



Seabird Colony Survey Report 2010

Kenai Fjords National Park and Alaska Maritime National Wildlife Refuge

Natural Resource Data Series NPS/KEFJ/NRDS—2012/246



ON THE COVER

Researchers photographing black-legged kittiwake photo plot, Chiswell Islands, AMNWR
Photograph by: Laura Phillips, KEFJ

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Abstract

Seabird colony surveys have not been regularly conducted in Kenai Fjords National Park (KEFJ) since its inception in 1980. A 2006 Interagency General Agreement led to cooperative seabird colony surveys along the eastern coast of the Kenai Peninsula in KEFJ and the Alaska Maritime National Wildlife Refuge (AMNWR) in 2007, the first time since 1986 that a comprehensive survey of seabird colonies had been completed in KEFJ. Since 2007, KEFJ staff has continued annual surveys of seabird colonies in KEFJ and AMNWR at some level. In 2010, we conducted a brief survey of select colonies in Aialik Bay and Northwestern Fjord as preparation for developing an intensive colonial seabird study that will begin in 2011. Surveys were conducted from the flying bridge of the 16m M/V Serac. Weather was generally poor during the survey period and the float plan was adapted as the trip progressed based on weather conditions at sites. For each survey the colony area was visually identified and all adults for every species present were counted. One survey was conducted at each colony location visited; these surveys are therefore valid for relative abundance measurements, but not population trends. Two replicate counts were typically completed for abundant species at colonies (glaucous-winged gulls, cormorant spp.) and counts were repeated until both surveyors obtained counts within 5%. Results from the current survey were compared with data from previous surveys in 2009 (McFarland et al. 2009), 2008 (Hahr 2009), 2007 (Hahr 2008), 1986 (Nishimoto and Rice 1987) and 1976 (Bailey 1976) to examine apparent changes in colony size and composition. We surveyed four colony locations in KEFJ and seven colony locations in AMNWR in 2010. Descriptive comparisons of limited count data available for select seabird species at colonies with multiple years of data reflect the apparent variability in colony attendance since 1976 with a general apparent increase in glaucous-winged gulls throughout the survey area. Seabird colony surveys along the Kenai Fjords coastline have been conducted sporadically, and during past survey efforts, replicate counts were rarely made and direct comparisons of data to recent surveys are complicated by differing survey techniques and record keeping. Recent surveys conducted by NPS and USFWS since 2007 were conducted to maintain some consistency among years, but we have not had the opportunity to fully follow USFWS protocols except during Chiswell area surveys in 2008. In 2011, we will begin a cooperative interagency project to identify spatial and temporal variability of colonial seabirds within this region. While data collected on colonial nesting seabirds in the KEFJ area is less than ideal for monitoring seabird populations, it does assist us in developing questions and objectives for future study.

Acknowledgments

We would like to thank Captain Jamie Thompson and deckhand Marybeth Phillis on the M/V Serac. We appreciate Luke Rosier's assistance with seabird counts. Fritz Klasner and Bud Rice provided helpful reviews of this report.

Introduction

Almost all seabirds are colonial nesters (Wittenberger and Hunt 1985), which allows for relatively easy survey efforts during the breeding season. These surveys can aid region-wide ecosystem analyses as seabirds are useful indicators of long- and short-term marine conditions (Piatt et al. 2007), including regime shifts and changes due to climate change. Many seabird species are noted as Species of Concern at KEFJ which was established in 1980 in part to “protect ... marine and other birds and to maintain their hauling and breeding areas in their natural state, free of human activity which is disruptive to their natural processes.” (ANILCA 1980). The USFWS also has a responsibility to monitor seabird populations as the AMNWR was established “to conserve fish and wildlife populations and habitats in their natural diversity including...marine birds and other migratory birds” (ANILCA 1980).

Seabird colonies on the southern Kenai Peninsula have not been surveyed frequently or consistently, however a 2006 General Agreement between the National Park Service (NPS), U. S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) sought to increase cooperation and efficiency between agencies where they share nearby coastal waters (USDI 2006). This agreement prompted a 2007 interagency survey of 14 seabird colonies along the coast of the Kenai Peninsula by NPS, Kenai Fjords National Park (KEFJ) and USFWS, Alaska Maritime National Wildlife Refuge (AMNWR) staff.

A second cooperative survey effort occurred in 2008 when two colony locations within KEFJ were surveyed during a trip to the Chiswell Islands and focused on black kittiwake and common murre counts. In 2009, staff from both agencies conducted surveys on both mainland seabird colonies within KEFJ (n=17) and islands within the AMNWR (n=18). Surveys conducted in 2009 were single visits to determine presence of nesting seabirds at a historic colony site. Although this survey did not follow the protocol of the USFWS (USFWS 1998, 2000a, 2000b, 2000c) that AMNWR uses to determine population trends, results were still used to estimate relative abundance in conjunction with historical data (McFarland et al. 2009).

Prior to the 2006 Agreement, the coastline of the southern Kenai Peninsula was surveyed in 1976 before the designation of KEFJ and AMNWR (Bailey 1976). A re-survey of this area, encompassing 982 km, was performed in 1986 (Nishimoto and Rice 1987). The 1986 survey focused on total species counts within 11 coastline units, lumping nesting birds with roosting birds and those on the water unless large aggregations of nesting birds were noted. Areas along the Kenai Fjords coast were also surveyed to identify potential impacts to seabirds from the Exxon Valdez Oil Spill including the Pye Islands (AMNWR), Chiswell Islands, and some segments of the coastline.

In 2010, KEFJ staff conducted a brief survey of select seabird colonies in Aialik Bay and Northwestern Fjord as preparation for developing an intensive colonial seabird study that will begin in 2011.

Methods

Site Selection

The south coast of the Kenai Peninsula is characterized by steep fjords composed of greywacke, slate or granite. The Harding Icefield and associated glaciers cover approximately 1,900 km² (Giffen et al. 2009). The climate along the coast is maritime, with mild temperatures and high rainfall due to orographic uplift and driven by the Aleutian Low (Lindsay and Klasner 2009). Numerous steep islands and island groups are located close to the mainland. KEFJ administers approximately 2,450 km²; its

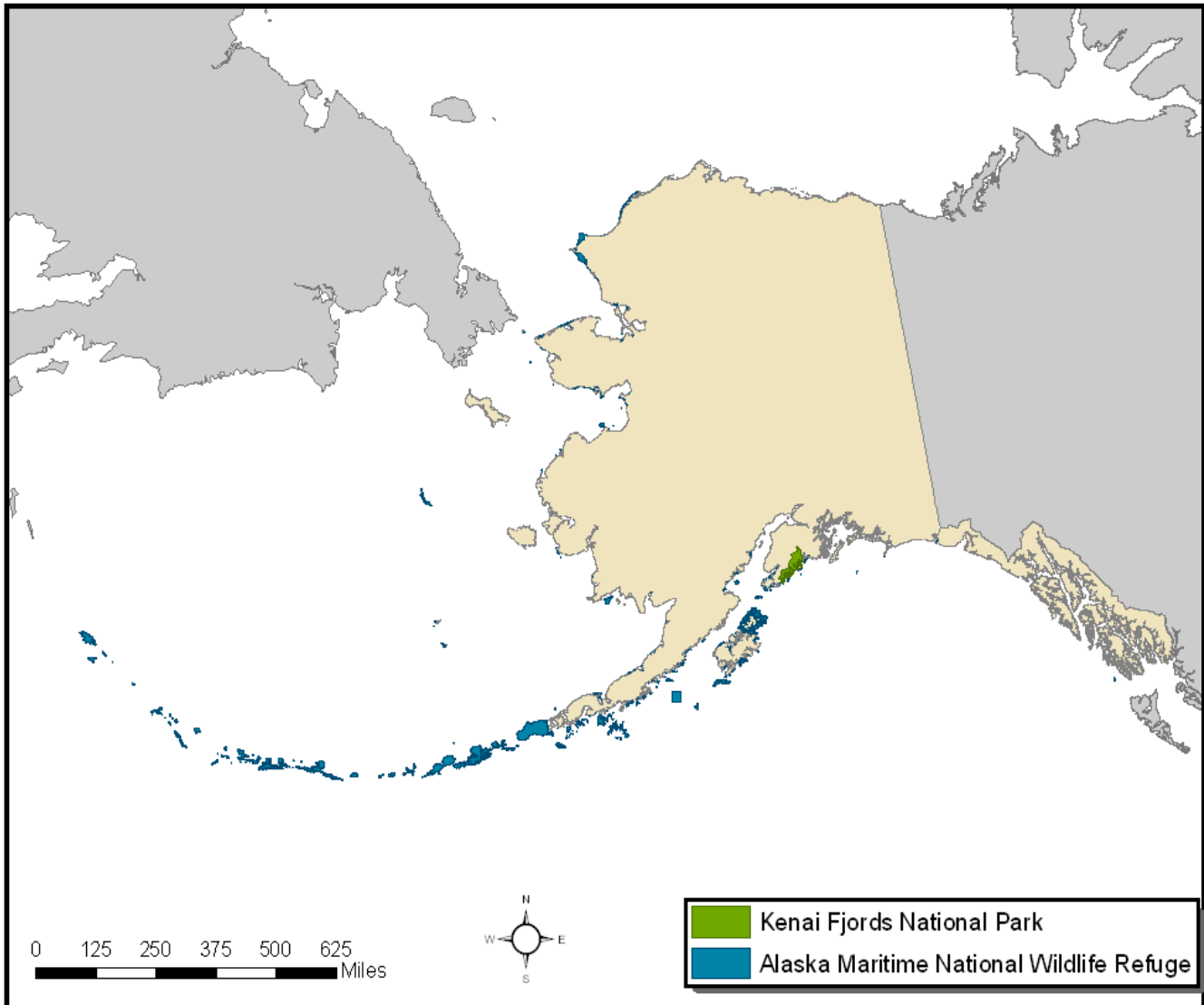


Figure 1. Location of Kenai Fjords National Park and the Alaska Maritime National Wildlife Refuge.

boundaries include an additional 255 km² managed primarily by the State of Alaska and Port Graham Native Corporation (Figure 1). The Alaska Maritime National Wildlife Refuge (AMNWR) (Figure 1) encompasses almost 20,000 km² and 2,500 islands, stretching along most of the coastline of Alaska.

Survey locations were known colonies from the U.S. Fish and Wildlife Service (USFWS) Seabird Colony Database and new locations identified through local knowledge (Figure 2). Colonies surveyed were within KEFJ or AMNWR (Figure 3). The western boundary of the survey was the west-side of Northwestern Fjord; the eastern boundary was Bear Glacier in Resurrection Bay. Colonies were surveyed as time permitted with the goal of surveying many colonies with a single visit each. Established black-legged kittiwake photo plots in the Chiswell Islands were visited as well as sites on Lone Rock. New colonies were identified when several nesting seabirds were observed to be spaced tightly in a distinct location.

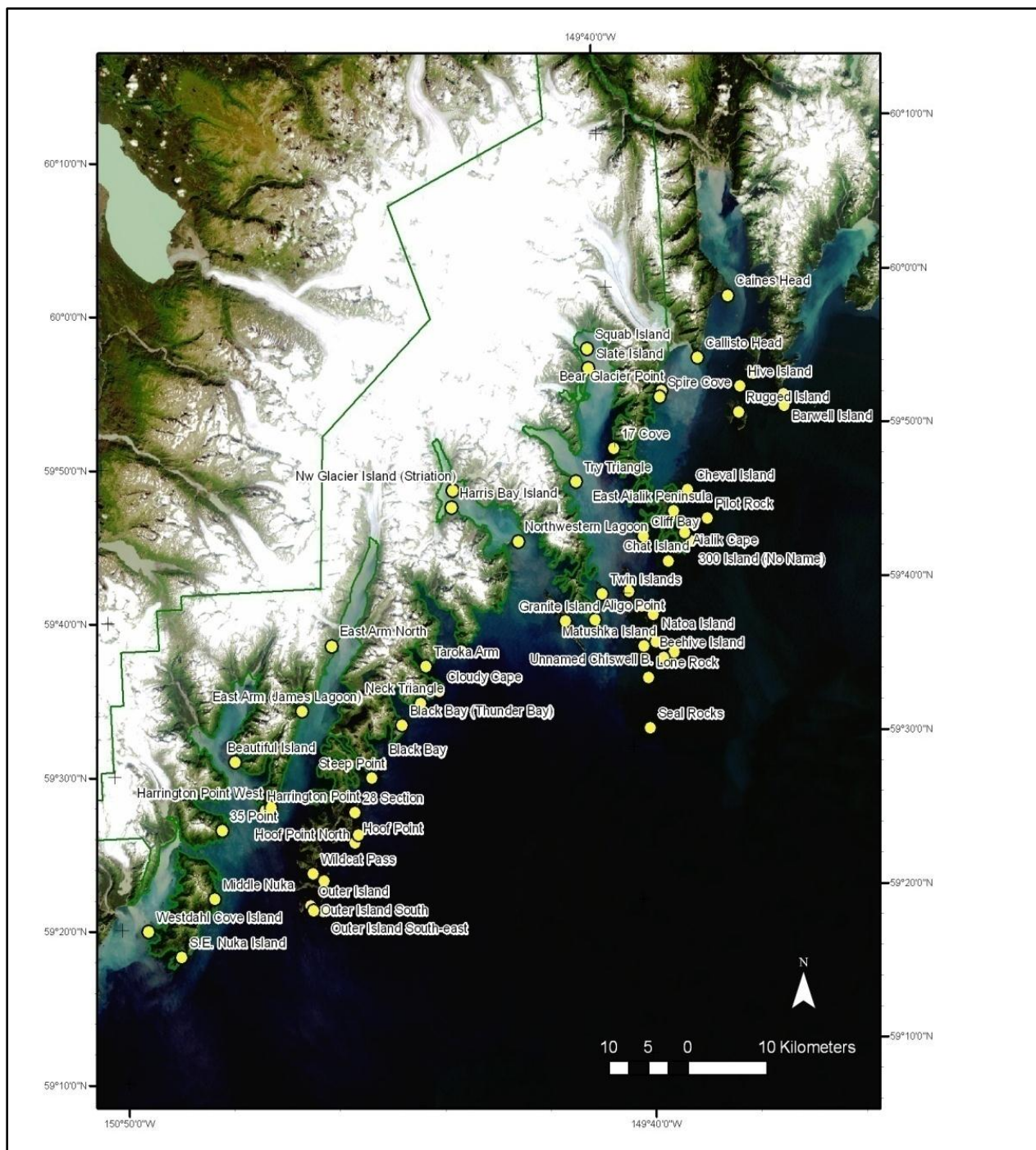


Figure 2. Location of KEFJ area seabird colonies.

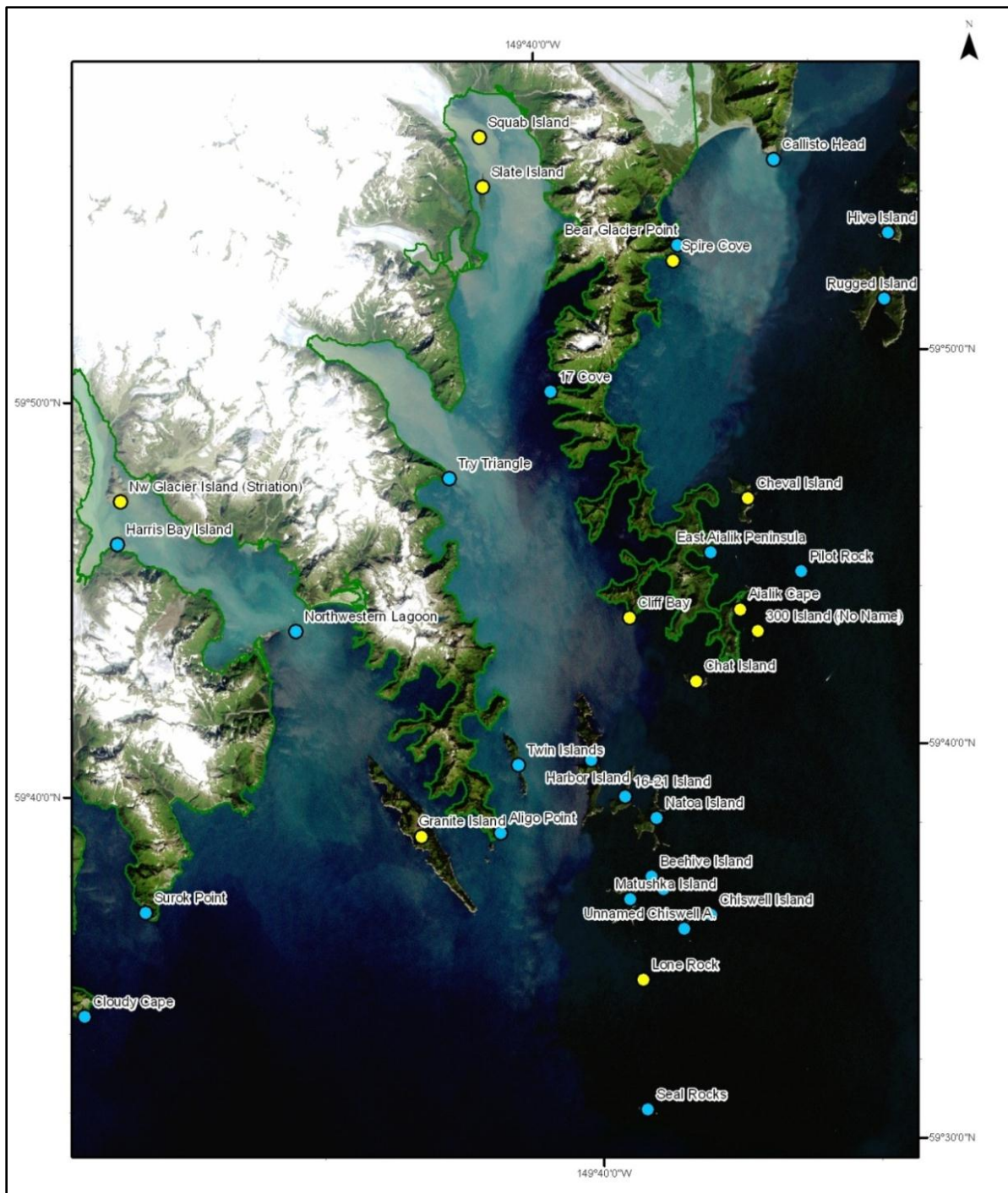


Figure 3. Yellow dots represent seabird colonies surveyed in 2010 along the southern coast of the Kenai Peninsula, Alaska. Locations are in NAD 1983 Albers.

Survey Techniques

Surveys were conducted from the flying bridge of the 16m M/V Serac. Weather was generally poor during the survey period with seas ranging from 0-2m swells and cloudy skies with some precipitation. We encountered weather and sea conditions that were so poor in some areas (>2m swell, driving rain) that we had to abandon plans to survey some locations and added other areas that were more protected. Surveys were performed between the hours of 0800 and 1800, from July 6-9, 2010.

For each survey, the colony area was visually identified and all adults for every species present were counted. Counts made with 14x40 or 12x40 image stabilized binoculars and hand-held tally meters. Roosting adults were counted separately from those attending nests. All birds were counted as breeding only if they were observed on land. Data for puffin species were obtained during other counts and therefore were not standardized for time. When a break occurred in a colony such that there would not be interactions between neighbors, we designated a new colony location and counted the adjacent colony separately.

One survey was conducted at each colony location visited; these surveys are therefore valid for relative abundance measurements, but not population trends. The USFWS standard procedure for monitoring populations of ledge-nesting seabirds (USFWS 2000) recommends 5-10 replicates per colony, preferably on different days, between the hours of 1100 and 1800. Two replicate counts per visit are required to validate population trends. Two replicates were typically completed for abundant species at colonies (glaucous-winged gulls, cormorant spp.) and were repeated until both surveyors obtained counts within 5%. A single observer completed one count for species with fewer individuals present (common murre, horned puffin, tufted puffin). Laura Phillips and Brooke McFarland (NPS) were the primary surveyors with Luke Rosier (NPS) assisting. Birds loafing onshore were recorded separately from birds that appeared to be attending colonies.

Results from the current survey were compiled with data from previous surveys in 2009 (McFarland et al. 2009), 2008 (Hahr 2009), 2007 (Hahr 2008), 1986 (Nishimoto and Rice 1987) and 1976 (Bailey 1976) to examine apparent changes in colony size and composition. We described apparent changes in breeding seabird population size at colonies with four or more years of data. Counts of adults attending colonies were included, but estimated total population of each colony was not. These data can be found in the original reports.

Results

We surveyed four colony locations in KEFJ and seven colony locations in AMNWR (Figure 3) in 2010. We did not observe any sign of breeding activity at two colony locations (Slate Island and Lone Rock) historically used by seabirds. We surveyed a location near Three-Hole Bay that was suspected of having a small colony of horned puffins, but we did not observe any puffins on land in the area. One new colony containing 82 glaucous-winged gulls was identified on a steep rocky cliff face near Northwestern Glacier (59.8343 N, -150.0601 W).

Descriptive comparisons of limited count data available for select seabird species at colonies with multiple years of data reflect the apparent variability in colony attendance since 1976 (Table 1-2, Figures 4-6). Generally, the number of glaucous-winged gulls at colonies in KEFJ and AMNWR appears to have increased since surveys in 1976 and 1986, while observations of horned puffins have apparently decreased (Figures 4-7). Repeated counts of cormorant species at colonies did not reflect a consistent pattern with numbers attending colonies in AMNWR showing an apparent decrease, while counts at some colonies in KEFJ increased (Figure 4-6). Summed totals of counts at colonies in KEFJ with 4 or more years of data showed a large increase in the number of glaucous-winged gulls, a decrease in horned puffins, and an apparent recent increase in the number of cormorants (Figure 7).

Table 1. Species composition and abundance at seabird colonies in KEFJ for all surveys, 1976-2010. Colony survey locations are listed west to east, from Nuka Bay to Resurrection Bay. * Denotes a lack of data for a site/year combination, - indicates no sightings for that category.

Colony/Spp	1976	1986	2007	2008	2009	2010
35 Point						
Glaucous-winged gull	30	-	95	*	90	*
Red-faced cormorant	10	-	-	*	-	*
Double-crested cormorant	-	12	5	*	-	*
Pelagic cormorant	-	25	-	*	1	*
Cormorant sp.	-	-	-	*	-	*
Harrington Point						
Glaucous-winged gull	-	-	166	*	1	*
Red-faced cormorant	-	29	-	*	-	*
Double-crested cormorant	-	-	18	*	-	*
Pelagic cormorant	-	12	-	*	-	*
Horned puffin	10	-	-	*	-	*
Harrington Point West						
Glaucous-winged gull	-	85	-	*	4	*
Double-crested cormorant	-	-	-	*	41	*
Pelagic cormorant	20	-	-	*	-	*
East Arm (James Lagoon)						
Glaucous-winged gull	120	-	-	*	-	*
East Arm North						
Arctic Tern	6	-	-	*	-	*
Glaucous-winged gull	40	162	-	*	4	*
Steep Point						
Glaucous-winged gulls	50	226	139	*	171	*
Double-crested cormorants	-	-	-	*	1	*
Pelagic cormorants	40	46	-	*	27	*
Tufted puffin	-	-	-	*	11	*
Black Bay						
Glaucous-winged gull	-	-	-	*	91	*
Red-faced cormorant	-	-	-	*	14	*
Double-crested cormorant	-	-	20	*	69	*
Pelagic cormorant	14	-	27	*	31	*
Horned puffin	140	-	-	*	11	*
Tufted puffin	-	-	1	*	16	*
Common murre	-	-	3	*	11	*

Table 1. Species composition and abundance at seabird colonies in KEFJ for all surveys, 1976-2010. (continued).

Colony/Spp	1976	1986	2007	2008	2009	2010
Nack Triangle						
Glaucous-winged gull	-	-	-	*	11	*
Red-faced cormorant	40	-	-	*	-	*
Black-legged kittiwake	-	-	-	*	-	*
Pelagic cormorant	20	-	-	*	-	*
Cloudy Cape						
Glaucous-winged gull	-	-	285	*	215	*
Black-legged kittiwake	-	22	-	*	-	*
Red-faced cormorant	-	-	-	*	2	*
Double-crested cormorant	-	-	40	*	35	*
Pelagic cormorant	-	-	-	*	70	*
Cormorant sp.	-	-	-	*	-	*
Horned puffin	-	-	-	*	2	*
Tufted puffin	-	-	-	*	7	*
Surok Point						
Glaucous-winged gulls	20	-	427	*	311	*
Red-faced cormorant	-	-	-	*	2	*
Double-crested cormorant	-	-	9	*	27	*
Pelagic cormorant	140	1	33	*	72	*
Cormorant sp.	-	-	-	*	-	*
Tufted puffin	-	-	-	*	15	*
Horned puffin	-	-	-	*	4	*
NW Glacier						
Glaucous-winged gulls	*	*	*	*	*	82
Try Triangle						
Horned puffin	10	-	-	*	-	*
17 Cove						
Horned puffin	10	-	-	*	-	*
Cliff Bay						
Double-crested cormorant	-	-	30	*	-	-
Pelagic cormorant	-	-	17	*	-	11
Horned puffin	3	-	28	*	-	-

Table 1. Species composition and abundance at seabird colonies in KEFJ for all surveys, 1976-2010. (continued).

Colony/Spp	1976	1986	2007	2008	2009	2010
Aialik Cape						
Glaucous-winged gull	-	-	-	98	-	-
Black-legged kittiwake	-	-	-	3	-	-
Red-faced cormorant	-	74 ¹	-	-	99	51
Double-crested cormorant	-	-	-	9	66	26
Pelagic cormorant	-	63 ¹	-	22	66	104
Cormorant sp.	-	8 ¹	-	-	2	-
Horned puffin	60	-	27	9	4	10
Tufted puffin	-	-	-	17	6	-
East Aialik Peninsula						
Horned puffin	20	-	-	*	12	*
Spire Cove						
Pelagic cormorant	-	-	-	*	11	-
Cormorant sp.	-	-	-	*	-	15
Horned puffin	30	-	-	*	30	1
Bear Glacier Point						
Glaucous-winged gull	-	-	-	32	-	*
Black-legged kittiwake	-	-	-	23	-	*
Double-crested cormorant	-	-	-	7	-	*
Pelagic cormorant	-	-	12	14	-	*
Horned puffin	50	-	19	4	7	*

¹ Aialik Cape and 300 Island (No Name) in AMNWR are combined in the 1986 survey data.

Table 2. Species composition and abundance at seabird colonies in AMNWR for all surveys, 1976-2010. Colony survey locations are listed west to east, from Nuka Bay to Resurrection Bay. * Denotes a lack of data for a site/year combination, - indicates no sightings for that category.

Colony/Spp	1976	1986	2007	2009	2010
Outer Island S to SE					
Glaucous-winged gull	190	1022	*	417	*
Red-faced cormorant	30	-	*	-	*
Pelagic cormorant	40	10	*	-	*
Cormorant sp.	-	-	*	15	*
Horned puffin	-	25	*	2	*
Tufted puffin	180	648	*	31	*
Common murre	-	2	*	-	*
Outer Island South-east					
Glaucous-winged gull	100	556	*	505	*
Black-legged kittiwake	1060	1089	*	759	*
Red-faced cormorant	20	36	*	-	*
Pelagic cormorant	80	28	*	26	*
Cormorant sp.	-	-	*	2	*
Horned puffin	100	30	*	10	*
Tufted puffin	500	58	*	109	*
Rabbit Island					
Pelagic cormorant	4	-	*	-	*
Cormorant sp.	-	-	*	72	*
Horned puffin	30	-	*	-	*
Wildcat Pass					
Glaucous-winged gull	-	4	*	242	*
Pelagic cormorant	40	11	*	-	*
Horned puffin	30	-	*	-	*
Tufted puffin	30	-	*	-	*
Hoof Point					
Glaucous-winged gull	90	137	*	297	*
Black-legged kittiwake	-	59	*	68	*
Red-faced cormorant	60	-	*	-	*
Double-crested cormorant	-	-	*	28	*
Pelagic cormorant	12	4	*	165	*
Cormorant sp.	-	-	*	-	*
Horned puffin	40	-	*	4	*
Tufted puffin	20	-	*	7	*

Table 2. Species composition and abundance at seabird colonies in AMNWR for all surveys, 1976-2010. (continued).

Colony/Spp	1976	1986	2007	2009	2010
Hoof Point North					
Glaucous-winged gull	80	-	*	731	*
Red-faced cormorant	40	-	*	-	*
Double-crested cormorant	-	-	*	4	*
Pelagic cormorant	160	-	*	86	*
Cormorant sp.	-	-	*	-	*
Horned puffin	1000	-	*	8	*
Tufted puffin	800	-	*	14	*
28 Section					
Glaucous-winged gull	-	-	*	58	*
Double-crested cormorant	-	-	*	124	*
Pelagic cormorant	10	present	*	33	*
Cormorant sp.	-	-	*	-	*
Tufted puffin	150	-	*	17	*
NW Glacier Island (Striation)					
Glaucous-winged gulls	16	-	-	309	594
Harris Bay Island					
Arctic tern	80	-	-	-	*
Glaucous-winged gull	40	-	-	30	*
Mew gull	60	-	-	-	*
Granite Island					
Glaucous-winged gull	500	*	*	495	1048
Black-legged kittiwake	100	*	*	-	-
Red-faced cormorant	400	*	*	-	17
Double-crested cormorant	-	*	*	32	-
Pelagic cormorant	72	*	*	40	-
Cormorant sp.	-	*	*	1	167
Horned puffin	130	*	*	24	-
Tufted puffin	100	*	*	26	-
Common murre	200	*	*	55	77
Aligo Point					
Red-faced cormorant	-	-	-	9	*
Double-crested cormorant	-	-	23	-	*
Pelagic cormorant	-	-	14	21	*
Cormorant sp.	-	-	-	-	*
Horned puffin	-	-	22	3	*
Puffin sp.	-	-	-	1	*

Table 2. Species composition and abundance at seabird colonies in AMNWR for all surveys, 1976-2010. (continued).

Colony/Spp	1976	1986	2007	2009	2010
Twin Islands					
Glaucous-winged gull	-	*	*	-	*
Black-legged kittiwake	-	*	*	-	*
Double-crested cormorant	-	*	*	-	*
Cormorant sp.	-	*	*	-	*
Horned puffin	50	*	*	35	*
Tufted puffin	-	*	*	-	*
Common murre	-	*	*	-	*
Slate Island					
Glaucous-winged gull	-	-	-	21	-
Mew gull	30	-	-	-	-
Horned puffin	56	-	-	1	-
Squab Island					
Glaucous-winged gull	400	444	-	610	412
Chat Island					
Glaucous-winged gull	205	286	*	270	303
Red-faced cormorant	34	-	*	-	-
Double-crested cormorant	-	17	*	9	-
Pelagic cormorant	43	7	*	24	-
Cormorant sp.	-	1	*	-	29
Horned puffin	80	76	*	24	17
Tufted puffin	30	70	*	2	29
Common murre	80	14	*	6	-
300 Island (No Name)					
Glaucous-winged gull	70	-	*	242	522
Red-faced cormorant	-	74 ¹	*	16	-
Pelagic cormorant	-	63 ¹	*	36	14
Cormorant sp.	-	8 ¹	*	-	17
Horned puffin	60	-	*	13	12
Tufted puffin	500	-	*	51	80
Common murre	-	-	*	13	-
Pilot Rock					
Glaucous-winged gull	20	-	*	84	*
Horned puffin	30	-	*	11	*
Tufted puffin	10	-	*	14	*

Table 2. Species composition and abundance at seabird colonies in AMNWR for all surveys, 1976-2010.
(continued).

Colony/Spp	1976	1986	2007	2009	2010
Cheval Island					
Glaucous-winged gull	140	-	*	104	500
Red-faced cormorant	100	-	*	3	-
Double-crested cormorant	36	-	*	18	3
Pelagic cormorant	20	7	*	31	17
Cormorant sp.	-	-	*	1	-
Horned puffin	210	-	*	58	59
Tufted puffin	140	-	*	32	8
Common murre	-	-	*	4	1
Lone Rock					
Northern Fulmar	40	18	*	*	-
Glaucous-winged gull	24	*	*	*	-
Horned puffin	40	-	*	*	-
Tufted puffin	80	-	*	*	-

* Denotes colonies were not surveyed

- Denotes no observations of species/ nest at colony.

¹ 300 Island (No Name) was combined with Aialik Cape for this year.

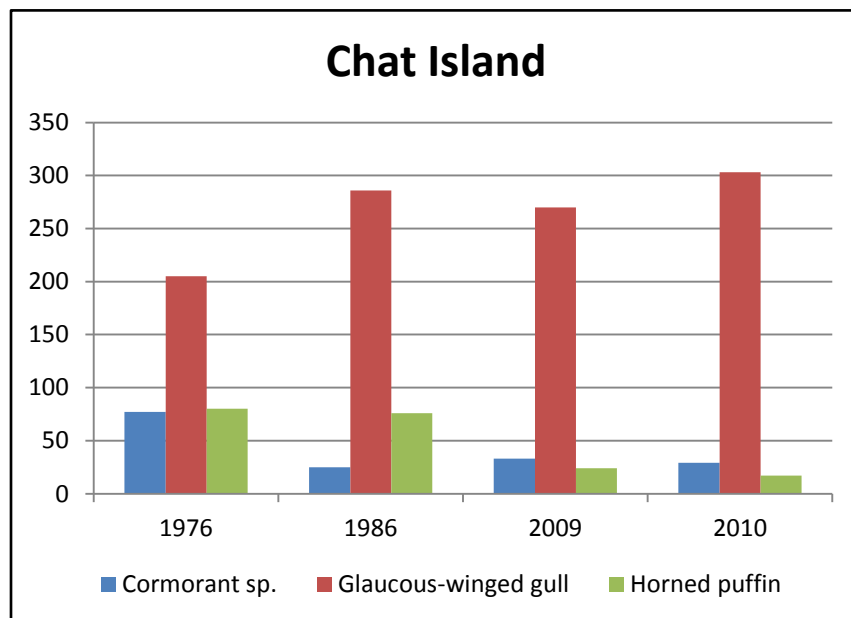
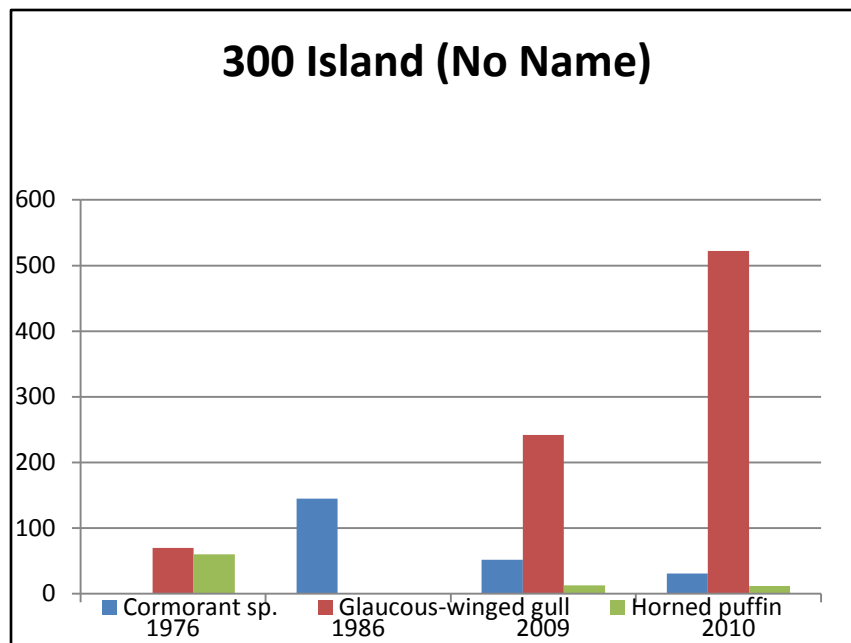


Figure 4. Graphs depicting the apparent breeding population size of glaucous-winged gulls, horned puffins, and 3 cormorant species (red-faced cormorants, double-crested cormorants, pelagic cormorants) at 2 colonies in AMNWR with four years of count data (1976, 1986, 2009, 2010).

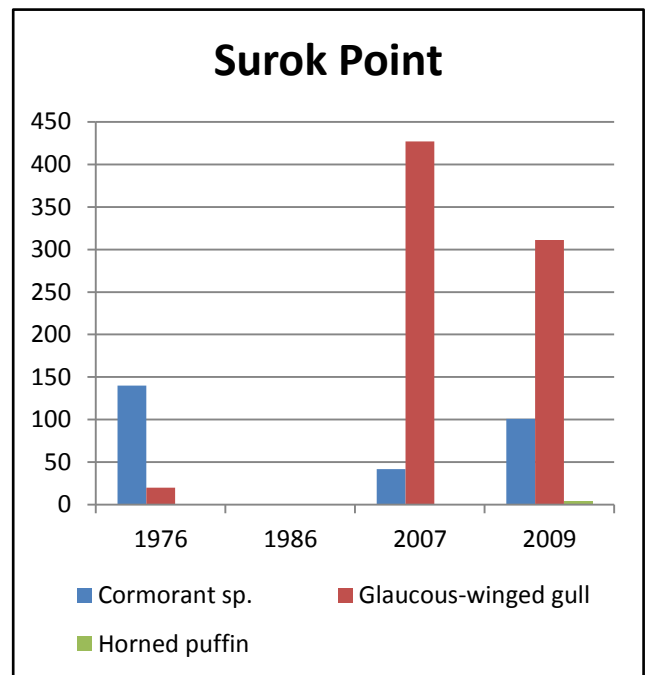
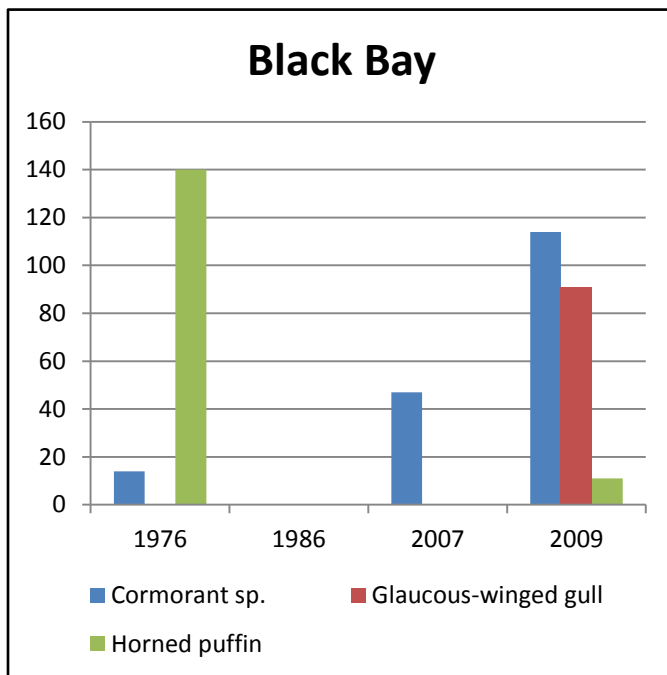
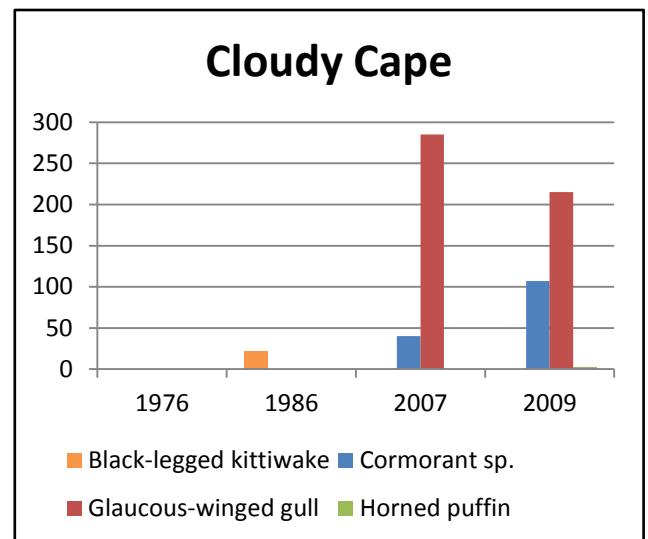
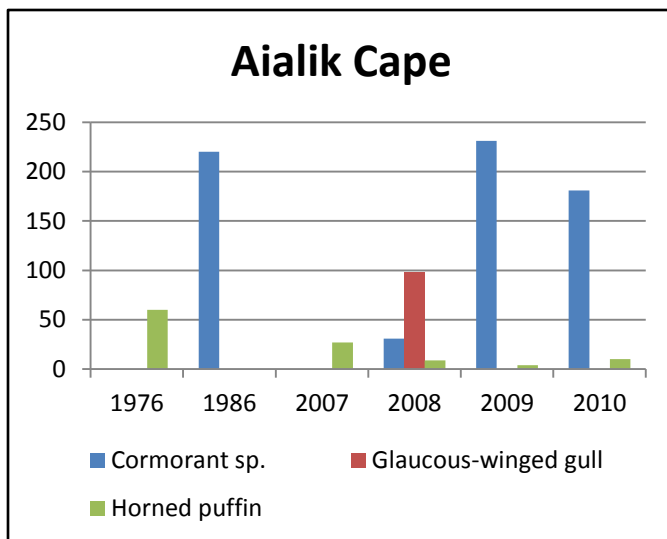


Figure 5. Graphs depicting the apparent breeding population size of glaucous-winged gulls, horned puffins, black-legged kittiwakes, and 3 cormorant species (red-faced cormorants, double-crested cormorants, pelagic cormorants) at 4 colonies in KEFJ with four years of count data (1976, 1986, 2007, 2009).

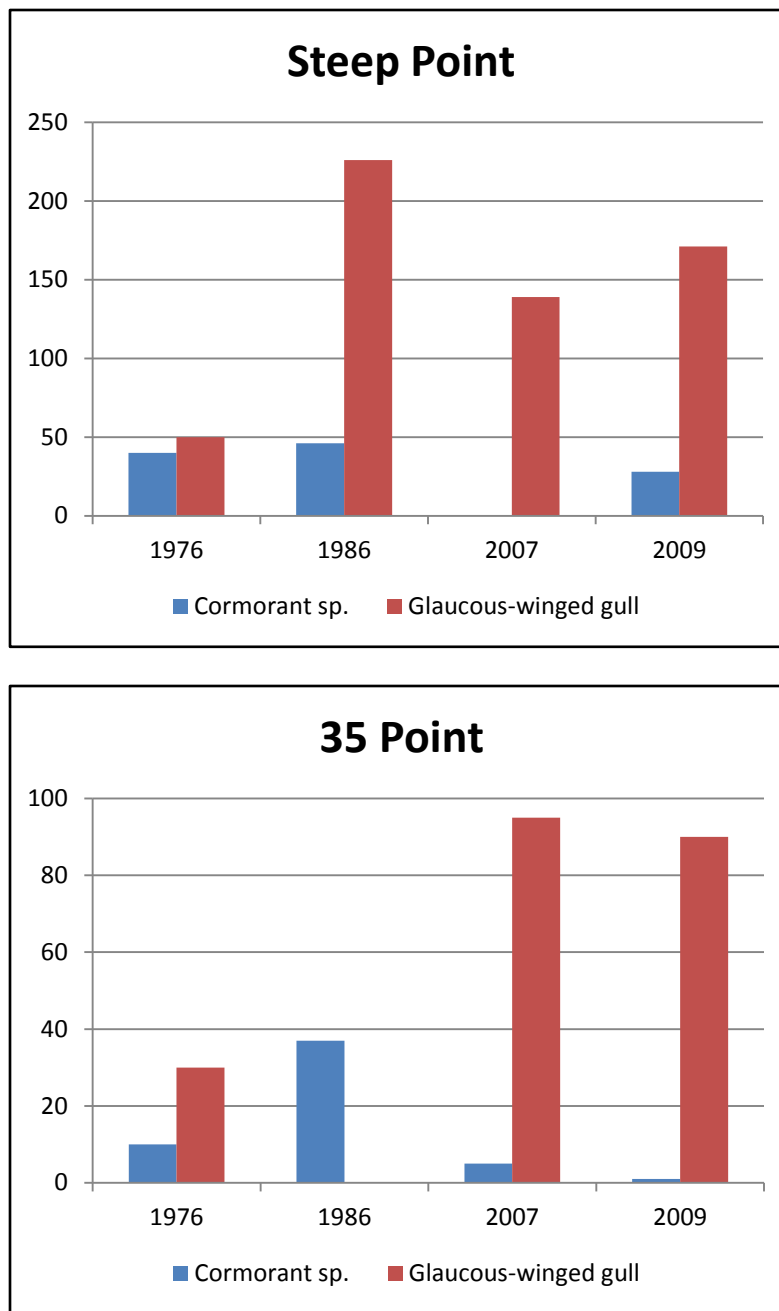


Figure 6. Graphs depicting the apparent breeding population size of glaucous-winged gulls, horned puffins, black-legged kittiwakes, and 3 cormorant species (red-faced cormorants, double-crested cormorants, pelagic cormorants) at 2 colonies in KEFJ with four years of count data (1976, 1986, 2007, 2009).

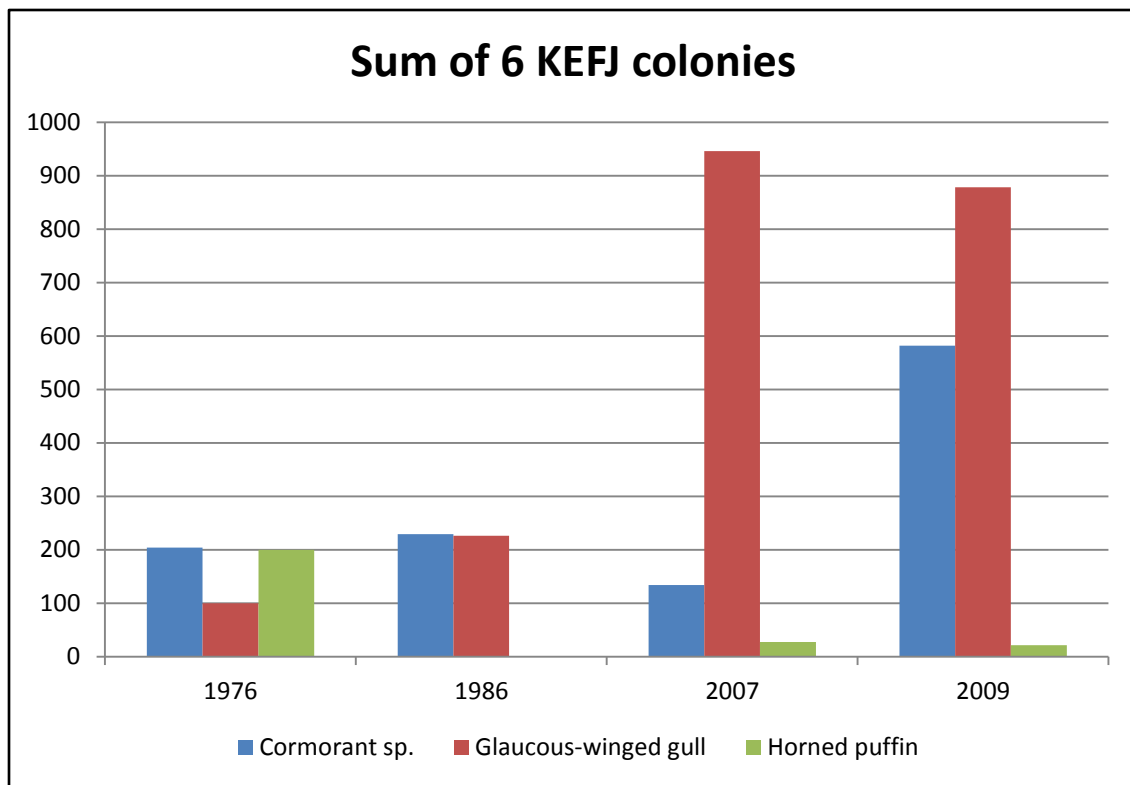


Figure 7. Graph depicting the apparent summed total breeding population size of glaucous-winged gulls, horned puffins, and 3 cormorant species (red-faced cormorants, double-crested cormorants, pelagic cormorants) at 6 colonies in KEFJ with four years of count data (1976, 1986, 2007, 2009).

Discussion

Seabird colony surveys have been conducted along the eastern Kenai Peninsula only sporadically since 1976. During past survey efforts, replicate counts were rarely made and direct comparisons of data to recent surveys are complicated by differing survey techniques and record keeping. When Bailey (1976) conducted his surveys of seabird colonies along the Kenai Fjords coastline, he made single counts of adult ledge-nesting seabirds (gulls, murres, cormorants, kittiwakes) at small cliffs, but frequently estimated numbers of birds at larger colonies by extrapolating from counts on portions of the cliff. He estimated populations of tufted puffins by enumerating and extrapolating burrows and individuals visible during boat based surveys and horned puffins from observed numbers and the amount of suitable habitat available. His estimates of puffin numbers are higher than any obtained on subsequent surveys in the Kenai Fjords area possibly due to his estimation methods; however, none of the surveys conducted since have used robust survey techniques for monitoring puffin numbers, especially tufted puffins (USFWS 2000b).

While Nishimoto and Rice (1986) attempted to duplicate Bailey's survey techniques to facilitate comparisons, a number of differences in methods and reporting make comparisons difficult. Nishimoto and Rice generally surveyed off a small inflatable boat resulting in a more limited field of view than Bailey. Nishimoto and Rice also reported many colony counts by area, lumping observations from multiple colonies into area totals or birds off colony (on water or in air) on transects in count totals making it difficult to compare across years at specific sites. They also appeared rushed in their survey schedule, suggesting that counts in some areas may have been artificially lower or absent due to lack of time.

Recent surveys conducted by NPS and USFWS since 2007 were generally performed from a larger vessel and observers made duplicate counts of birds on a single visit at most colonies visited. While we've tried to maintain consistency among years since 2007, we have not had the opportunity to fully follow USFWS protocols (USFWS 2000a-c) except during Chiswell area surveys in 2008.

Colony locations can be fairly stable for many species; however, others, most notably cormorants, move colonies frequently (USFWS 2006). Using GIS coordinates has improved our ability to accurately identify colony locations, although the time of day, season and weather during which the surveys are performed might affect the ability to identify locations and may affect the number of individuals observed at colonies. Shifting of individuals from one colony to another among years may also affect count estimates for populations if the area surveyed does not adequately monitor potential breeding habitat.

Single visits to colonies and poor weather in 2010 probably affected our ability to obtain precise counts of birds attending colonies and to detect the presence of seabirds at some small colonies. Species such as cormorants were especially difficult to detect and identify to species in the low light, rain and high seas. We did not detect any breeding activity at Lone Rock, which historically had northern fulmars nesting on it along with puffins and glaucous-winged gulls. This island was the only location in the KEFJ area that nesting northern fulmars had been found. The island had not been visited by staff since 1986 (Nishimoto and Rice 1986), and while our single visit to the island suggests seabirds no longer use the island for nesting, the island should be visited in future years to determine the presence or absence of nesting seabirds, especially northern fulmars. We also did not detect any seabird breeding activity at Slate Island, which had a small colony of glaucous-winged gulls in 2009 and mew gulls and horned puffins nesting in 1976. Slate Island is frequented by black bears during the summer, so it is possible that gulls attempted to nest on the island in 2010 and nests were depredated prior to our survey of the

island. Given the poor survey conditions in 2010, we would have predicted lower counts of seabirds at colonies; however, at 5 of 7 AMNWR colonies visited, we detected a higher number of glaucous-winged gulls than in 2009, suggesting an increase in their numbers at some colonies, although the difference might be attributed to gulls attending nests in greater numbers due to the cool, wet weather conditions during the 2010 survey.

In 2011, we will begin a cooperative interagency project to identify spatial and temporal variability of nesting seabirds within this region. While data collected on colonial nesting seabirds in the KEFJ area is less than ideal for monitoring seabird populations, it does assist us in developing questions and objectives for this future study such as:

- Developing statistically valid protocols for monitoring long-term trends in colonial seabird populations.
- Monitoring the presence or absence of difficult to survey or uncommon nesting seabird species such as rhinoceros auklets, parakeet auklets, fork-tailed storm petrels, and northern fulmars.
- Monitoring colonies that contain a disproportionate number of some species of breeding seabirds such as common murre, black-legged kittiwakes, and tufted puffins at Outer Pye Island and certain Chiswell Islands (Natoa, Chiswell, Chiswell B, Beehive, Beehive B, Matushka) and cormorant species at KEFJ Outer Coast colonies such as Black Bay, Cloudy Cape, Surok Point, and Aialik Cape.
- Detecting potential impacts of disturbance on nesting seabirds at colonies in areas of high public use or visibility.
- Integrating colonial seabird surveys into SWAN marine bird and mammal survey.
- Integrating studies of seabird predators such as bald eagles and peregrine falcons into seabird monitoring surveys.
- Defining colony locations for long-term monitoring given the variation observed in spatial extent.
- Examining trends in productivity of seabirds at select colonies given time and funding constraints.
- Identifying potential management needs or actions.

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