Monitoring and Avian Influenza Sampling of Nesting Waterfowl on Kigigak Island, 2010

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SUMMARY
The 19^{th} consecutive year of monitoring nesting productivity, annual survival, and estimating recruitment and age-specific demographics of spectacled eiders occurred on Kigigak Island, Alaska in 2010. A total of 119 spectacled eider nests were located on 34 plots; 118 were found active and 1 was found depredated. Peak nest initiation occurred between 29 - 31 May and peak hatch occurred between 22 - 24 June. Of the 118 active nests, 21 were unsuccessful due to natural causes, including depredation (11 nests, 9.3%), addled/inviable eggs (4 nests, 3.4%), and destruction due to a storm surge in June (6 nests, 5.1%). Depredation was mainly attributed to glaucous and mew gulls. One fox was observed prior to nest initiation. Other fox sign (scat, tracks, fur, etc) was infrequently found throughout field work. Mayfield nest success of 98 nests was 73.9% (95% CI; 64.2-84.9%). A total of 75 adult females were captured or visually identified, 15 of which were originally banded as ducklings on Kigigak Island. The 2010 field season was a pilot study year for a graduate research project through the Alaska Sea Life Center in Seward, Alaska and the University of Alaska, Fairbanks, Alaska. The main goal was to test data collecting equipment and collection methods that will be part of the field work over the next two field seasons.

KEY WORDS Spectacled Eiders, Common Eiders, Pacific Black Brant, Emperor Geese, Avian Influenza, Nest Success, Productivity, Food Availability, Baseline Limnology Data

INTRODUCTION

Since the listing of spectacled eiders (*Somateria fischeri*) in 1993, the U.S. Fish & Wildlife Service has monitored the eider population, assessed possible reason(s) for the decline, and developed management strategies to facilitate population recovery (U.S. Fish & Wildlife Service 1996). Over the last 18 years, research on Kigigak Island has documented adult female annual survival, nest success, duckling survival, and recruitment. This research continued in 2010 with the addition of a graduate research project focusing on baseline limnology data, food availability, and habitat use.

This research is particularly important, considering the potential impacts of climate change on spectacled eider productivity. Scientists predict that habitats along the Bering Sea coast will change dramatically over the next 50 years, and have a significant impact on the refuge's coastal ecosystems. Climate scientists suspect that over the next few decades sea level will rise and storm surges along the Bering Sea coast will increase in frequency and severity (T. Jorgenson, pers. comm.). During such surges, ocean water can flood the entire island increasing salt concentrations in wetlands used by spectacled eiders and their broods. This increase in salt can potentially affect food availability, duckling growth, and ultimately spectacled eider productivity.

Recently there has been concern about the westward spread of highly pathogenic (HP) H5N1 Asian avian influenza (AI) from Asia to Europe, Africa, and North America by migrating wild birds. The U.S. Fish & Wildlife Service began a sampling program to determine whether it is present in Alaska. If it is not currently present, the Service will be able to document when it arrives (Interagency Asian H5N1 Early Detection Working Group 2006). Species sampled on Kigigak Island included spectacled and common eiders, Pacific black brant (*Branta bernicla nigricans*), and emperor geese (*Chen canagica*).

Study Objectives

1. Document nesting chronology and quantify productivity parameters for spectacled eiders and Pacific black brant.
2. Capture and mark adult female spectacled eiders for estimation of annual survival.
3. Collect cloacal and oral-pharyngeal swabs from four species, including 50 emperor geese, 50 spectacled eiders, 60 Pacific common eiders (*Somateria mollissima v-nigra*), and 65 brant to detect presence of avian influenza.
4. Collect baseline data for weather, pond depths, and water chemistry in relation to spectacled eider productivity and habitat use.
5. Assess food availability for spectacled eider broods by sampling a random selection of ponds for macro invertebrates.

STUDY AREA

Kigigak Island (32.5 km2) (60◦50'N, 165◦50'W) is located along the outer fringe of Yukon Delta National Wildlife Refuge (YDNWR) near the mouth of Baird Inlet (Figure 1). The island, bordered by the Ninglick River and the Bering Sea, contains many shallow ponds, lakes, and a network of tidal sloughs. Habitat consists of low coastal tundra, sedges, and grasses. Spring and fall storm tides regularly inundate the island, except for upland areas which are flooded only during severe storm tides.

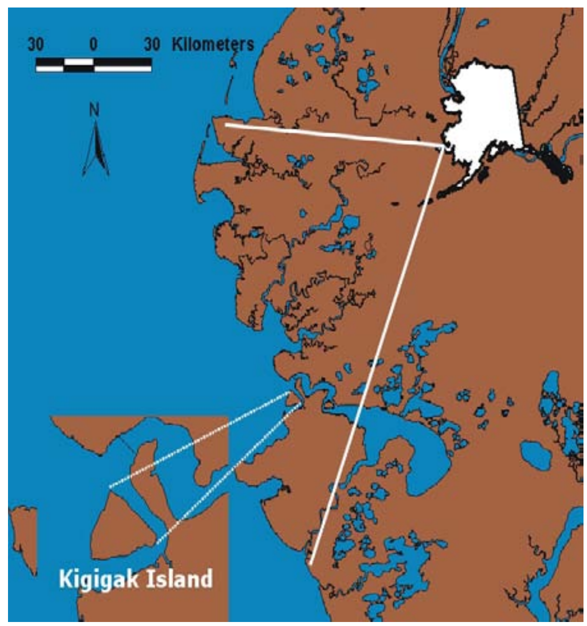

Figure 1. Location of Kigigak Island within the coastal zone of Yukon Delta NWR, Alaska

METHODS

Data Collection

As recommended by the Spectacled Eider Recovery Team, a two person research team arrived 24 April prior to bird arrival in order to: 1) monitor migration arrive, 2) increase identifying previously marked spectacled eiders, and 3) estimate fox population size. Three additional personnel arrived on 14 May and a five person camp was maintained until 1 July. Personnel searched for spectacled and common eider and emperor goose nests on 34, 0.17 km^2 plots previously identified as preferred spectacled eider nesting habitat (Harwood and Moran 1993) (Figure 2). Additional nests were located opportunistically while moving between plots. Only spectacled eider nests were monitored to determine nest fate. Three nesting concentrations of brant were selected for monitoring.

Data were recorded according to guidelines developed by the USGS – Alaska Science Center (Grand 1993). On the initial nest visit a white flag was placed approximately 3 m from the nest and nest location was recorded with UTM coordinates. Each egg was uniquely numbered to document the number of new and depredated eggs on subsequent visits. Each egg was floated (Westerkov 1950) and candled (Weller 1956) to estimate days of incubation and viability. Ten contour feathers were collected from each spectacled eider nest bowl for future DNA and stable isotope analyses.

Nests were revisited every 7 days until hatch. On all nest visits, nest status (laying, depredated, abandoned, hatched) and egg status (number present, new, missing, inviable) were recorded. We attempted to identify marked females on all nest visits by reading nasal and tarsal band codes with spotting scopes or binoculars. If we were unsuccessful, an attempt was made to capture the female within a few days of the expected hatch date.

Bownet traps (Salyer 1962) and mist nets were used to trap females late in incubation. Hatch dates were calculated based on egg float angle and candling data, assuming a 24-day incubation period for spectacled eiders and brant and a 26-day incubation period for common eiders and emperor geese. Unbanded female spectacled eiders were marked with metal, U.S. Fish & Wildlife Service leg bands and alphanumerically coded, yellow, plastic tarsal bands and nasal disks (Lokemoen and Sharp 1985). The cloaca and oral cavity of spectacled eiders, common eiders, emperor geese, and brant females were swabbed for avian influenza H5N1 testing (Interagency Avian Influenza Working Group 2006).

Ponds selected for macro invertebrate sampling were chosen randomly from four different vegetation strata. At least two ponds were sampled from each strata between breakup and the end of the field work in July. A sampling point in each cardinal direction was chosen at each pond. Each point was marked with GPS coordinates and plankton, benthic, and water column samples were collected. A 180 µm plankon net was used to collect plankton; a D-net was used to sample the water column; and an Eckman dredge was used to collect sediment which was then run through a 250 µm sieve. All samples were transferred to Whirl Packs and Alka –Seltzer tablets were used to kill organisms. Samples were later transferred to Nalgene bottles and preserved with a 70% ethanol solution.

A YSI (YSI Incorporated, Yellow Springs, OH) conductivity meter was used at each sampling location and conductivity, temperature, and salinity were recorded. A Hobo conductivity logger and Hobo water level logger were placed in one pond in each of the four strata using a float and anchor system. A staff gauge was installed to manually record water levels throughout the field season. Gauges were benchmarked to the mean high water mark on the shoreline. Readings were taken at opportunistic times when working in the area.

A Hobo weather station was installed at base camp to collect weather data (temperature, wind speed and direction, barometric pressure, and radiation) over the course of the spring/summer/fall. The instrument was programmed to take a reading every hour and was left out until 10 September to gather weather data late into the season. The Hobo loggers were also pulled at this time and data will be downloaded from them.

Data Analysis
Nest initiation and hatch dates, clutch size, and nest fate were only reported for spectacled eiders and brant. Estimated hatch dates were used to determine timing of nest trapping to collect avian influenza samples. Initiation dates for spectacled eider and brant nests found during laying were estimated by subtracting 1 day for each egg present. For nests found during incubation, egg float angle and candling data were backdated according to the incubation period for each species and a laying rate of one egg per day (Grand and Flint 1997). Hatch date was similarly estimated using egg float angle and candling data. For nests that survived to incubation, clutch size was the total number of eggs laid. Nests were defined as successful if ≥ 1 egg hatched. Nests with unknown fates, found depredated, abandoned due to human disturbance or that contained all inviable eggs were excluded from nest success analysis. Nest success was estimated using the model of Dinsmore et al. (2002). A constant daily survival rate and an overall exposure period of 29 days was assumed (Harwood and Moran 1993).

Apparent fate of all spectacled eider eggs was documented. Eggs were classified as hatched if detached membranes or ducklings were observed. Depredated, infertile, and addled eggs were recorded. If the clutch was intact or some eggs had hatched, cold eggs were assumed to be abandoned. If abandonment occurred after trapping the female, it was assigned to human cause. When the fate of an egg could not be determined it was classified as unknown.

RESULTS

Fox Observations
Arctic fox were rare on Kigigak Island over the two month time period that personnel were present. The only direct sighting of an arctic fox occurred 1.6 km north of camp prior to nest initiation (3 May). After nest initiation had commenced, occasional indications of fox presence (tracks, scat, etc) were observed, but magnitude of nest depredation was believed minimal.

Nesting Chronology
The first pair of spectacled eiders was observed on 14 May. Nest initiation occurred between 24 May and 25 June with peak nest initiation between 31 May – 4 June (Figure 3). A total of 119 nests were located on 34 plots (Figure 2). Hatch occurred between 17 June and 2 July with peak hatch between 24 - 28 June (Figure 4).

The first group of brant was sighted on 10 May. A total of 198 brant nests were located within 3 nesting aggregations. Brant nests were initiated between 17 May and 5 June with peak initiation between 27 - 29 May. Hatch occurred between 18 - 30 June with peak hatch between 20 - 22 June.

Clutch size
Spectacled eider clutch size ranged from 1-9 eggs, with a mean clutch size of 4.4 eggs (Table 1, Figure 5).

Brant clutch size ranged from 1-7 eggs, with a mean clutch size of 3.5 eggs.

Nest Success
The fate of 98 spectacled eider nests was determined, including: 82 (83.7%) hatched, 9 (9.2%) depredated, 6 (6.1%) destroyed, and 1 (1.0%) abandoned. A 6-day storm with persistent wind and rain began on the morning of 13 June and lasted through the evening of 17 June. Wind speed reached highs around 23 knots. Ironically, 6 nests were destroyed by this 6-day storm. The estimated nest success, assuming an exposure period of 29 days, was 75.6% (95% C.I. 63.3-84.2; Table 2). The fate of 503 eggs was determined, including: 334 (61.3%) hatched, 83 (15.2%) depredated, 9 (1.7%) abandoned due to natural causes, 19 (3.5%) abandoned due to monitoring activity, 34 (6.2%) inviable or addled, 21 (3.9%) destroyed by storm, and 3(0.6%) damaged during handling, trapping, or when the attending female flushed from the nest (Table 3). Egg depredation was mainly attributed to glaucous and mew gulls.

The fate of 185 brant nests was determined, including: 103 (55.7%) hatched, 30 (16.2%) depredated, 28 (15.1%) abandoned, and 24 (13.0%) destroyed by the 6-day storm in mid-June. The fate of 653 eggs was determined, including: 349 hatched (53.4%), 108 depredated (16.5%), 101 abandoned due to natural causes (15.5%), 72 (11.0%) destroyed by storm, 22 inviable or addled (3.4%), and 1 (0.2%) that was broken when the attending female flushed from the nest.

Female capture
A total of 69 spectacled eider females were nest trapped. Six additional females were visually identified by nasal disc. Twenty-five of the trapped females were new captures and they were banded with a metal USFWS band and an individually coded, plastic, nasal disk and tarsal band. Fifteen of the 50 banded adult females identified in 2010 were originally banded as ducklings on Kigigak Island. One of these 15 adult females was detected nesting for the first time on Kigigak Island since being banded as a duckling in 2004 (Table 4).

Avian Influenza Sampling
All avian influenza quotas were met. Cloacal and oral-pharyngeal swab samples to detect avian influenza presence were taken from 50 spectacled eiders, 50 emperor geese, 65 brant, and 60 common eiders.

Mortality
No adult females or ducklings died as a direct result of our field efforts. One duckling was found dead in a nest after a 6-day wind and rain storm.

Limnology Data
A total of 120 invertebrate samples were collected from 10 different ponds in 2010. Samples were sent to the University of Alaska – Fairbanks at the end of the field season and will be sorted, dried, weighed, and keyed out during fall and winter.

DISCUSSION

Fox abundance was predicted to be high in 2010 due to high microtine densities observed within the refuge's coastal fringe in 2009. Fox predation has caused catastrophic nest failures on Kigigak Island in the past (2001 and 2003). Therefore, fox predation and its potential effects on the eider population was a concern in 2010. As prescribed in the refuge's brant management plan (U.S. Fish & Wildlife Service 2010, Draft) arctic fox were not controlled on Kigigak Island in 2010. A pre-break up camp was established on Kigigak in late April in an effort to estimate fox population size. Only one arctic fox was sighted and few signs of fox presence were observed throughout the field season and the magnitude of fox depredation did not appear to significantly affect spectacled eider production. Egg remains at depredated nests indicated glaucous and mew gulls were the main predator. In addition to nest predation, a large wind and rain storm in mid-June caused nest destruction and abandonment that impacted brant production more than spectacled eiders. Nevertheless, the 2010 estimate of spectacled eider nest success increased for the second straight year indicting that the spectacled eider population was not negatively affected by the lack of fox removal in 2010.

Resighting efforts were also initiated prior to breakup in 2010. The first spectacled eider pair was observed 15 May. When the second crew arrived in mid-May mobility was an issue because of flooding. Ice/snow melt covered the island in water which prevented access to much of the island until the water drained. In addition, spectacled eider females are often skittish and flush from their nests during nest initiation making resighting efforts difficult until later in incubation when females sit tightly on their nests. To increase resighting results, a SLR camera with a 400 mm zoom lens was purchased for the 2011 field season. The quality of this equipment will allow photographic identification of previously marked females. This technique is particularly effective when incubating females flush. It also provides occasional identification of females as they fly by or as they attempt to conceal themselves while incubating. Photography will increase the resighting efforts on Kigigak Island and provide a visual reference to verify band observations and minimize observer errors.

The number of unbanded birds captured (25) in 2010 is slightly lower than the long-term average of 29 (mode 27, median 32). One adult female banded as a duckling was detected nesting for the first time in 2010, increasing the total number of these birds observed during this study to 59. These observations indicate that the first year breeding age for spectacled eider females is three years. Many of these females have contributed to more than one nesting attempt over the years.

Kigigak Island is a relatively stable, closed system where the population size is not increasing in relation to other populations. During the first half of this study (1992-2001) the average number of newly marked females was 35 (mode 27, median 33). During the second half of the study (2002-2010) the average number of newly marked females was 28 (mode 32, median 27). These averages include years (2001, 2003, and 2008) where nest success was unusually low due to predation. This decrease is not biologically significant and should not concern the Spectacled Eider Recovery Team. The resighting effort in 2010 was lower than it otherwise would have been because the time available to focus on indentifying previously marked and unmarked females was limited by the time required to achieve avian influenza quotas. At this point a large portion of the female eiders on Kigigak Island have been banded and we expect to mark between 20 and 30 new females each year.

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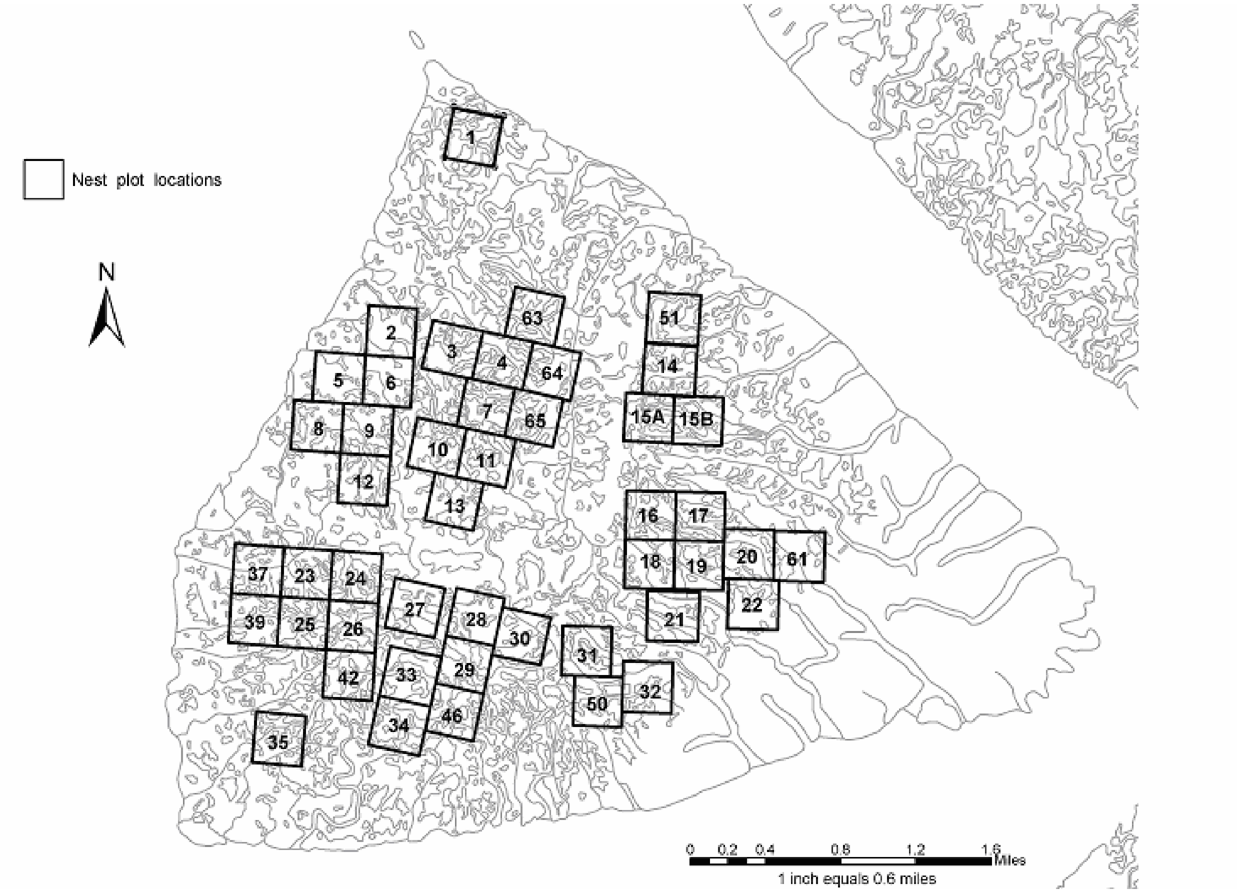

Figure 2. Locations of plots (N=48) searched for eider nests on Kigigak Island, Alaska (plots 66 [east of 11] and 68 [east of 13] are not shown).

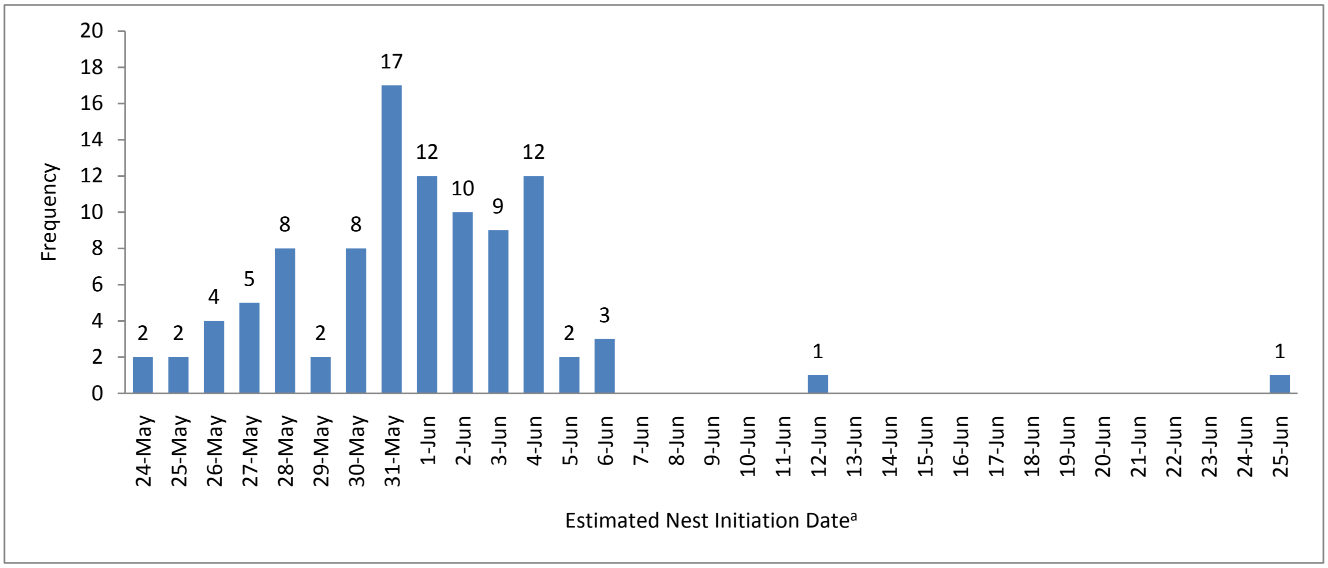

Figure 3. Estimated nest initiation dates for spectaced eider nests in 2010.
[a] Estimates assume an incubation period of 24 days and a laying rate of one egg per day.

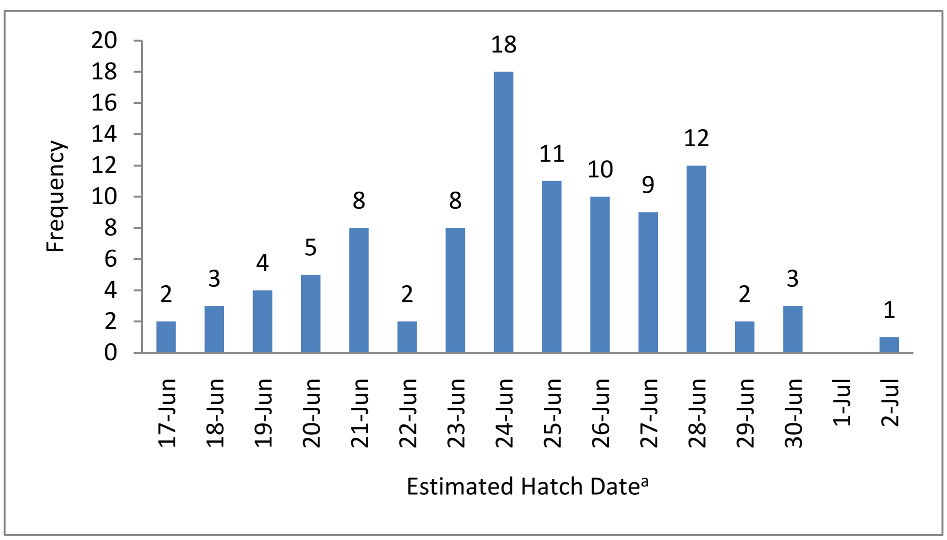

Figure 4. Estimated hatch dates for spectacled eider nests in 2010.
[a] Estimates assume an incubation period of 24 days

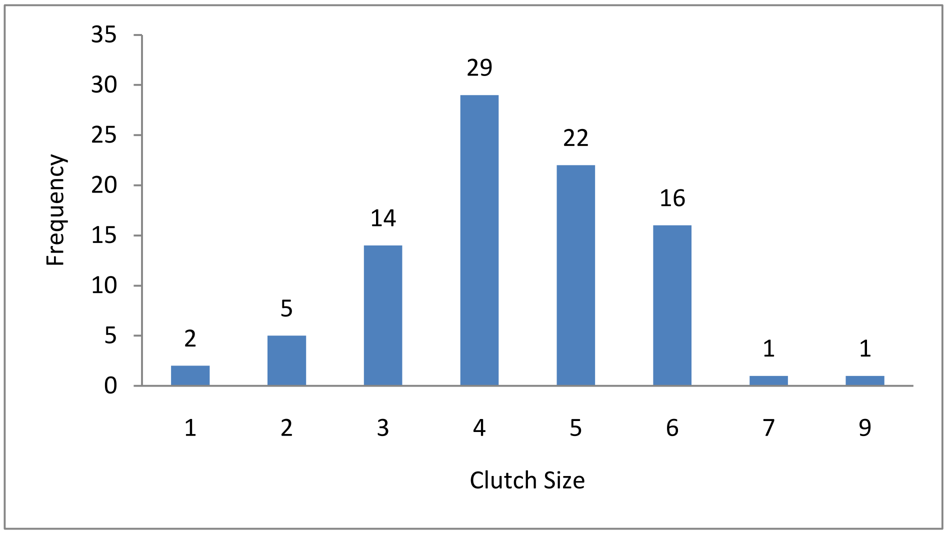

Figure 5. Clutch size frequencies for spectacled eider nests in 2010.

Table 1. Mean clutch size for spectacled eider nests

Year	n	$\bar{x}$	S.D
1992	64	5.5	0.8
1993	74	5.2	1.1
1994	70	5.4	0.9
1995	92	4.7	1.1
1996	106	5.1	0.8
1997	132	4.9	0.8
1998	104	4.5	0.8
1999	121	4.8	0.9
2000	117	5	1.1
2001	22	4	0.9
2002	143	5.2	1.1
2003	131	4.7	1.3
2004	147	5	1.1
2005	147	4.8	1
2006	169	4.9	1
2007	180	5.2	0.9
2008	131	5.1	0.9
2009	76	4.5	1.1
2010	90	4.4	1.3

Table 2. Estimates of nest success for spectacled eider nests.

Year	n	DSR[a]	Exposure Days	Apparent Success (%)	Mayfield Success (%)[b]	95% Mayfield C.I.
1992	64	0.997	1043	95.0	92.0	83.5-101.2
1993	74	0.984	1025	78.4	63.4	50.4-79.5
1994	73	0.986	1099	79.5	67.1	54.6-82.4
1995	95	0.985	1451	76.8	64.2	53.1-77.5
1996	113	0.993	1969	87.6	81.3	72.8-90.8
1997	138	0.992	2429	86.2	79.6	71.7-88.4
1998	111	0.994	1770	90.1	83.5	74.8-93.1
1999	127	0.986	2102	77.2	66.8	57.5-77.6
2000	118	0.99	2038	83.1	75.1	66.0-85.4
2001	39	0.909	295.5	7.7	6.3	2.5-15.6
2002	136	0.988	2356	76.2	70.7	62.0-80.6
2003	131	0.968	2104	48.9	39.1	29.8-48.0
2004[c]	154	0.986	---	81.8	68.5	57.2-77.5
2005[c]	129	0.994	---	89.1	83.5	72.6-89.0
2006[c]	171	0.989	---	81.9	71.6	62.2-79.1
2007[c]	173	0.997	---	94.2	91.4	85.0-95.3
2008[c]	134	0.984	---	75.0	63.0	52.1-72.0
2009[c]	90	0.986	---	75.6	65.7	52.2-76.3
2010[c]	98	0.990	---	84.7	75.6	63.3-84.2

[a] Daily Survival Rate

[b] Estimates exclude nests whose fates were suspected of being influenced by visitor impact, specifically trapping

[c] Estimated using model of Dinsmore et al. (2002)

Table 3. Apparent fate of spectacled eider eggs.

			Egg Fate (%)								
Year	Total Eggs	Total Nests	Hatched	Depredated	Abandoned (natural)	Abandoned (human)	Inviable/ Addled	Damaged	Collected	Destroyed/ Dead[b]	Unknown
1992	354	64	76.3	5.4	7.9	0	1.7	0.6	0.8	0	6.8
1993	390	75	62.3	22.6	2.1	2.1	2.8	1.0	0	0	0.1
1994	442	84	54.5	13.3	1.8	1.8	4.8	1.1	0	0	10.4
1995	479	103	52.0	25.7	0.4	0.4	7.1	2.7	0	0	12.1
1996	594	120	69.7	6.4	4.5	4.5	5.5	3.4	0	0	10.3
1997	690	147	63.0	12.8	1.3	13	9.9	0.1	0	0	7.8
1998	480	111	81.9	9.0	0.4	0.4	4.2	0.4	0	0	1.0
1999	602	134	73.8	17.9	3.2	3.2	5.5	1.0	0	0	3.5
2000	587	119	70.5	10.9	0.1	0.1	9.2	0.3	0	0	7.2
2001	143	43	7.7	88.8	3.5	3.5	0	0	0	0	0
2002	744	143	65.3	20.3	0.1	0.7	10.9	1.1	0.5	0	1.6
2003	597	135	40.9	42.4	3.0	0.2	9.5	0.3	0	0	3.7
2004	754	157	71.6	15.5	1.5	1.1	4.1	0.1	4.9	0	1.2
2005	674	140	57.4	8.6	3.4	0.6	12	0	0	0	18.0
2006	840	174	57.2	17.4	4.2	0	7.0	0.7[a]	0	0	13.5
2007	954	183	63.0	4.0	3.0	0	12	1.0[a]	0	0	17.0
2008	698	139	61.0	23.0	2.0	0	9.0	0.4[a]	0	0	4.0
2009	450	98	65.1	19.1	3.8	1.3	4.4	0.7[a]	0	0	5.6
2010	545	118	61.3	15.2	1.7	3.5	6.2	0.6[a]	0	3.9[c]	7.5

[a] Includes those damaged during handling, trapping, or when the attending female flushed

[b] Includes eggs broken/destroyed due to a storm surge in June

[c] Includes 1 duckling that was found dead at nest site

Table 4. Number of adult female spectacled eiders, banded as ducklings on Kigigak Island, and the year they were first detected nesting on the island.

Year Banded	Year First Detected												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
1999	---	---	0	6	3	0	1	0	0	0	0	0	10
2000	---	---	---	0	1	2	1	0	0	0	0	0	4
2002	---	---	---	---	---	4	7	6	1	1	0	0	19
2003	---	---	---	---	---	---	2	2	2	0	0	0	6
2004	---	---	---	---	---	---	---	6	10	1	0	1	18
2005	---	---	---	---	---	---	---	---	2	0	0	0	2
2006	---	---	---	---	---	---	---	---	---	0	0	0	0
2007	---	---	---	---	---	---	---	---	---	---	0	0	0
2008	---	---	---	---	---	---	---	---	---	---	---	0	0
2009	---	---	---	---	---	---	---	---	---	---	---	---	0
Total	---	---	0	6	4	6	11	14	15	2	0	1	59