablesforwebrevisetable1.pdf*

Rutecki TL, 2004b. Longline survey of the Gulf of Alaska and Eastern Bering Sea, May 28 – September 1, 2003. National Marine Fisheries Service. Juneau, AK. *www.afsc.noaa.gov/abl/MarFish/pdfs/DSO3TEXTRPTALL.pdf*

Rutecki TL, 2005. Longline survey of the Gulf of Alaska and Eastern Aleutian Islands June – September 1, 2004. NMFS. Juneau, AK.

Speckman SG, 2002. Pelagic seabird abundance and distribution in lower Cook Inlet. In (JF Piatt, ed) Responses of seabirds to fluctuations in forage fish density, Exxon Valdez oil spill restoration project final report (Restoration Project 01163M) and Mineral Management Service (Alaska OCS Study MMS 2002-068). Anchorage, AK: US Geological Survey, Alaska Science Center; 27-32.

Sullivan KM, McKnight AE, Irons DB, Stephensen SW and Howlin S, 2005. Marine bird and sea otter population abundance of Prince William Sound, Alaska: Trends following the T/V Exxon Valdez Oil Spill, 1989-2004. Exxon Valdez Oil Spill Restoration Project Annual Report (Restoration Project 04159). U.S. Fish and Wildlife Service. Anchorage, AK.

USFWS (US Fish and Wildlife Service), 2002. Birds of Conservation Concern 2002. U.S. Fish and Wildlife Service. Arlington, VA.

USFWS (US Fish and Wildlife Service), 2003. Biological Opinion on the effects of the Total Allowable Catch (TAC)-setting process for the Gulf of Alaska (GOA) and Bering Sea/Aleutian Islands (BSAI) groundfish fisheries to the endangered short-tailed albatross (*Phoebastria albatrus*) and threatened Steller's eider (*Polysticta stelleri*). US Fish and Wildlife Service. Anchorage, AK.

Weimerskirch H, Brothers N and Jouventin P, 1997. Population dynamics of wandering albatross *Diomedea exulans* and Amsterdam albatross *D. amsterdamensis* in the Indian Ocean and their relationships with long-line fisheries: conservation implications. Biological Conservation 79:257-270.

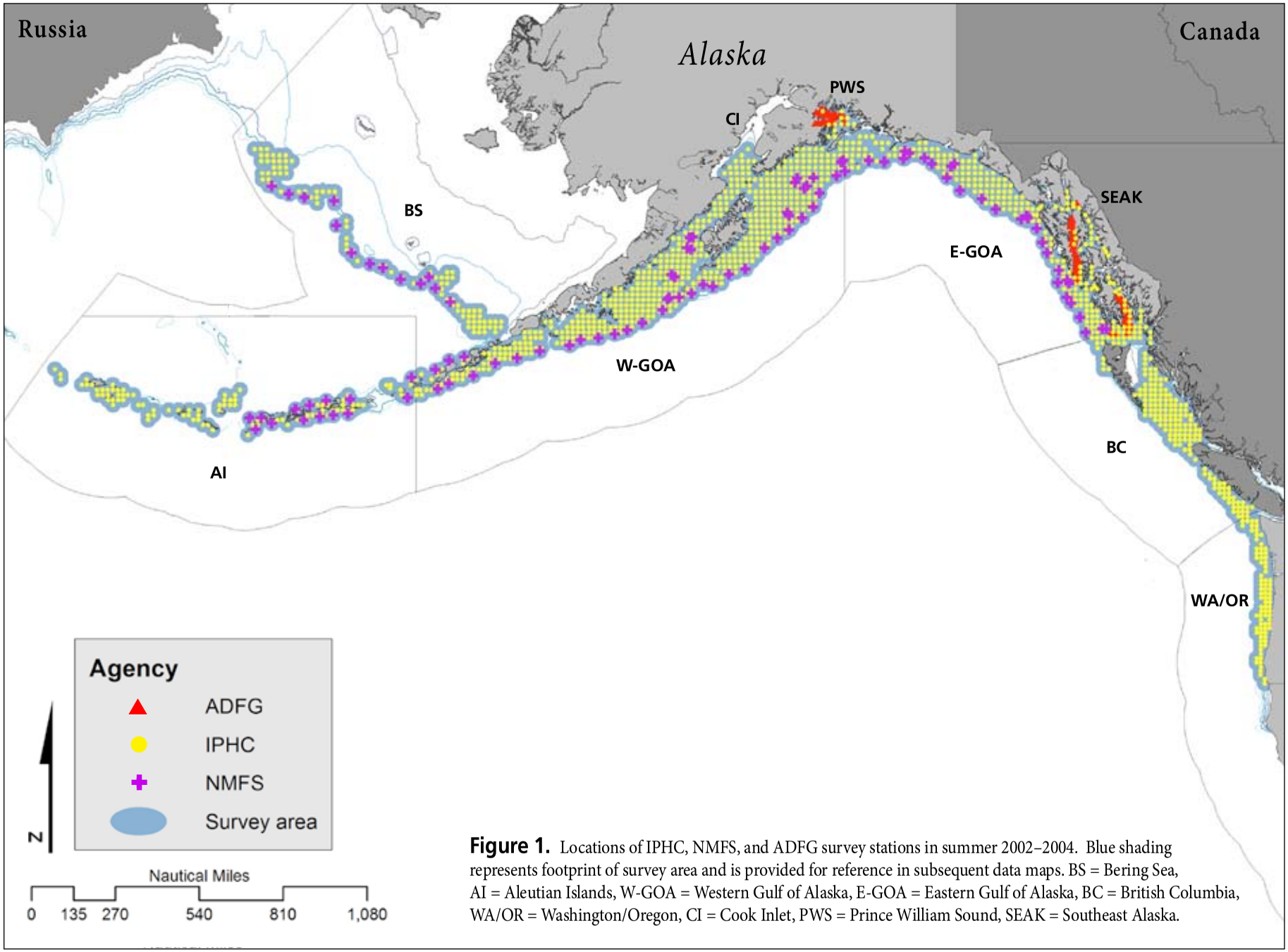
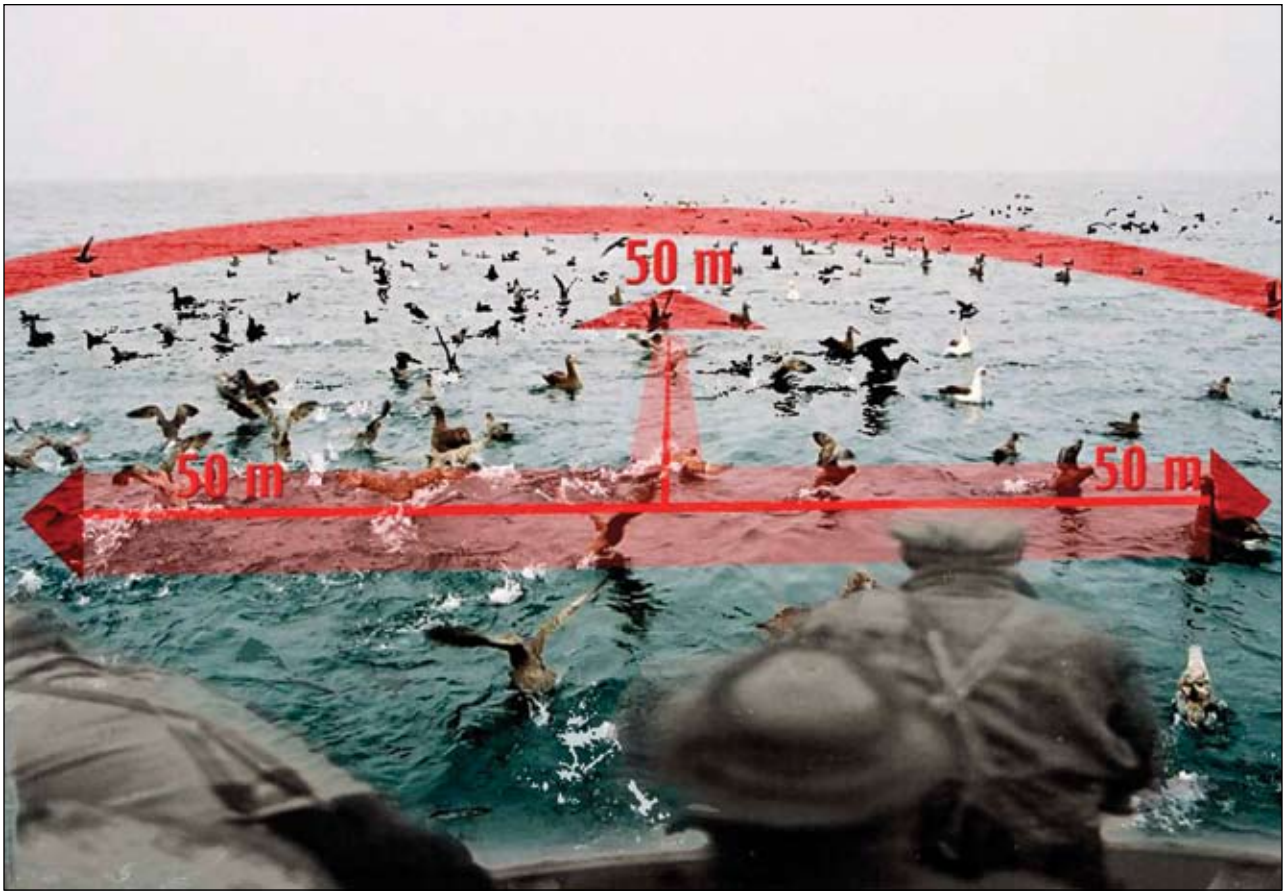


Figure 1. Locations of IPHC, NMFS, and ADFG survey stations in summer 2002–2004. Blue shading represents footprint of survey area and is provided for reference in subsequent data maps. BS = Bering Sea, AI = Aleutian Islands, W-GOA = Western Gulf of Alaska, E-GOA = Eastern Gulf of Alaska, BC = British Columbia, WA/OR = Washington/Oregon, CI = Cook Inlet, PWS = Prince William Sound, SEAK = Southeast Alaska.



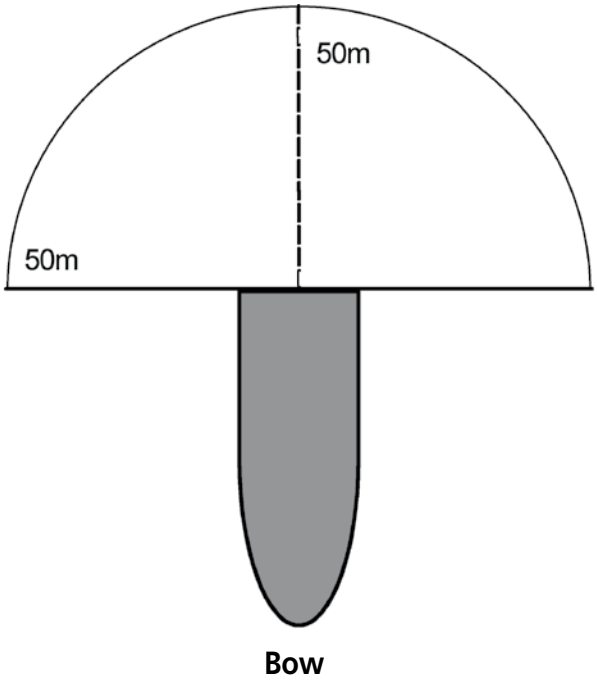


Figure 2. The 50-meter hemisphere at the stern in which counts of seabirds on the water and in the air were conducted immediately after longline gear was hauled.

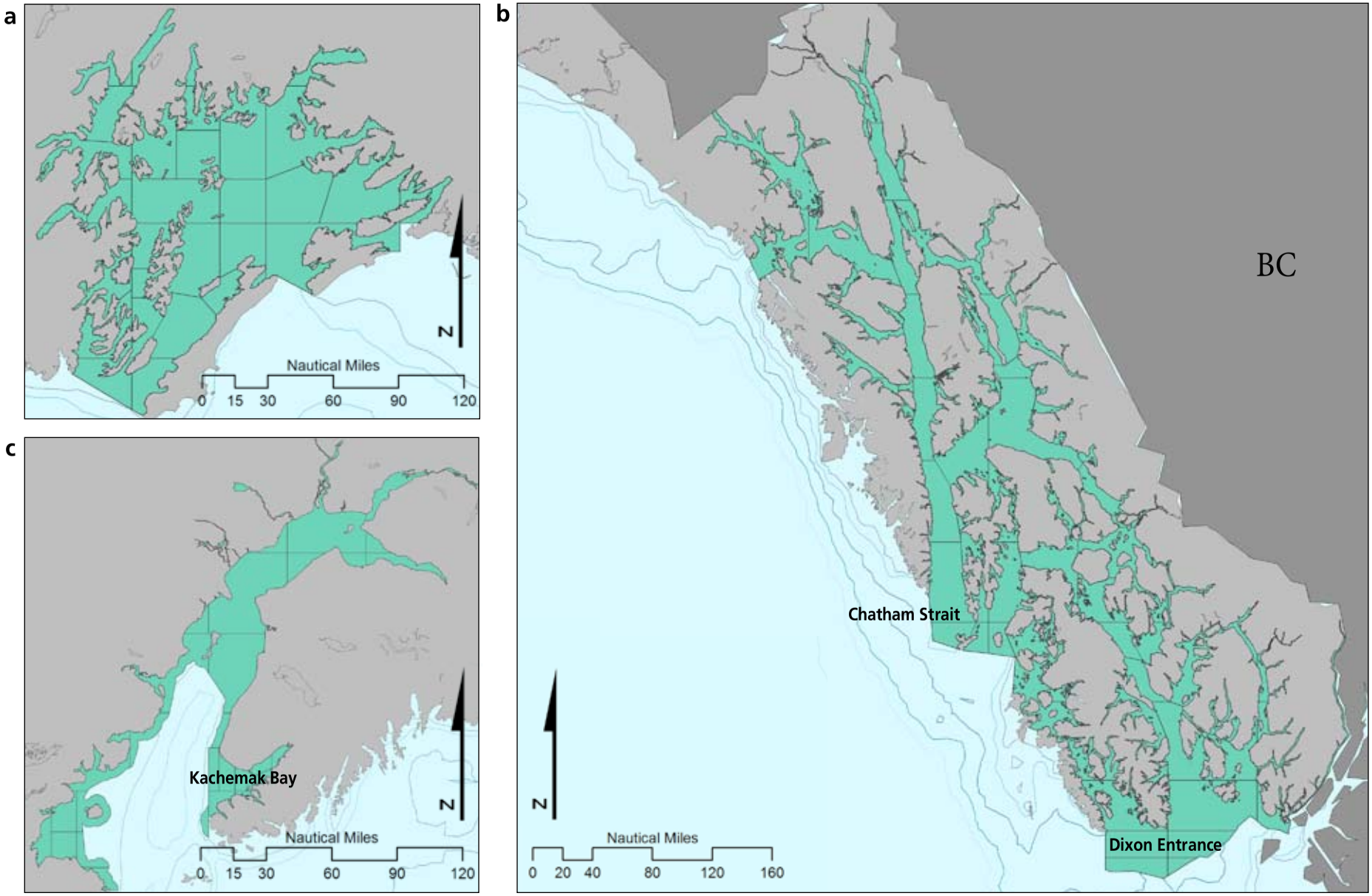


Figure 3. Inside waters (green statistical areas) as defined by current seabird avoidance regulations: a) Prince William Sound (NMFS Area 649), b) Southeast Alaska (NMFS Area 659), and c) state waters of Cook Inlet.

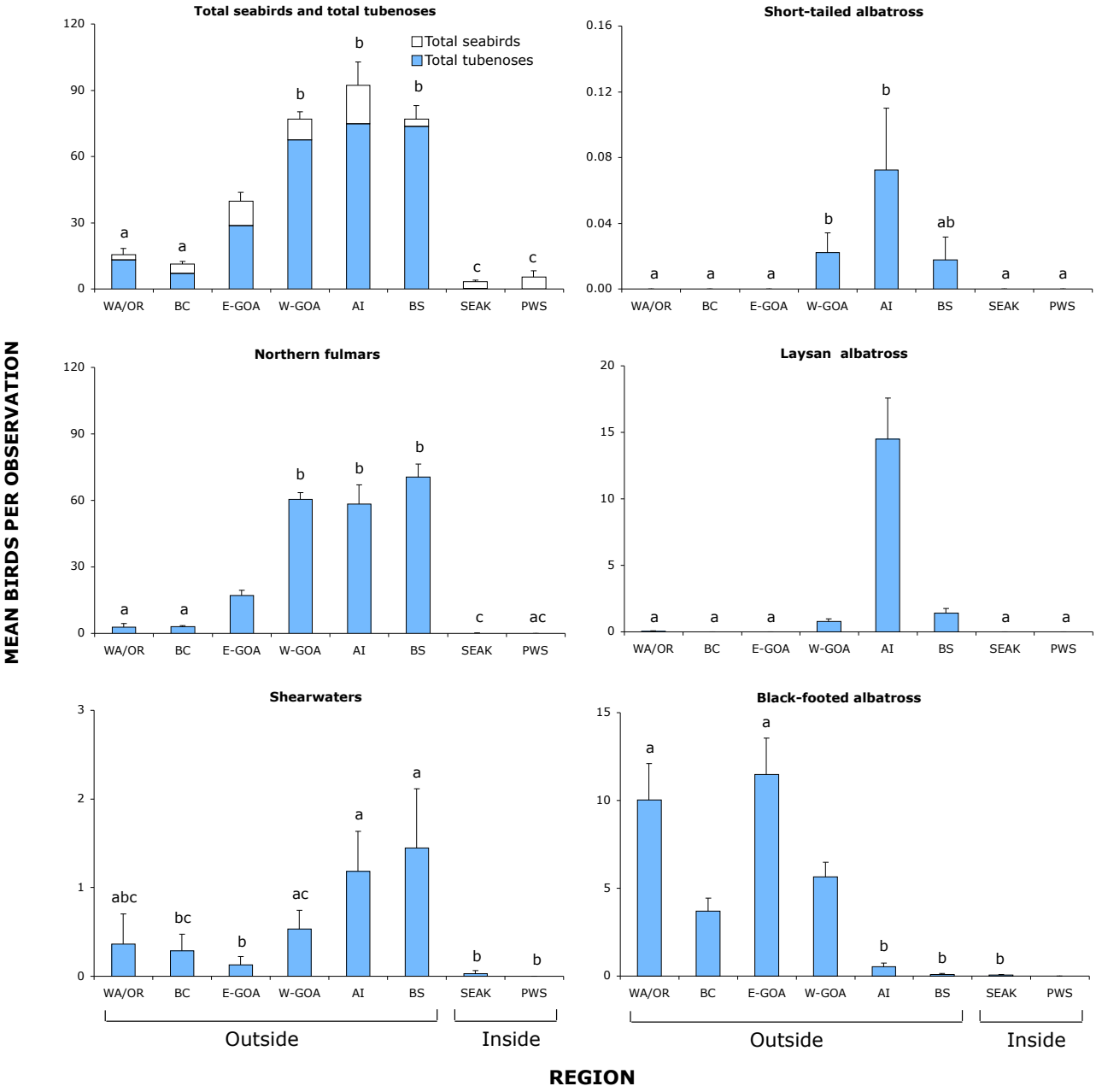


Figure 4. Mean observation rates of several seabird species and species groups by analysis region. Note that y-axis scales vary dramatically. Outside waters include Washington/Oregon (WA/OR), British Columbia (BC), the Eastern Gulf of Alaska (E-GOA), Western GOA (W-GOA), Aleutian Islands (AI), and Bering Sea (BS). Inside waters include Southeast Alaska (SEAK) and Prince William Sound (PWS). For relationship to NMFS management areas, see Methods. Error bars represent 95% confidence intervals. Lowercase letters denote significant post-hoc groupings ($p<0.05$). In top left graph, letters indicate groupings for total seabirds; groupings for total tubenoses include W-GOA=AI=BS and SEAK=PWS (WA/OR and BC are significantly different from each other and all other regions).

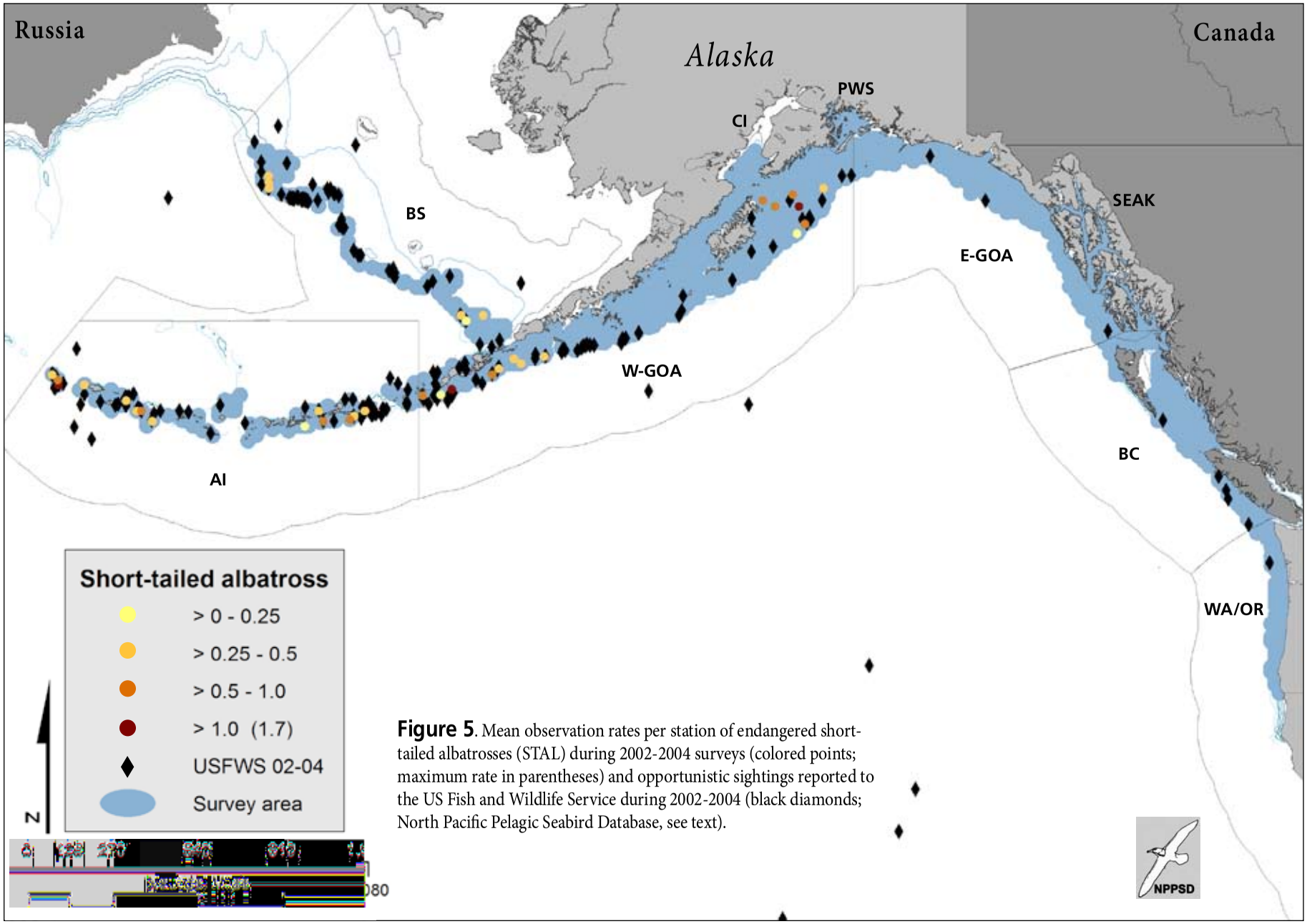


Figure 5. Mean observation rates per station of endangered short-tailed albatrosses (STAL) during 2002-2004 surveys (colored points; maximum rate in parentheses) and opportunistic sightings reported to the US Fish and Wildlife Service during 2002-2004 (black diamonds; North Pacific Pelagic Seabird Database, see text).

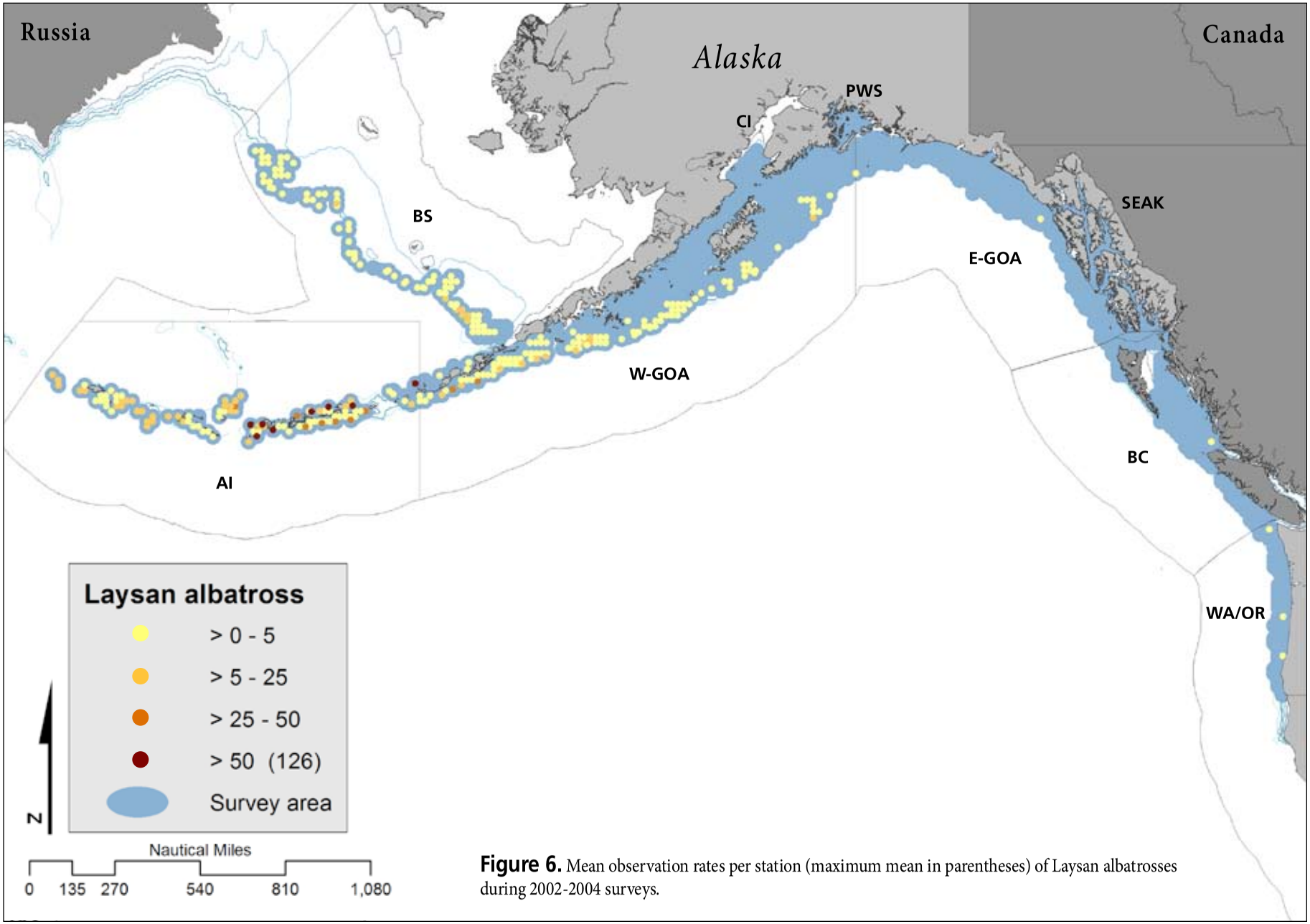


Figure 6. Mean observation rates per station (maximum mean in parentheses) of Laysan albatrosses during 2002-2004 surveys.

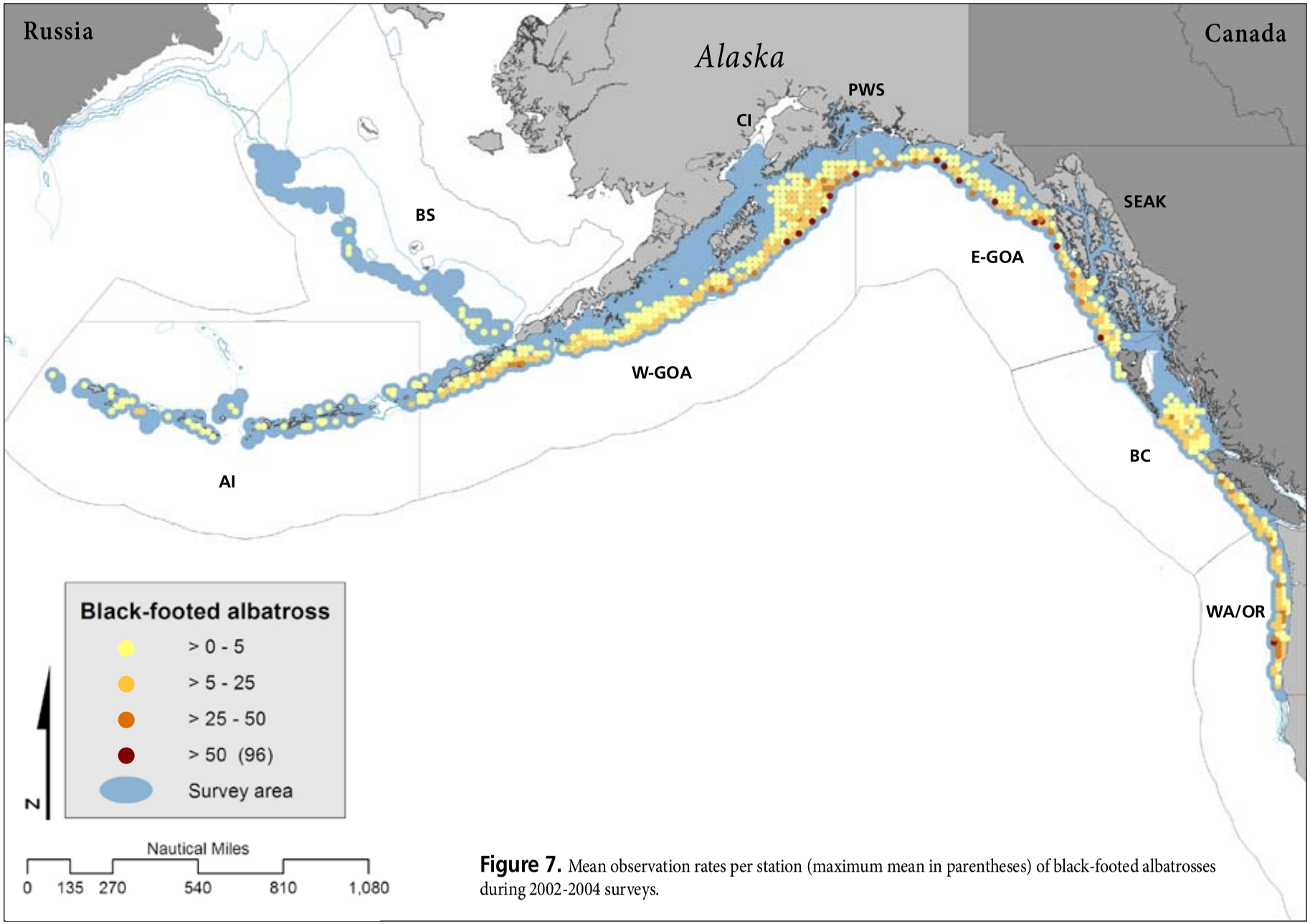


Figure 7. Mean observation rates per station (maximum mean in parentheses) of black-footed albatrosses during 2002-2004 surveys.

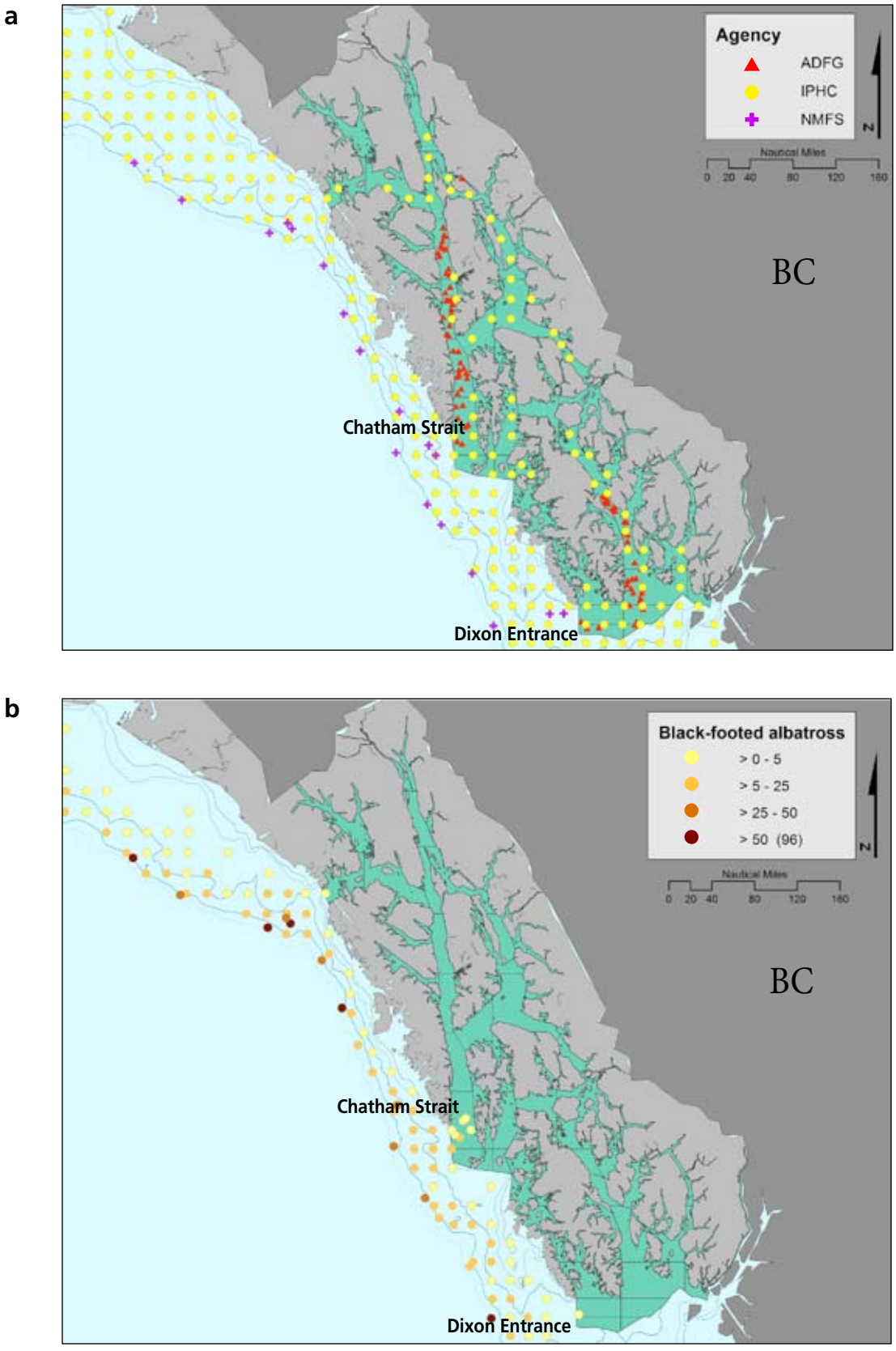
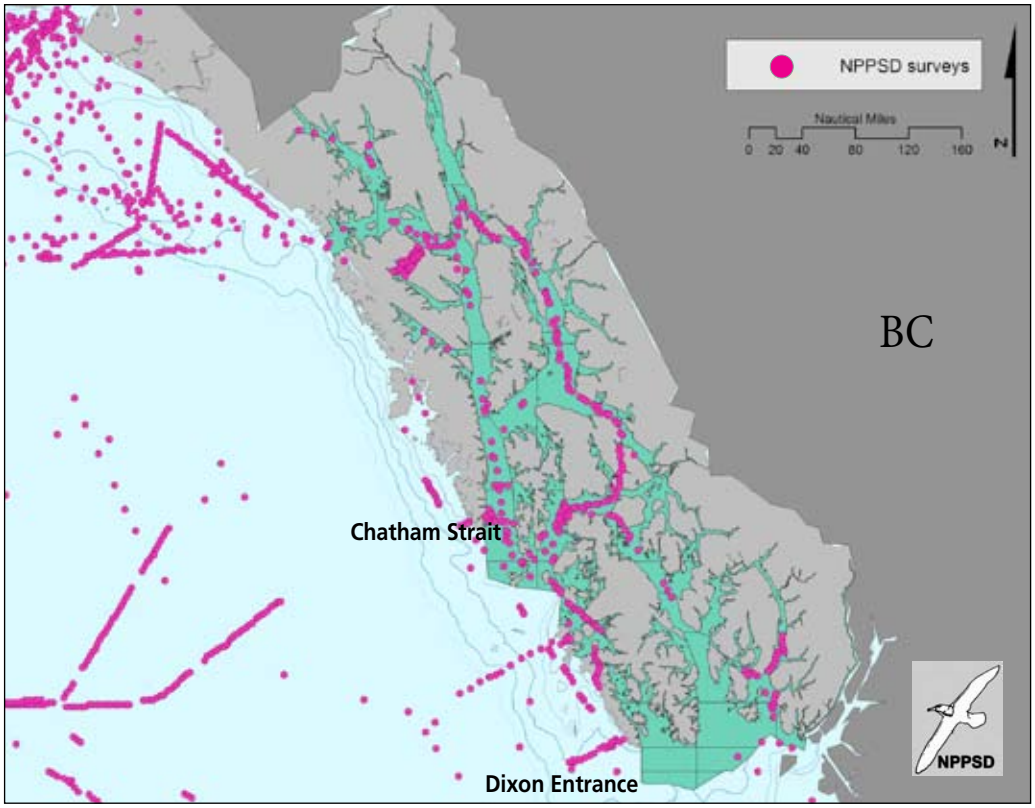
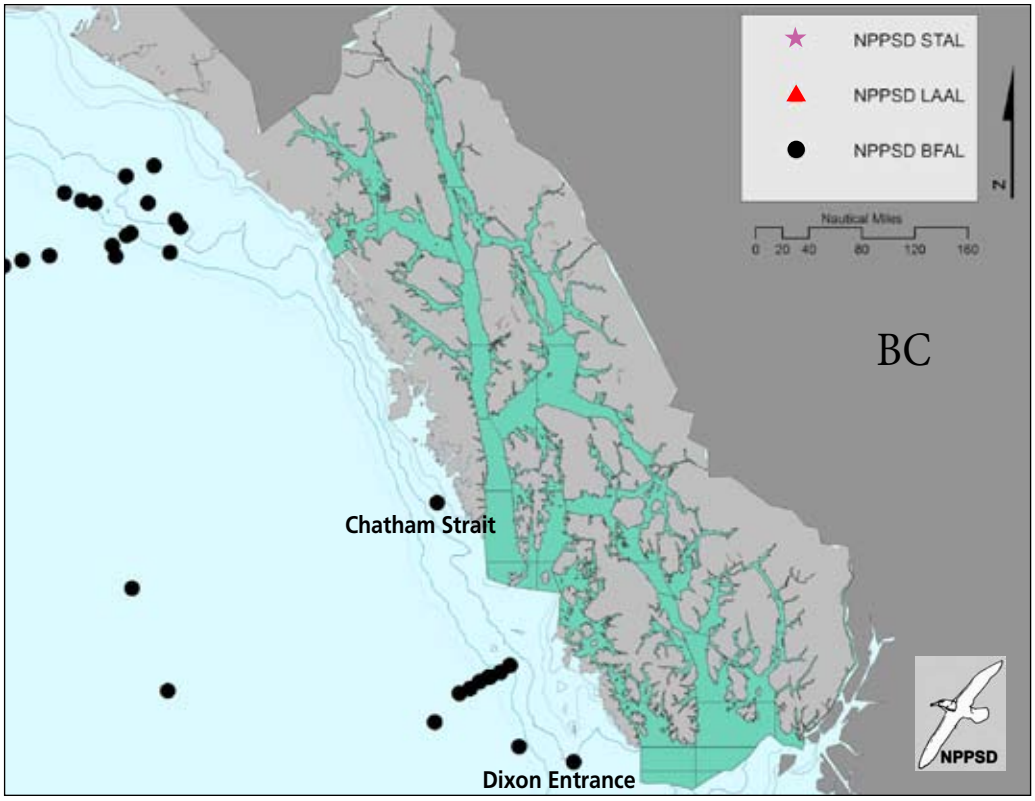


Figure 8. Focal maps of Southeast Alaska showing a) 2002-2004 survey station locations and inside waters (green), b) 2002-2004 survey sightings of black-footed albatrosses, c) North Pacific Pelagic Seabird Database (NPPSD) survey/transect locations, and d) NPPSD survey/transect albatross sightings.

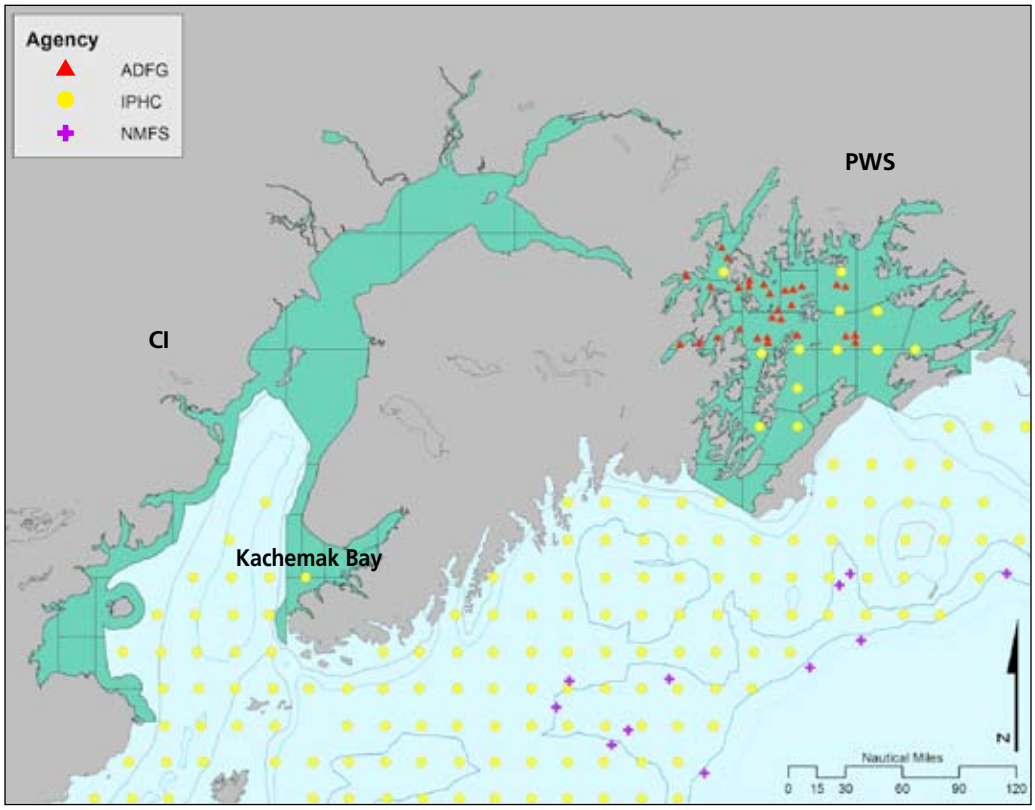
c


NPPSD surveys
Nautical Miles
0 20 40 80 120 160
N
BC
Chatham Strait
Dixon Entrance
NPPSD

d


NPPSD STAL
NPPSD LAAL
NPPSD BFAL
N
Nautical Miles
0 20 40 80 120 160
BC
Chatham Strait
Dixon Entrance
NPPSD

a



b

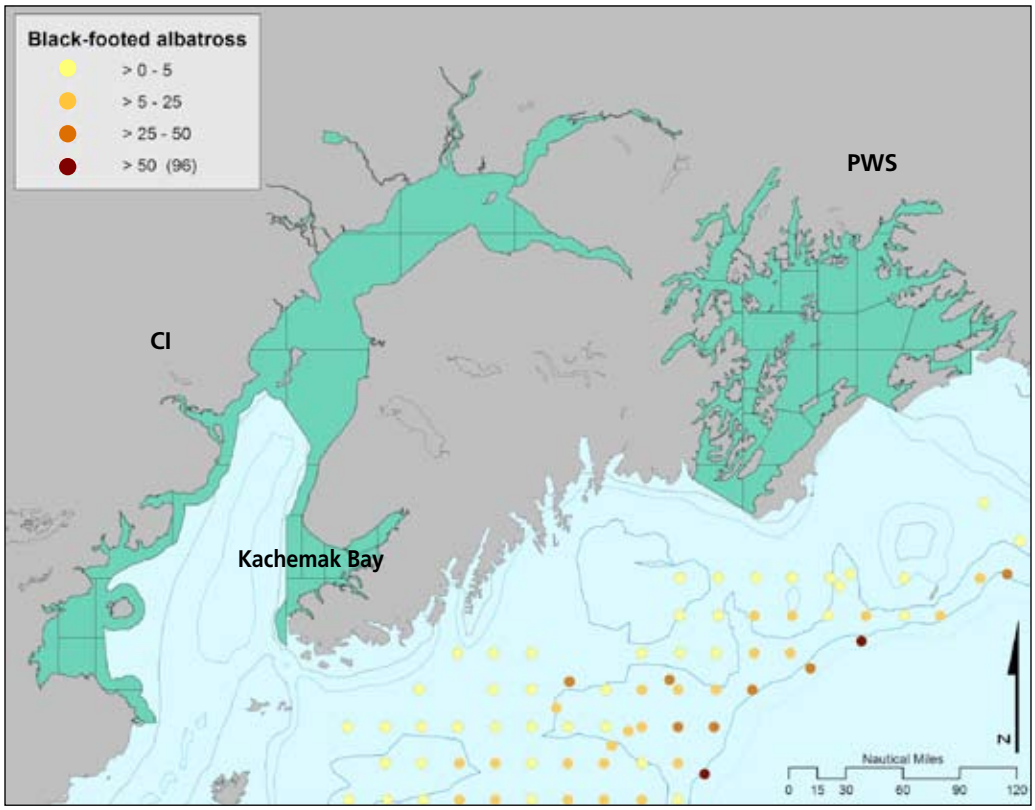
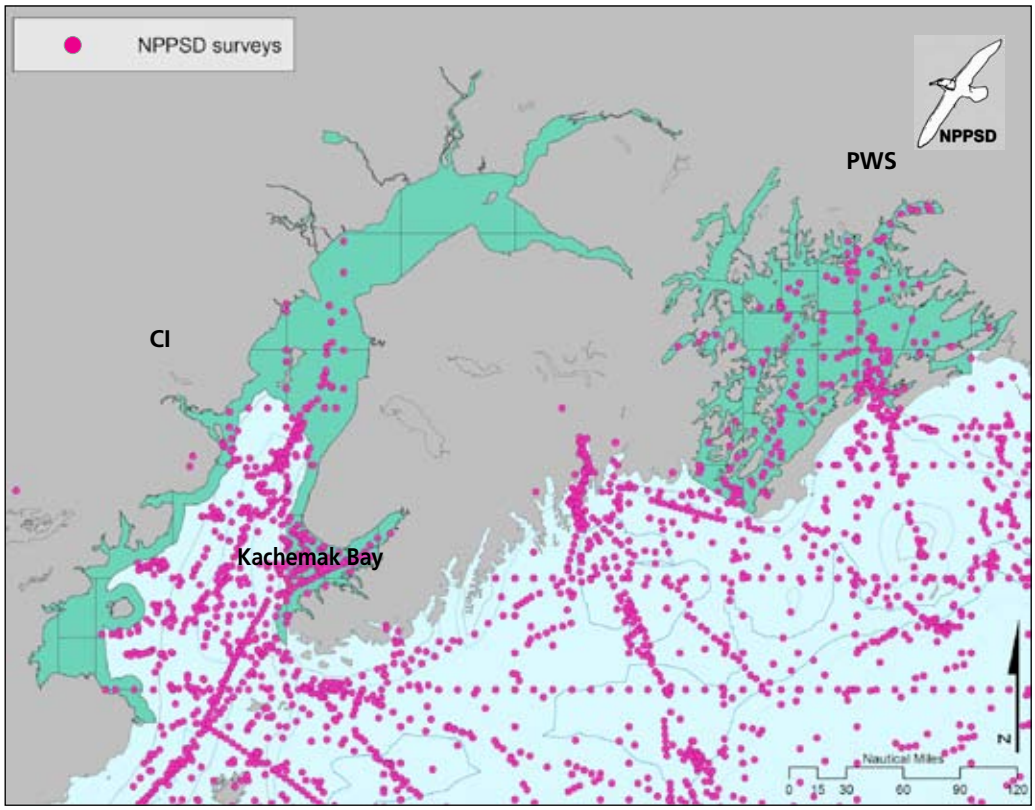
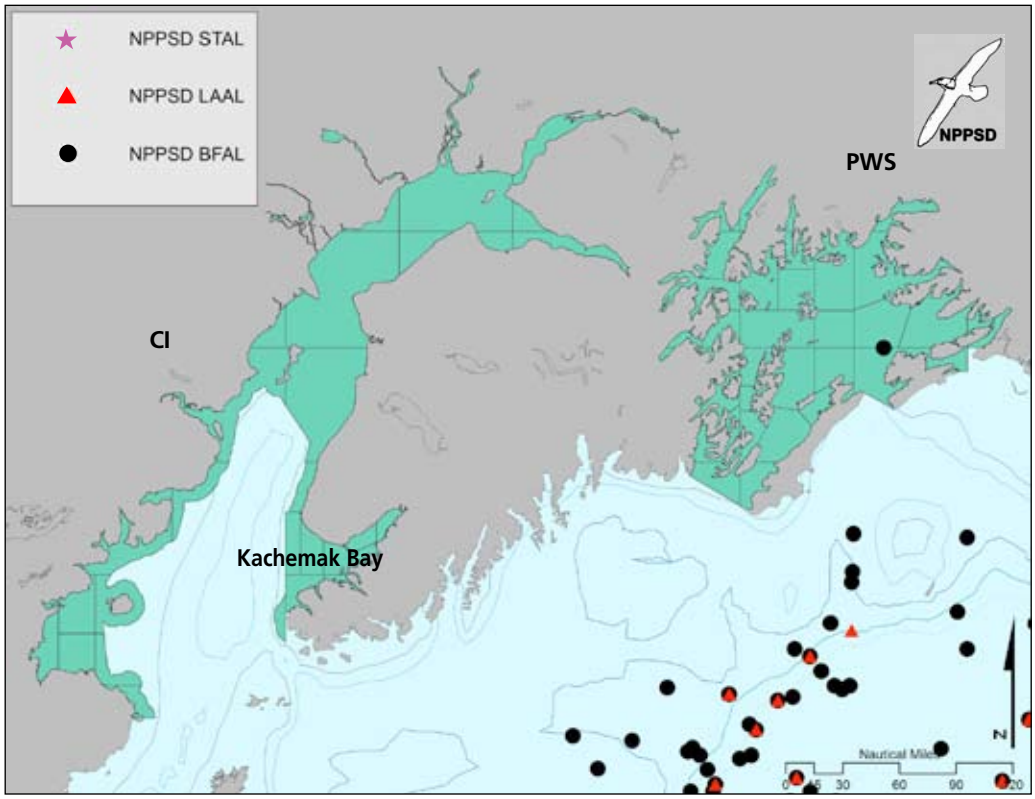


Figure 9. Focal maps of Cook Inlet and Prince William Sound showing a) 2002-2004 survey station locations and inside waters (green), b) 2002-2004 survey sightings of black-footed albatrosses, c) North Pacific Pelagic Seabird Database (NPPSD) survey/transect locations, and d) NPPSD survey/transect albatross sightings.

c


NPPSD surveys
NPPSD
PWS
CI
Kachemak Bay
N
Nautical Miles
0 15 30 60 90 120

d


NPPSD STAL
NPPSD LAAL
NPPSD BFAL
NPPSD
PWS
CI
Kachemak Bay
N
Nautical Miles
30 60 90 120

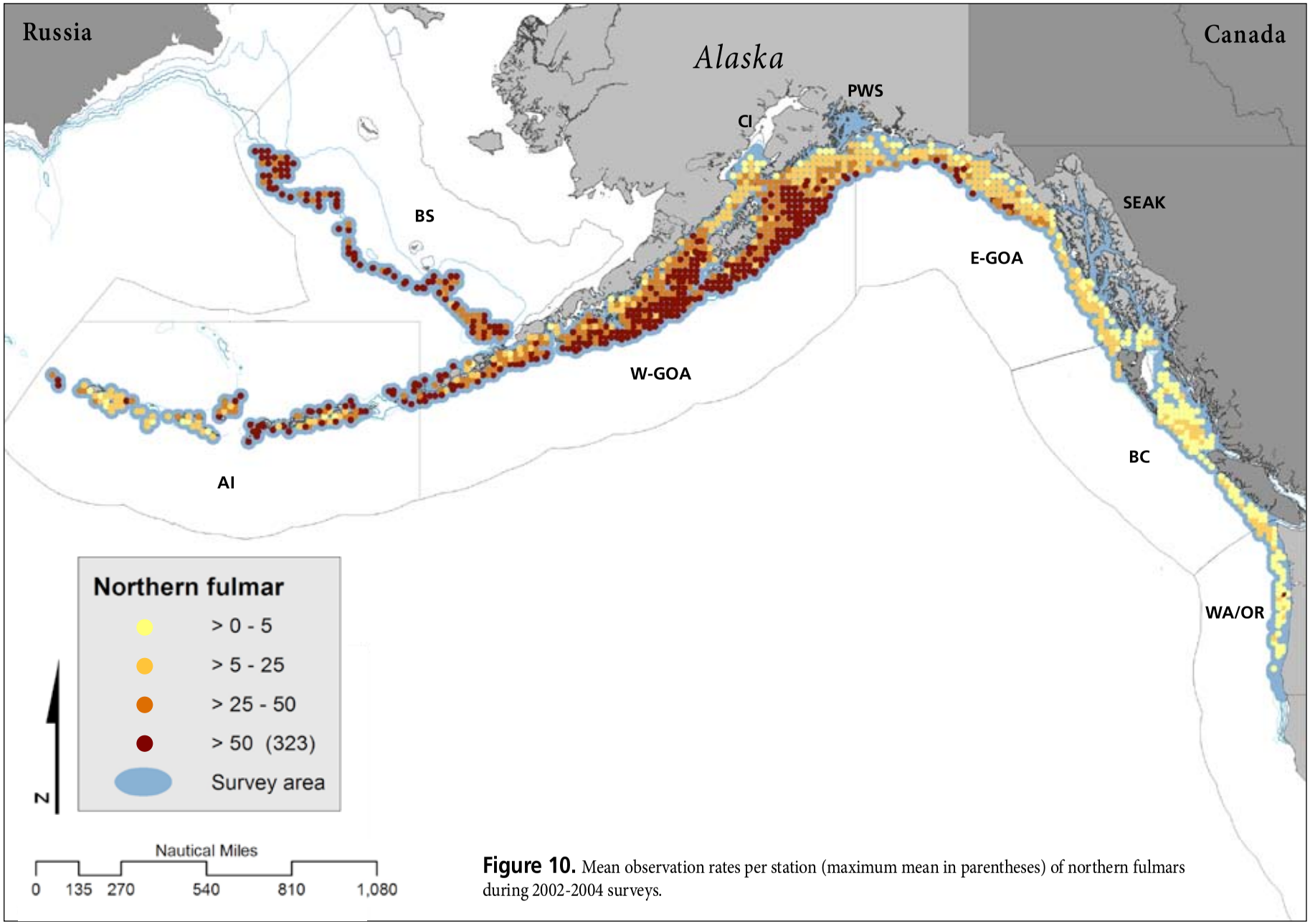


Figure 10. Mean observation rates per station (maximum mean in parentheses) of northern fulmars during 2002-2004 surveys.

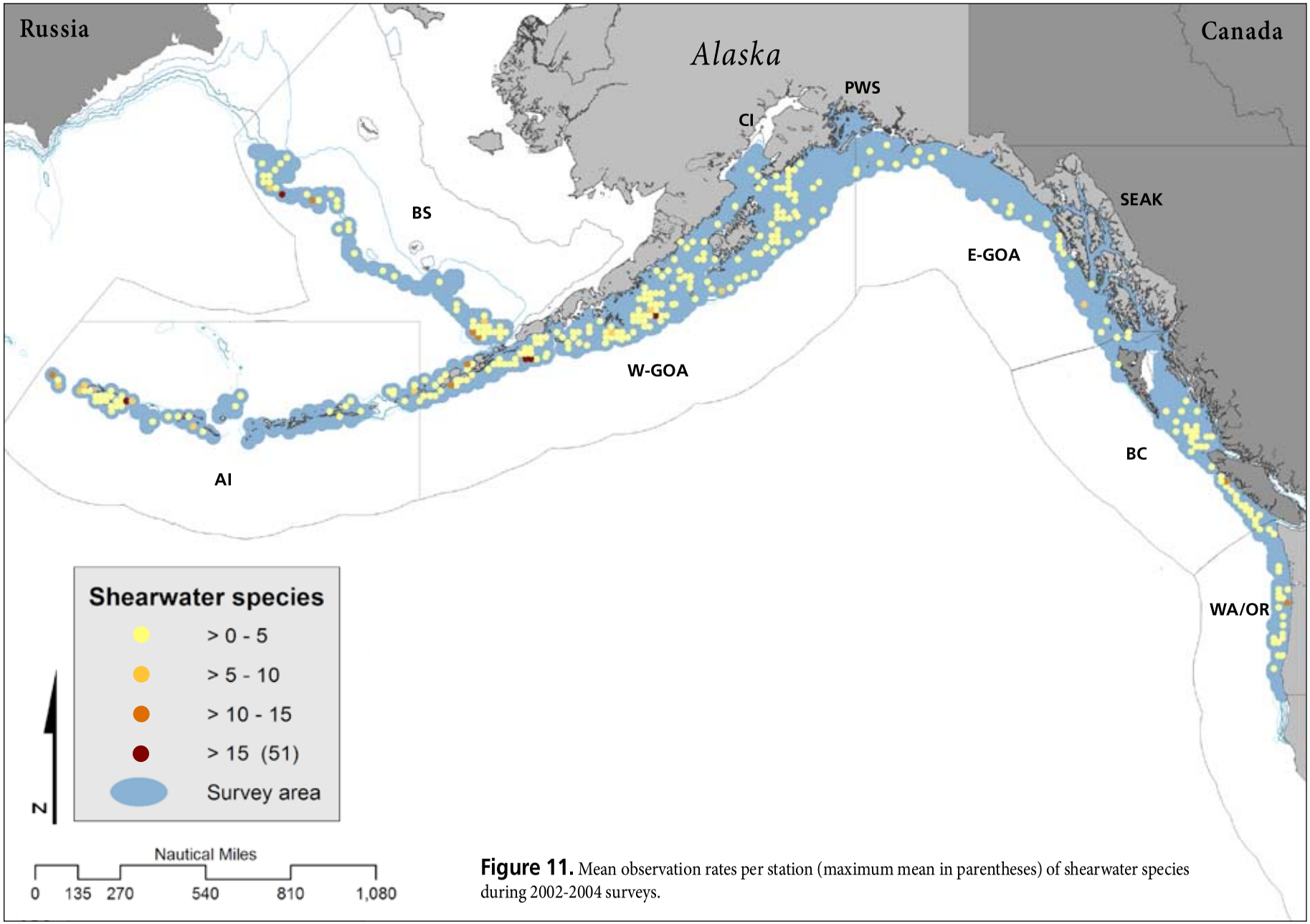


Figure 11. Mean observation rates per station (maximum mean in parentheses) of shearwater species during 2002-2004 surveys.

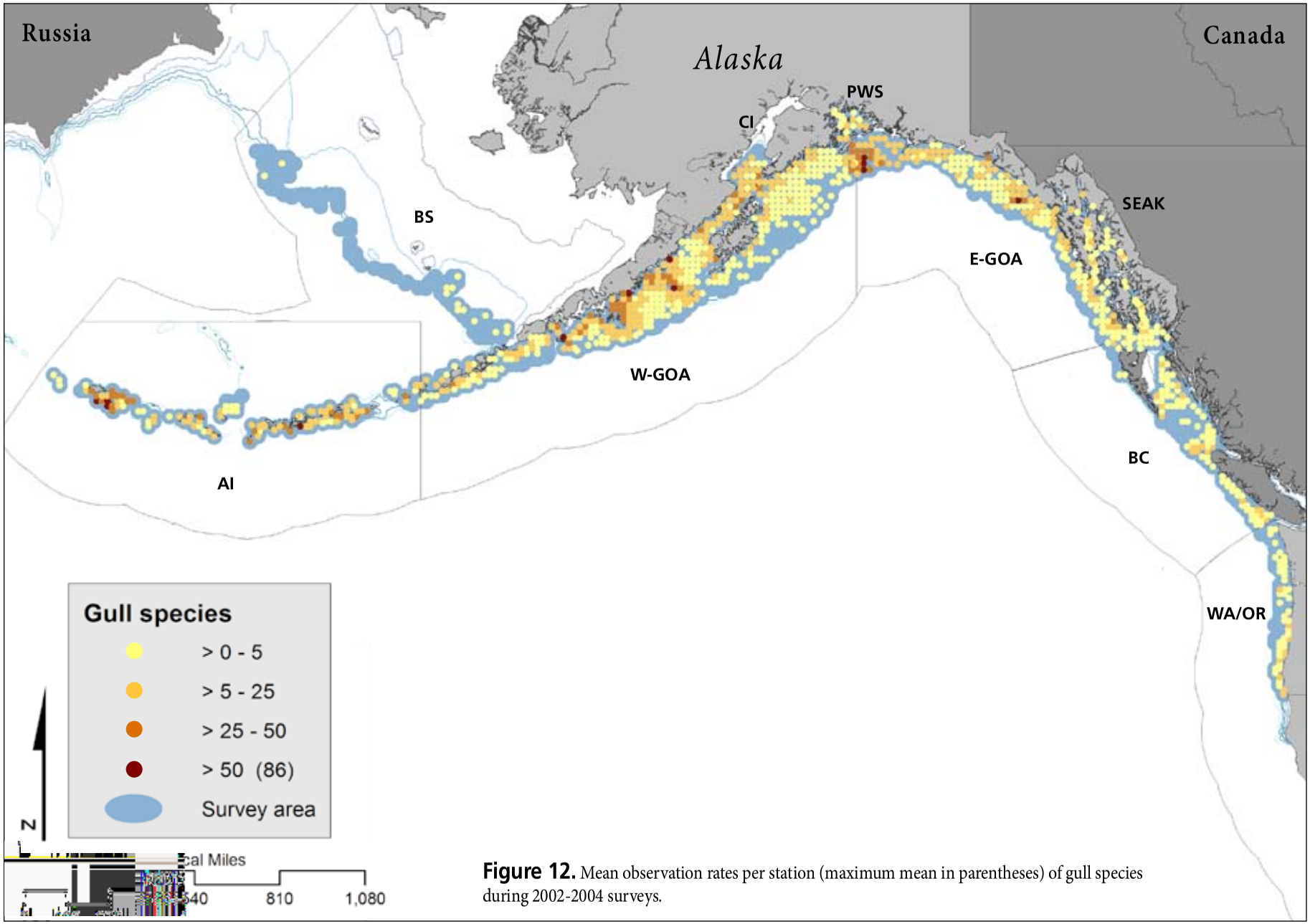


Figure 12. Mean observation rates per station (maximum mean in parentheses) of gull species during 2002-2004 surveys.

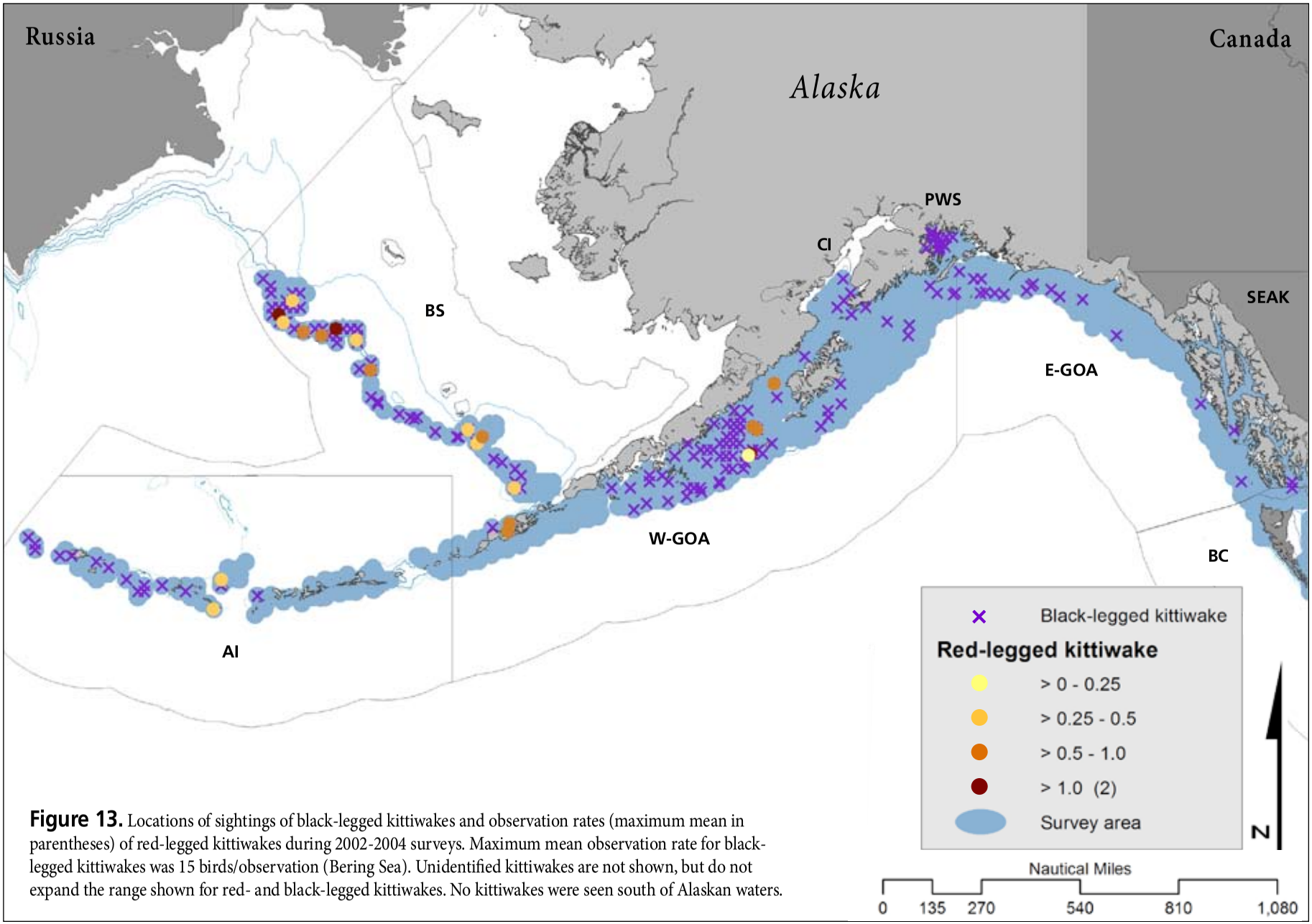


Figure 13. Locations of sightings of black-legged kittiwakes and observation rates (maximum mean in parentheses) of red-legged kittiwakes during 2002-2004 surveys. Maximum mean observation rate for black-legged kittiwakes was 15 birds/observation (Bering Sea). Unidentified kittiwakes are not shown, but do not expand the range shown for red- and black-legged kittiwakes. No kittiwakes were seen south of Alaskan waters.

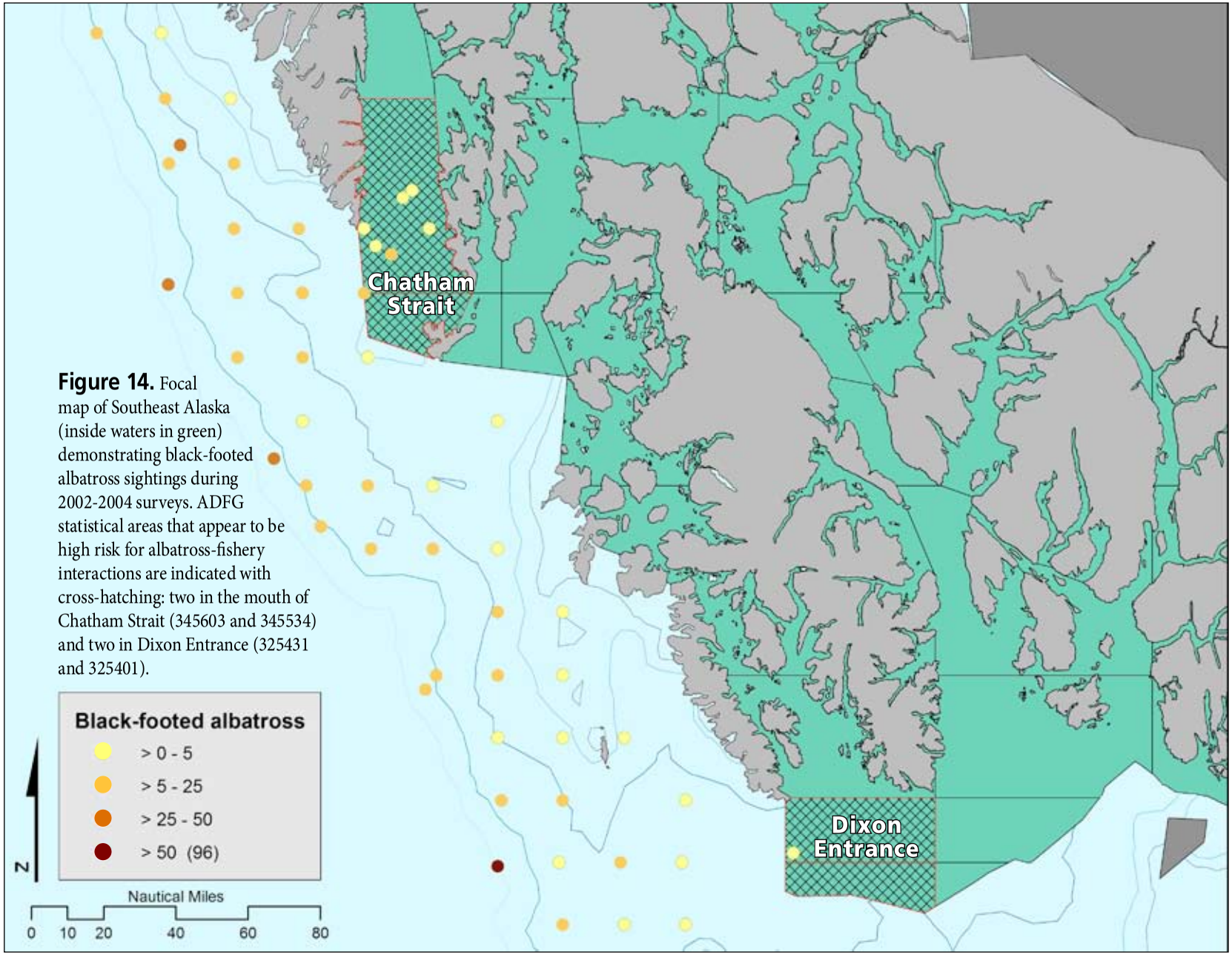


Figure 14. Focal map of Southeast Alaska (inside waters in green) demonstrating black-footed albatross sightings during 2002-2004 surveys. ADFG statistical areas that appear to be high risk for albatross-fishery interactions are indicated with cross-hatching: two in the mouth of Chatham Strait (345603 and 345534) and two in Dixon Entrance (325431 and 325401).

Acknowledgements

This project would not have been possible without the dedicated support and commitment of IPHC. We also thank IPHC, NMFS, and ADFG biologists who were instrumental in incorporating seabird observations into their existing research protocols, specifically B. Bechtol, K. Carroll, W. Dunne, D. Holum, C. Lunsford, V. O'Connell, K. Orwig, B. Richardson, S. Romain, and M. Vaughn. We also greatly appreciate the efforts of A. Ranta, IPHC, who designed the seabird database. We thank T. Kong and A. Taheri, IPHC, M. Plotnick, ADFG, and T. McMichael, CFEC, for running numerous vessel characterization queries. N. Milne helped with the collation of three years of data, preliminary analyses and mapping. Color graphic in Figure 2 by Stephen Wischniowski. We also thank G. Balogh, W. Dunne, S. Fitzgerald, G. Hunt, K. Kuletz, B. Leaman, V. O'Connell, K. Rivera, M. Vaughn, and W. Wilson for comments on earlier drafts. Funding was provided by USFWS, IPHC, NMFS, ADFG, and WSGP.

Washington Sea Grant Program
University of Washington
3716 Brooklyn Avenue N.E.
Seattle, WA 98105-6716
Campus Mail: Box 355060
206.543.6600
Fax: 206.685.0380

seagrant@u.washington.edu

wsg.washington.edu

WSG-AS 06-01









Clockwise from top left: Short-tailed albatross (*Phoebastria albatrus*), four – six years old, photo by Graham Robertson; short-tailed albatross, one – two years old, and northern fulmars (*Fulmarus glacialis*); Laysan albatross (*Phoebastria immutabilis*); black-footed albatross (*Phoebastria nigripes*), photo by Graham Robertson; dark shearwater (*Puffinus* spp.); black-legged kittiwake (*Rissa tridactyla*); red-legged kittiwake (*Rissa brevirostris*), photo by Yuri Artukhin; glaucous-winged gulls (*Larus glaucescens*); and dark and light phase northern fulmars. All other photos, WSGP.

Cover photo: Seabird aggregation in the Bering Sea.

Sea Grant
Washington

Washington Sea Grant Program

University of Washington

3716 Brooklyn Avenue N.E.
Seattle, WA 98105-6716
Campus Mail: Box 355060
206.543.6600
Fax: 206.685.0380

seagrant@u.washington.edu

wsg.washington.edu