Monitoring of Nesting Spectacled Eiders on Kigigak Island, Yukon Delta NWR, 2011

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SUMMARY
Nesting spectacled eiders were monitored for the 20th consecutive year on Kigigak Island, Alaska in 2011. Clutch size, hatch date, and final nest status were determined to estimate nesting productivity of spectacled eider females. In addition, adult females were resighted, captured, and marked to estimate annual survival. Peak nest initiation and hatch occurred 27-30 May and 20-23 June, respectively. We located 114 spectacled eider nests on 33 plots. Of these 114, 27 were unsuccessful due to natural causes, including depredation (25 nests, 21.9%) and addled/inviable eggs (2 nests, 1.8%), and 2 were unsuccessful due to human influences (1.8%). The estimated Mayfield nest success of 103 nests was 57.9% (95% CI; 45.0-68.7%). Eighty-six adult females were identified in 2011: 71 were nest-trapped and 15 were visually identified by nasal disk or tarsal band. Forty-six of the nest-trapped females were recaptures; the other twenty-five were new captures. Three of the 46 recaptured birds had been banded as ducklings in 2008 and were observed nesting on Kigigak Island for the first time in 2011.

KEY WORDS Spectacled Eider, Nest Success, Productivity, Food Availability, Habitat Use, Brood Observations, Salinity

INTRODUCTION

Since spectacled eiders (*Somateria fischeri*) were listed as a threatened species 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 20 years, research on Kigigak Island has documented clutch size, hatch date, and final nest status to estimate nesting productivity of spectacled eider females. In addition, adult females were either resighted or captured and marked to estimate annual survival of adult females. The data collected from Kigigak Island have been used to analyze adult female annual survival, duckling survival, and recruitment. The research on Kigigak Island continued in 2011 along with a graduate research project (conducted by N.G., University of Alaska Fairbanks), to determine habitat use of spectacled eider broods in relation to salinity and food availability.

Study Objectives

1. Determine clutch size, hatch date, and final nest status of spectacled eider females to estimate nesting productivity.
2. Resight or capture and mark adult females to generate estimates of annual survival.

Graduate Research Objectives

1. Collect salinity samples within four habitat strata and observe brood habitat to determine the effect of salinity on brood habitat selection, as well as to determine annual variation between strata.
2. Sample ponds (selected via a stratified random design) for macro-invertebrates and seeds to assess food availability for spectacled eider broods.
3. Determine brood habitat selection through observational study in four habitat strata.

STUDY AREA

Kigigak Island (32.5 km^2) (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.

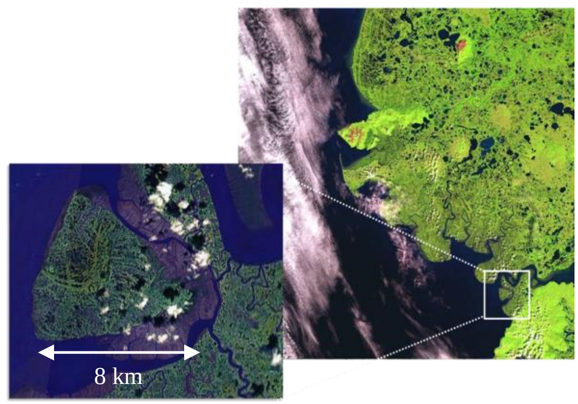

Figure 1. Location of Kigigak Island within the coastal zone of Yukon Delta NWR, Alaska

METHODS

Data Collection

A four-person research team arrived 13 May. Personnel searched for spectacled and common eider nests on 33, 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. Three nesting concentrations of brant were also monitored.

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 north of the nest. The nest location was recorded by GPS using UTM's as the mapping unit. 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. Contour feathers (10-20) were collected from each spectacled eider nest bowl for future DNA and stable isotope analyses.

Nests were revisited every 7 days until a few days before hatch when nests may be visited more frequently to confirm appropriate time for capture. On all nest visits, nest status (incubating, laying, depredated, abandoned, hatched) and egg status (number present, new, missing, inviable) were recorded. We attempted to identify marked spectacled eider females on all nest visits by reading nasal and tarsal band codes with spotting scopes, binoculars, or by using a Nikon D700 camera with 80-400mm zoom lens. If we were unsuccessful or if the female did not have any bands, 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 spectacled eider females late in incubation, usually 3-4 days before estimated hatching. Hatch dates were calculated based on egg float angle and candling data, assuming a 24-day incubation period for spectacled eiders. Unbanded female spectacled eiders were each marked with a metal, U.S. Fish & Wildlife Service leg band; an alphanumerically coded, yellow, plastic tarsal band; and a nasal disk (Lokemoen and Sharp 1985).

Graduate Research

In 2011, a large scale salinity mapping effort was conducted across the island in June. Collections occurred at two different time intervals (6-10 June and 21-23 June) prior to hatch to document salinity changes across the island. The results of the salinity mapping effort will be reported at a later time.

A total of five observation towers were placed in four habitat types (1 high-sedge meadow, 1 high-graminoid meadow, 1 dwarf shrub upland, and 2 intermediate-sedge meadow) to observe brood activity and pond use across the island. Ponds within a 300 m radius of each tower were scanned for spectacled eider broods. A random selection of used and unused ponds was sampled for salinity, macro invertebrates, and seeds within each tower's observation radius (300 m). A pond was considered used if a brood was observed foraging for a period of five minutes or longer. A pond was considered unused if no broods were seen actively using the pond during observation periods. One plankton and one benthic sample were collected from each selected pond using a plankton tow and Ekman grab, respectively. Activities of the female and brood were recorded using the instantaneous focal sampling method (Altmann 1974). When a brood was observed the time of day was recorded along with activities, which were recorded every minute for a set one hour time period. Activities included feeding, resting, preening, swimming, traveling on land or water, and any competition or threat present.

Data Analysis

Nest initiation and hatch dates, clutch size, and nest fate are only reported for spectacled eiders in this report. Common eider (*Somateria mollissima*) and Pacific black brant (*Branta bernicla nigricans*) data are archived at Yukon Delta National Wildlife Refuge (Bethel) and will be analyzed at a later date. Estimated spectacled eider hatch dates were used to determine timing of nest trapping. Clutch initiation dates for spectacled eider 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 used to estimate clutch age. Initiation dates were then estimated by backdating the estimated clutch age 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 the start of 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 found with 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 were assumed (Harwood and Moran 1993).

Apparent fate of all spectacled eider eggs found during nest searching activities was documented. Eggs were classified as hatched if detached membranes or ducklings were observed. Depredated, infertile, and inviable 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 or missing and was assumed to be depredated. The predators in these cases were usually unknown; this topic warrants further research.

Graduate Research
Invertebrate samples were sent to the University of Alaska – Fairbanks at the end of the season to be sorted, dried, weighed, and keyed out (to genus, when possible) to calculate relative abundance of available food items in the ponds on Kigigak Island.

RESULTS

Nesting Chronology
The first pair of spectacled eiders was observed on 13 May. We found a total of 114 nests on 33 plots. Nest initiations occurred between 21 May and 16 June with the peak between 27-30 May (Figure 3). Hatching occurred between 14 June and 10 July with the peak between 20-23 June (Figure 4). The mean hatch date in 2011 (27 June) was three days later than both 2010 and the long-term average (1991-2011).

Clutch Size
Spectacled eider clutch sizes ranged from 1-7 eggs, with a mean of 4.7 + 1.1 (SD) eggs (Table 1, Figure 5).

Nest Success
The fates of 103 spectacled eider nests were determined, including: 76 (73.8%) hatched, 25 (24.3%) depredated, and 2 (1.9%) abandoned. The estimated nest success, assuming an exposure period of 29 days, was 57.9% (95% C.I. 45.0-68.7; Table 2, Figure 6). This was an 18% decrease from 2010 and was 15% below the long-term average.

Apparent Egg Fate
The apparent fates of 530 eggs were determined, including: 339 (64.0%) hatched, 147 (27.7%) depredated, 5 (0.9%) abandoned due to monitoring activity, 10 (1.9%) abandoned due to natural causes, 23(4.3%) inviable or addled, and 6 (1.1%) damaged during handling, trapping, or when the attending female flushed from the nest (Table 3). We suspected that egg depredation was mainly due to glaucous gulls (*Larus hyperboreus*), mew gulls (*Larus canus*), and Arctic fox (*Alopex lagopus*). Actual observations of depredation were limited, however, gulls were responsible for depredating 11 eggs (7.5%). The other 136 (92.5%) eggs that were depredated could not

confidently be attributed to any of the predators.

Female capture
Seventy-one spectacled eider females were nest- trapped. An additional 15 were visually identified (scope, binoculars, camera) (Figure 7-9). Twenty-five of the trapped females were new captures. Out of the 46 recaptures 11 were banded as locals and resighted in previous years; 3 others were banded as locals in 2008 and observed nesting on Kigigak Island for the first time in 2011. A total of 1579 spectacled eiders have been marked on Kigigak Island (573 adult females, 1006 ducklings), and 426 have been resighted there at least once in a year subsequent to their original marking. Many of the females returning to Kigigak Island have contributed to more than one nesting attempt over the years. In 2011, 80.7% of the nests found were initiated by females that were previously marked and resighted on Kigigak Island.

Mortality
No adult female spectacled eiders or ducklings died as a direct result of our field efforts.

While searching eider plots south of camp on 30 May, we found one dead female brant with a bullet wound under its wing. The bird had a white-on-black tarsal band along with a metal leg band. Both were removed. The bands were submitted to the Bird Banding Laboratory at Patuxent Wildlife Research Center. The bird was banded on Kigigak Island on 23 June 2007.

Graduate Research
Brood observations began 24 June and ended 24 July with a total of 262 hours and 22 minutes of observation time. Initial analysis of water samples indicate that Eurytemora (genus), Limnocalanus (genus), and Harpacticoida (order) are the three main macro-invertebrate taxa found in the plankton communities, with a limited number of Copepoda families and Chironomidae dominating the benthic community. Eider broods were generally observed frequenting small ponds early in brood-rearing. As ducklings reached several weeks of age, broods switched to larger ponds, for longer feeding periods. Feeding methods included tipping up, head under, diving, and skimming; individuals often changed feeding methods within and between ponds.

Fox Presence
Two Arctic foxes were observed on Kigigak Island during the 2011 field season. One fox was observed after break-up in mid-May. The fox was observed 4 additional times during the field season. At the end of July, a second fox was observed in the presence of the first fox. We made one additional observation of the two foxes together.

DISCUSSION

The point estimate for nest success in 2011 (57.9%) was the third lowest in the history of the project. The lowest two years of nest success occurred in 2001 (6.3%) and 2003 (39.1%). While predators almost certainly contributed to the low nest success in those years, the environmental factors (late break-up, wind storms, etc) cannot be ignored and may have exacerbated the impact of predation.

After the first nest searching effort occurred in early June 2011, depredation began to affect nests in the eastern part of the island. Many nests that were active during the first search were depredated by the time we conducted the second search. Few signs of depredation were present other than empty nest bowls or missing eggs. Most of the spectacled eider egg/nest losses in 2011 were concentrated within plots located in the eastern half of the island. Goose (brant, cackling, and emperor) nests were also found abandoned or with missing eggs in the same area on Kigigak. It can be hard to distinguish predation between avian and mammalian predators. This is especially true when eggs are removed from a nest since both fox and gulls are known to take eggs from nests. Most of the depredation events that occurred in 2011 (96.2%) could not be attributed to any particular predator. Nesting birds and eggs are abundant on the island and the predators did not seem to be targeting any one species.

Resighting efforts were enhanced in 2011 with the addition of a SLR camera with a zoom lens. The camera proved effective in documenting nasal discs of females swimming in ponds, incubating, or flushing from their nest. Tarsal bands were also documented when females flushed or used mudflats to preen. Resighting with scope, binoculars, and camera allowed us to make fewer trips to nests and reduced nest/female disturbance.

Over 1500 spectacled eiders have been banded on Kigigak Island since the start of the project in 1991. Many of the females that have returned to Kigigak Island contributed to more than one nesting attempt over the years. With such a large portion of the female population being banded (80.7% in 2011) we expect to continue to mark between 20 and 30 new females each year.

Three adult females, originally banded as ducklings, were detected nesting for the first time in 2011. Between 1999 and 2008, 461 ducklings were banded. Sixty-two of which have returned to Kigigak Island. It is unclear what factors are influencing duckling recruitment on Kigigak Island. The mean body mass of ducklings on Kigigak Island in 2008 was 26% lower than in 1999. This is a concern because the body mass of ducklings prior to fledging is positively related to survival at age of first potential breeding (age two). It is unclear if duckling recruitment is influenced by poor body condition prior to fledging, increases in pond salinity, changes in food abundance/quality, or changes in brood rearing and wintering areas. The graduate project will provide information about salinity, brood habitat, and duckling food availability on Kigigak Island. We would also like to re-initiate brood captures in late July to record duckling body mass and other morphometric measurements. This will allow us to correlate duckling mass with habitat components on Kigigak Island, such as salinity of ponds, to answer questions about growth rates and habitat quality. We would also like to increase the duckling banding effort to increase the sample for evaluating recruitment rates.

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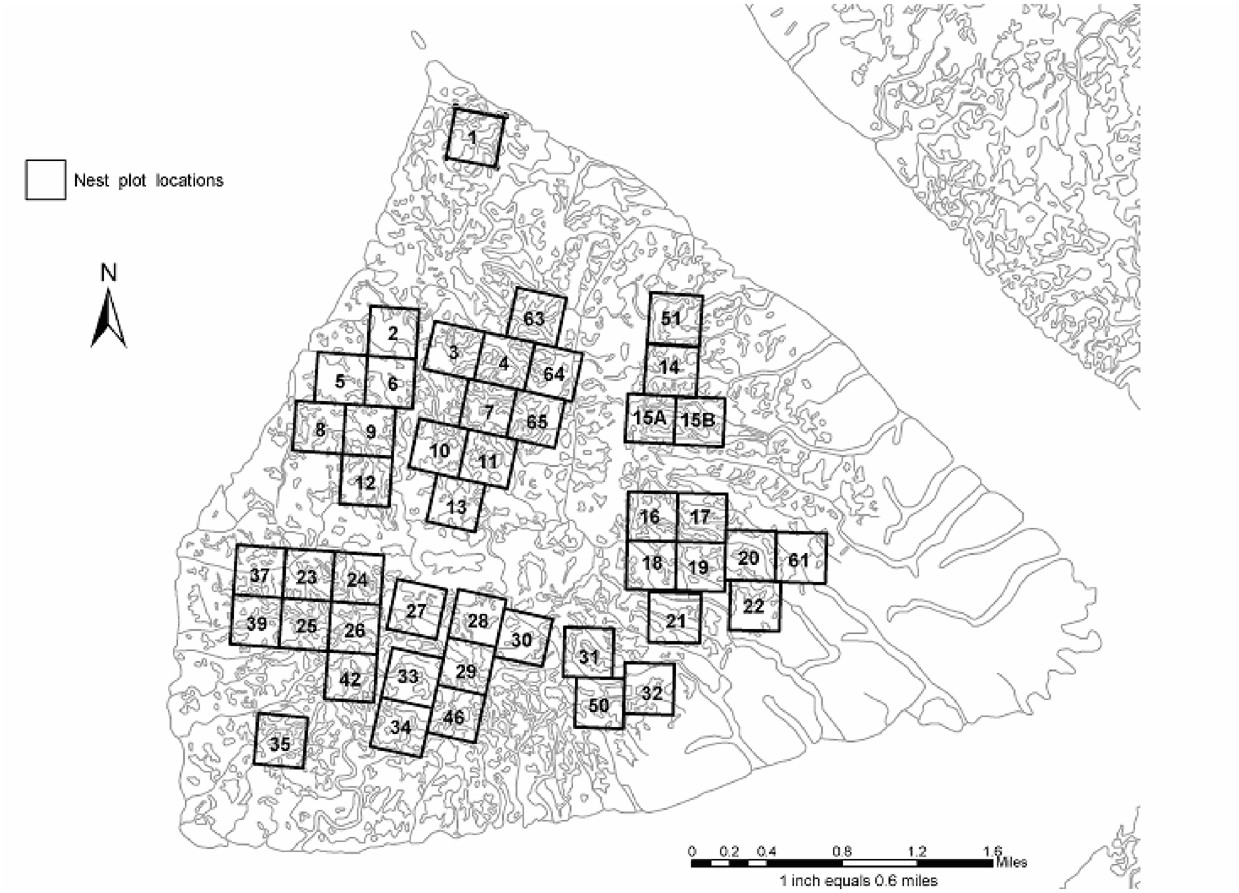

Figure 2. Location of spectacled eider plots (N=46) on Kigigak Island, Yukon Delta National Wildlife Refuge, Alaska.

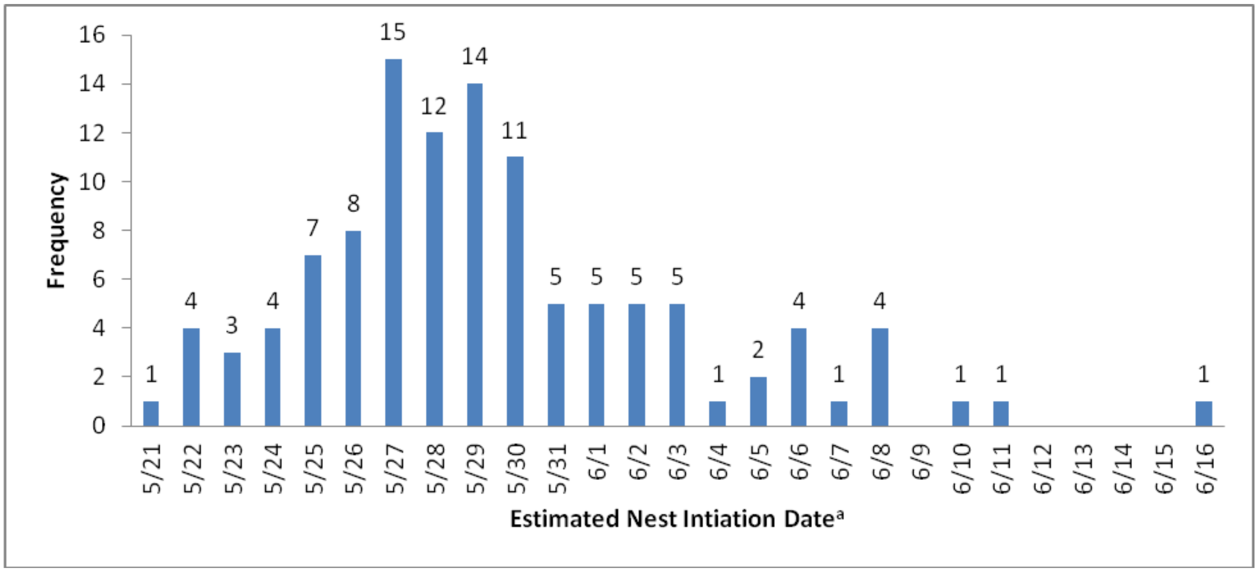

Figure 3. Estimated nest initiation dates for spectaced eider nests in 2011.
[a] Estimates assume an incubation period of 24 days and a laying rate of one egg per day.

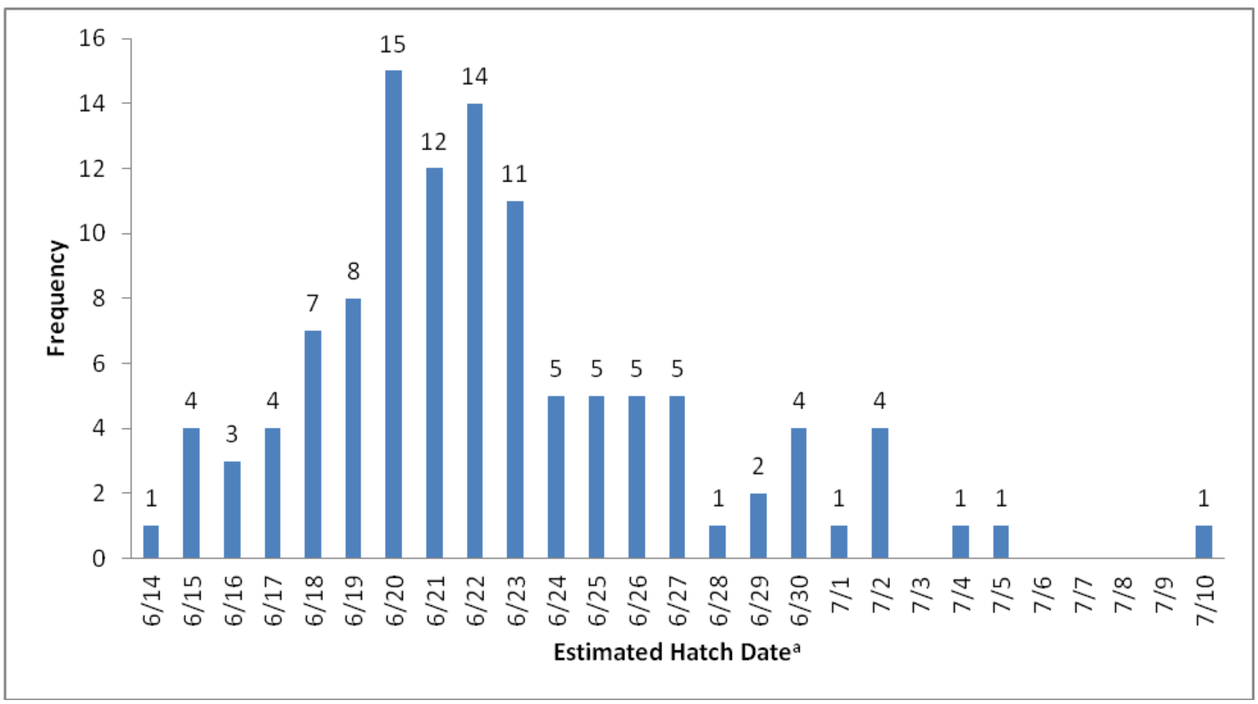

Figure 4. Estimated hatch dates for spectacled eider nests in 2011.
[a] Estimates assume an incubation period of 24 days

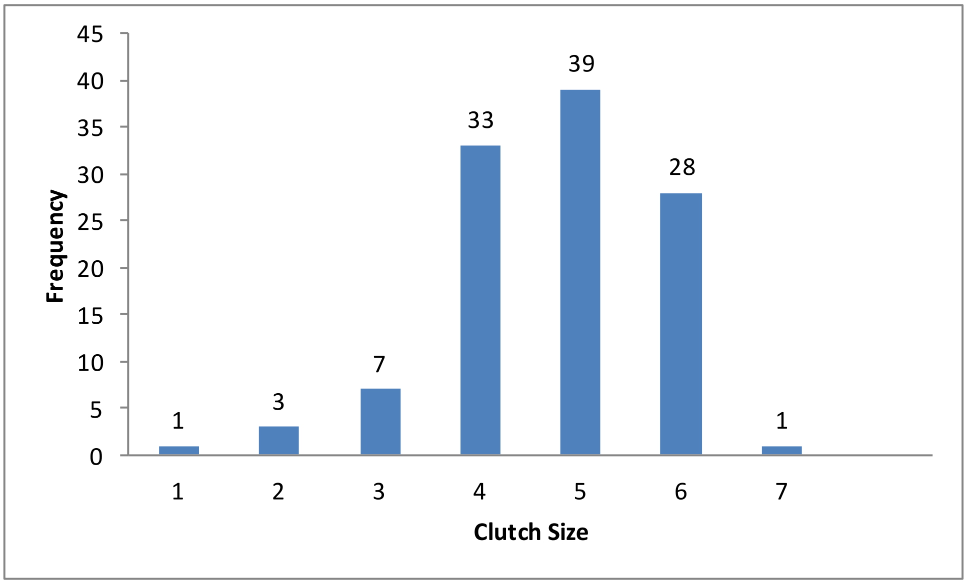

Figure 5. Clutch size frequencies for spectacled eider nests in 2011.

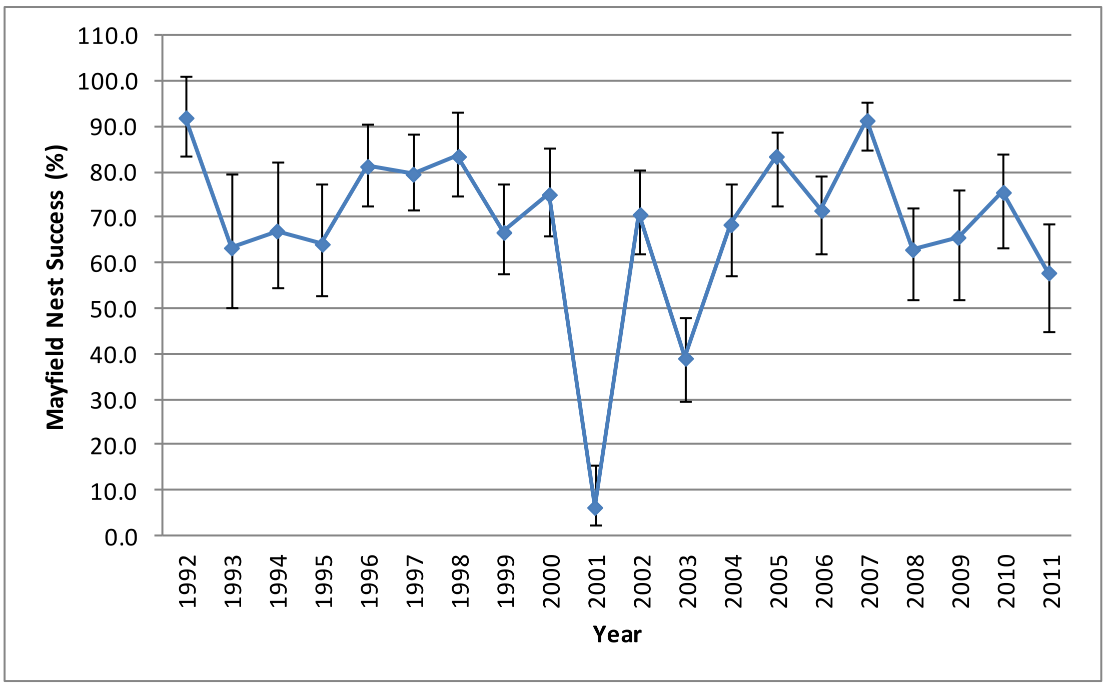

Figure 6. Estimate of success for spectacled eider nests with 95% confidence intervals. Estimates excluded nests whose fates were suspected of being influenced by visitor impact, specifically trapping. Beginning in 2004 estimates were made using the model of Dinsmore et al. (2002).

Figure 7. Photograph of a spectacled eider female incubating her clutch taken with SLR camera. We were able to determine the nasal disc code (KJ8).

Figure 8. Photograph of a spectacled eider female on the bank of a pond taken with SLR camera. We were able to determine the tarsal band number (585).

Figure 9. Photograph of a spectacled eider female flushing from her nest taken with SLR camera. We were able to determine the tarsal band number (JPA) and nasal disc number (KT8).

Table 1. Mean clutch size for spectacled eider nests

Year	n		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	5.0	1.1
2001	22	4.0	0.9
2002	143	5.2	1.1
2003	131	4.7	1.3
2004	147	5.0	1.1
2005	147	4.8	1.0
2006	169	4.9	1.0
2007	180	5.2	0.9
2008	131	5.1	0.9
2009	98	4.6	1.1
2010	118	4.6	1.2
2011	112	4.7	1.1

Table 2. Daily survival rate and Mayfield success of spectacled eider nests on Kigigak Island, Yukon Delta National Wildlife Refuge, Alaska.

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	0.990	2038	83.1	75.1	66.0-85.4
2001	39	0.909	295.5	7.70	6.30	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
2011[c]	103	0.981	---	73.8	57.9	45.0-68.7

[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	13.0	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	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	12.0	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
2011	530	112	64.0	24.7	1.9	0.9	4.3	1.1[a]	0	0	3.0

[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