Nesting Ecology of Spectacled Eiders on Kigigak Island, Yukon Delta NWR, Alaska, 2008

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Summary: In order to continue monitoring nesting productivity, annual survival, and estimate recruitment and age-specific demographics of spectacled eiders, the 17th consecutive year of sampling was conducted at Kigigak Island, Alaska. A total of 151 spectacled eider nests (n = 140 on traditional study plots) were located in 34 days; 139 were found active and 12 were found depredated. Mean nest initiation and hatch dates were 25 May and 23 June, respectively. Of the nests found active, many were depredated (n = 32), few were abandoned (n = 2) and nest success to 29 days was estimated as 63.0% (95% CI; 52.1-72.0). A total of 74 adult females were recaptured or visually identified, 18 of which were originally banded as ducklings.

INTRODUCTION

As recommended by the spectacled eider recovery team (USFWS 1996), fieldwork on Kigigak Island continued for the 17th consecutive year. Three to 4 researchers monitored spectacled eider (*Somateria fischeri*) nests between 26 May and 6 July 2008. Spectacled eider broods were captured from 24 to 27 July.

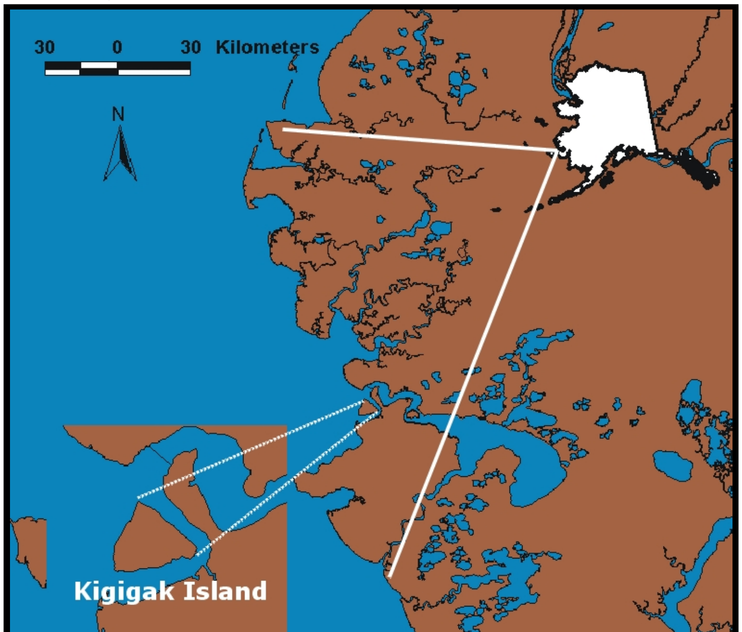
<u>Study Objectives:</u>

1. Monitor clutch size, nest hatch date, and final nest status for estimation of nesting productivity.
2. Resight, capture, and mark adult females for estimation of annual survival.

3. Capture and mark ducklings just prior to fledging for estimation of recruitment, natal fidelity, age-specific demographics, and age of first breeding.
4. Remove arctic fox (*Alopex lagopus*) prior to eider nest initiation.
5. Examine duckling survival, movements, and growth in relation to pond salinity (new 2008 objective).

STUDY AREA

Kigigak Island (32.5 km²) (165°50'W, 60°50'N) is located along the outer fringe of Yukon Delta National Wildlife Refuge (YDNWR), near the mouth of Baird Inlet. The island, bordered by the Ninglick River and the Bering Sea, contains many shallow ponds, lakes, and a network of tidal sloughs. Many permanent wetlands favored by eiders occur on the island. 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.



Location of Kigigak Island on the coastal zone of the Yukon-Kuskokwim Delta, Alaska.

METHODS

Data Collection

Three researchers searched for nests on 45 plots of 0.17 km^2 each, selected from approximately 9 km^2 of the island (Fig. 1). These plots were previously identified as preferred spectacled eider nesting habitat (Harwood and Moran 1993). Additional nests were located opportunistically while moving between plots.

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 3m from the nest, nest location was documented with UTM coordinates, and nest site type (slough bank, lakeshore [water body >3m wide], poolshore [water body <3m wide], peninsula, island, mudflat, grassflat, displaced island, mud island) and number of eggs were recorded. Each egg was uniquely numbered in order to measure length and width (± 1mm), and determine number of new, depredated, or inviable eggs on subsequent nest visits. Each egg was floated (Westerkov 1950) and candled (Weller 1956) to estimate days of incubation. Ten contour feathers were collected from each nest bowl in order to catalog samples for future DNA analyses. Nests were revisited every 7 days until hatch. On all nest visits, we documented whether the nest was covered and eggs were warm, presence/absence of the female and male, band status of the female, and nest status (laying, incubating, depredated, abandoned, hatched, and other [primarily eggs all inviable]). We attempted to identify marked females on all nest visits by reading band codes with spotting scopes or binoculars. If we were unsuccessful, females were captured.

Bownet traps (Salyer 1962) and mist nets were used to trap females approximately 1-2 days prior to hatch. Hatch date was calculated based on egg float and candling data, assuming a 24-day incubation period (Dau 1974). Females were marked with a U.S. Fish and Wildlife Service metal leg band and a yellow, plastic, alphanumeric leg band. Nasal disks were placed on adult females (Lokemoen and Sharp 1985). Culmen and tarsal lengths (± 1mm) and mass (± 1g) were recorded. Two head feathers and two tips of primary feathers were collected from some captured females in order to catalog samples for future DNA and stable isotope analyses. The cloaca and oral cavity of each captured female were swabbed for avian influenza H5N1 testing (IAIWG 2006). In 2008, a VHF transmitter was attached to 35 adult females. Broods were tracked and ducklings counted on days 3, 6, 9, and weekly thereafter. Salinity measurements, UTM coordinates, and other pond variables(length, width, depth, temperature) were recorded for each brood visit.

Brood drives were conducted to capture ducklings at approximately 35 days of age. This was accomplished by gently flushing ducklings and attending females into mist nets placed on ponds. Female ducklings were marked with both a U.S. Fish and Wildlife Service metal leg band and a yellow, plastic, alphanumeric leg band. Male ducklings were marked only with a U.S. Fish and Wildlife Service metal leg band. Previously marked adult females were captured or visually identified, and bands and nasal disks were placed on unmarked adult females. The mass, tarsus, and culmen of all captured individuals were measured. The cloaca and oral cavity of all captured ducklings and attending adults were swabbed for avian influenza H5N1 testing (IAIWG 2006).

Data Analysis

Nest initiation dates for nests found during laying were estimated by subtracting 1 day for each egg in the nest bowl. For nests found during incubation, egg float and candling data were backdated, assuming a 24-day incubation period (Dau 1974) and a laying rate of one egg per day (Grand and Flint 1997). Hatch date was estimated using egg float and candling data from nests that survived to hatch. For nests that survived to incubation, clutch size was the total number of eggs laid in a nest. Mean values were reported for egg widths and lengths and egg volume was calculated similar to Petrula (1994).

Nests were defined as successful if ≥ 1 egg hatched. Nests that were found depredated 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 were assumed (Harwood and

Moran 1993). Apparent fate of all eggs was assessed. Eggs were classified as hatched if membranes or ducklings were observed. Depredated eggs exhibited obvious signs of depredation (i.e., several or all eggs missing or broken). If the clutch was intact or some eggs had hatched, cold eggs were assumed to be abandoned. If abandonment occurred after trapping the female, we assumed it was human caused. We documented inviable or addled eggs. When we could not determine the fate of the eggs, fate was classified as unknown.

RESULTS

Nesting chronology, location

During 34 days of nest searching and monitoring, 151 nests were located, of which 140 were on traditional study plots. Estimated nest initiation dates ranged from 17 May to 11 June, with mean nest initiation date on 25 May (Fig. 2). Estimated hatch dates ranged from 18 June to 5 July, with mean hatch date on 23 June (Fig. 3). Most nests were located along lakeshores and islands (Fig. 4).

Clutch and egg size

Clutch size ranged from 2 – 7 eggs (Fig. 5), with mean clutch size of 5.1 eggs (Table 1). Mean egg length, width, and volume were 67.5mm, 45.4mm, and 139.5cc, respectively (Table 2).

Nest success and apparent egg fate

The fate of 134 nests were used in estimation of nest success (Table 3). Of these nests, 32 were depredated, 2 were abandoned, and 100 hatched. Estimated nest success to 29 days was 63.0% (95% CI; 52.1-72.0; Table 3). The fate of 698 eggs was determined, and apparent egg hatching success was 61.0% (Table 4). Of 698 eggs, 9.0% were inviable or addled, 23.0% were depredated, and fate of 4.0% was unknown. 0 eggs (0.0%) were abandoned from our activity, and 3 were damaged during handling, trapping, or when the attending female flushed from the nest (.4%; Table 4).

In 2008, 2 females marked as ducklings were observed nesting for the first time. 58 females marked as ducklings have now been observed nesting at Kigigak Island.

Duckling survival, movements, and growth in relation to pond salinity

From 17 to 29 June, VHF transmitters were attached to 35 adult females just prior to hatch. The nests of two females were depredated before hatch, which reduced the sample of broods to 33. 12 broods experienced total failure during the first 9 days, including 8 broods from days 1 to 3, 3 broods from days 4-6, and 1 brood from days 7-9. 6 broods experienced total failure at >9 days. We captured, weighed, measured, and marked ducklings from the remaining 15 broods. Salinity measurements collected adjacent to nests prior to hatch and at ponds used by broods were nearly all less than 10.0ppt.

Female and brood capture, male departure

Of 151 nests, 92 (61.0%) were attended by marked females, 24 by unmarked females, and the marked status of 35 females was not determined. We identified 74 (80.4%) of 92 marked females. 18 (24.3%) identified females were originally banded as ducklings, of which 2 were observed for the first time in 2008 (Table 5). We captured and marked 9 of 24 unmarked nesting females Depredation of nests in 2008 hampered our efforts to determine whether nests were attended by marked females, and to identify marked females. In total, 27 nests were of unknown band status due to depredation. 15 of those nests were depredated prior to hatch and 12 were found depredated. In addition, 9 nests were known to be attended by marked females, but were depredated before the attending female was identified.

Between 24 and 27 July, 79 ducklings (33 males, 46 females) from 26 broods were captured and banded. We also captured or visually identified 21 adult females with broods.

The last male spectacled eider was observed on 25 June.

Mortality

No adult females or ducklings died as a direct result of our field efforts.

DISCUSSION

The 2008 estimate of nest success for spectacled eiders was the third lowest in 17 years of study on Kigigak Island. The only years when nest success was lower (2001 and 2003) corresponded to an unprecedented level of nest depredation by foxes. Since 2005 fox trapping has been conducted prior to the initiation of nests, and has resulted in complete or near complete removal of all foxes from Kigigak Island. In response to this effort, nest success has increased. Although 7 foxes were removed from Kigigak Island prior to the initiation of nests in 2008, at least 4 foxes remained, and nest success was lower than during 2005-2007. Nest bowl and egg remains at depredated nests indicated that foxes were the apparent cause of most nest failure. It is likely that complete removal of foxes in all years from Kigigak Island is not possible. Nevertheless, nest success in 2008 was maintained at levels much greater than the lows of 2001 and 2003, indicating a benefit of incomplete fox removal.

Two adult females banded as ducklings were detected nesting for the first time in 2008. This sample was probably lower than it otherwise would have been due to depredation of nests. The sample of adult females who were banded as ducklings and observed nesting is now at 58, and many of these birds have contributed more than one nesting attempt. Thus, data to accomplish the objectives of estimating recruitment and age-specific productivity on Kigigak Island have been collected. Information learned from these data can be used as inputs to the population model. In addition, other things can be learned such as relationships between early growth and life-history.

Most mortality of ducklings occurred during the first 9 days, which is consistent with a previous study on Kigigak Island (Flint et al. 2006). In the previous study by Flint et al. (2006), ducklings on Kigigak Island experienced little mortality after 9 days of age. In contrast, 6 broods that were >9 days old experienced total failure following a week of rain and cold temperatures in 2008. Salinity measurements collected adjacent to nests just prior to hatch and from ponds occupied by broods were nearly all lower than 10.0ppt. DeVink et al. (2004) documented that a salinity value of 11.0ppt caused 17% mortality within 7 days in common eiders. Further analysis of these data will accomplish the objective of assessing salinity effects on duckling survival, movements, and growth.

ACKNOWLEDGEMENTS

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2008 Field Crew. From left to right: Dave Safine, Steve Olson, Bryce Lake, Jessica Lewis, Tom Fondell, Melonie Rieck.

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Table 1. Mean clutch size for spectacled eider nests.

Year	n	$\overline{X}$	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	5.0	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

Table 2. Mean length, width, and volume of spectacled eider eggs.

		Length (mm)		Width (mm)		Volume (cc)[a]	
Year	n	$\overline{X}$	S.D.	$\overline{X}$	S.D.	$\overline{X}$	S.D.
1993	72	67.7	1.8	45.5	1.2	140.2	9.2
1994	362	67.9	4.8	45.5	2.1	140.6	16.7
1995	405	68.2	4.2	45.4	2.6	140.0	28.0
1996	470	68.2	5.6	45.4	3.0	-	-
1997	624	67.9	4.7	45.3	2.5	139.6	21.2
1998	448	67.6	5.7	45.1	2.8	137.6	17.6
1999	580	67.4	4.3	45.0	2.6	136.6	20.0
2000	593	67.4	4.1	45.2	2.4	137.7	17.0
2001	134	67.5	2.5	45.2	1.5	138.4	11.6
2002	730	68.1	4.7	45.5	3.4	142.2	16.6
2003	534	68.0	3.2	45.5	1.8	141.1	0.7
2004	736	68.0	2.6	45.5	1.2	141.3	10.4
2005	674	68.0	3.3	45.5	2.5	141.7	17.3
2006	832	67.9	3.1	45.1	1.6	138.3	12.6
2007	954	67.9	2.4	45.1	1.3	138.2	10.0
2008	697	67.5	2.5	45.4	1.3	139.5	10.2

[a] Volume = length x width^2 / 1000 (Petrula 1994).

Table 3. 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

[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 4. Apparent fate of spectacled eider eggs.

Year	Egg Fate (%) Hatched	Depredated	Abandoned (natural cause)	Abandoned (human cause)	Inviable/ Addled	Damaged	Collected	Unknown	Total Eggs	Total nests
1992	76.3	5.4	7.9		1.7	0.6	0.8	6.8	354	64
1993	62.3	22.6	2.1	2.1	2.8	1.0	0.0	0.1	390	75
1994	54.5	13.3	1.8	1.8	4.8	1.1	0.0	10.4	442	84
1995	52.0	25.7	0.4	0.4	7.1	2.7	0.0	12.1	479	103
1996	69.7	6.4	4.5	4.5	5.5	3.4	0.0	10.3	594	120
1997	63.0	12.8	1.3	13	9.9	0.1	0.0	7.8	690	147
1998	81.9	9.0	0.4	0.4	4.2	0.4	0.0	1.0	480	111
1999	73.8	17.9	3.2	3.2	5.5	1.0	0.0	3.5	602	134
2000	70.5	10.9	0.1	0.1	9.2	0.3	0.0	7.2	587	119
2001	7.7	88.8	3.5	3.5	0.0	0.0	0.0	0.0	143	43
2002	65.3	20.3	0.1	0.7	10.9	1.1	0.5	1.6	744	143
2003	40.9	42.4	3.0	0.2	9.5	0.3	0.0	3.7	597	135
2004	71.6	15.5	1.5	1.1	4.1	0.1	4.9	1.2	754	157
2005	57.4	8.6	3.4	0.6	12.0	0.0	0.0	18.0	674	140
2006	57.2	17.4	4.2	0.0	7.0	0.7[a]	0.0	13.5	840	174
2007	63.0	4.0	3.0	0.0	12.0	1.0[a]	0.0	17.0	954	183
2008	61.0	23.0	2.0	0.0	9.0	0.4[a]	0.0	4.0	698	139

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

Table 5. Numbers of adult female spectacled eiders detected first nesting that were banded as ducklings.

Year Banded	Year First Detected										
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Total
1999	---	---	0	6	3	0	1	0	0	0	10
2000	---	---	---	0	1	2	1	0	0	0	4
2002	---	---	---	---	---	4	7	6	1	1	19
2003	---	---	---	---	---	---	2	2	2	0	6
2004	---	---	---	---	---	---	---	6	10	1	17
2005	---	---	---	---	---	---	---	---	2	0	2
2006	---	---	---	---	---	---	---	---	---	0	0
Total	---	---	0	6	4	6	11	14	15	2	58

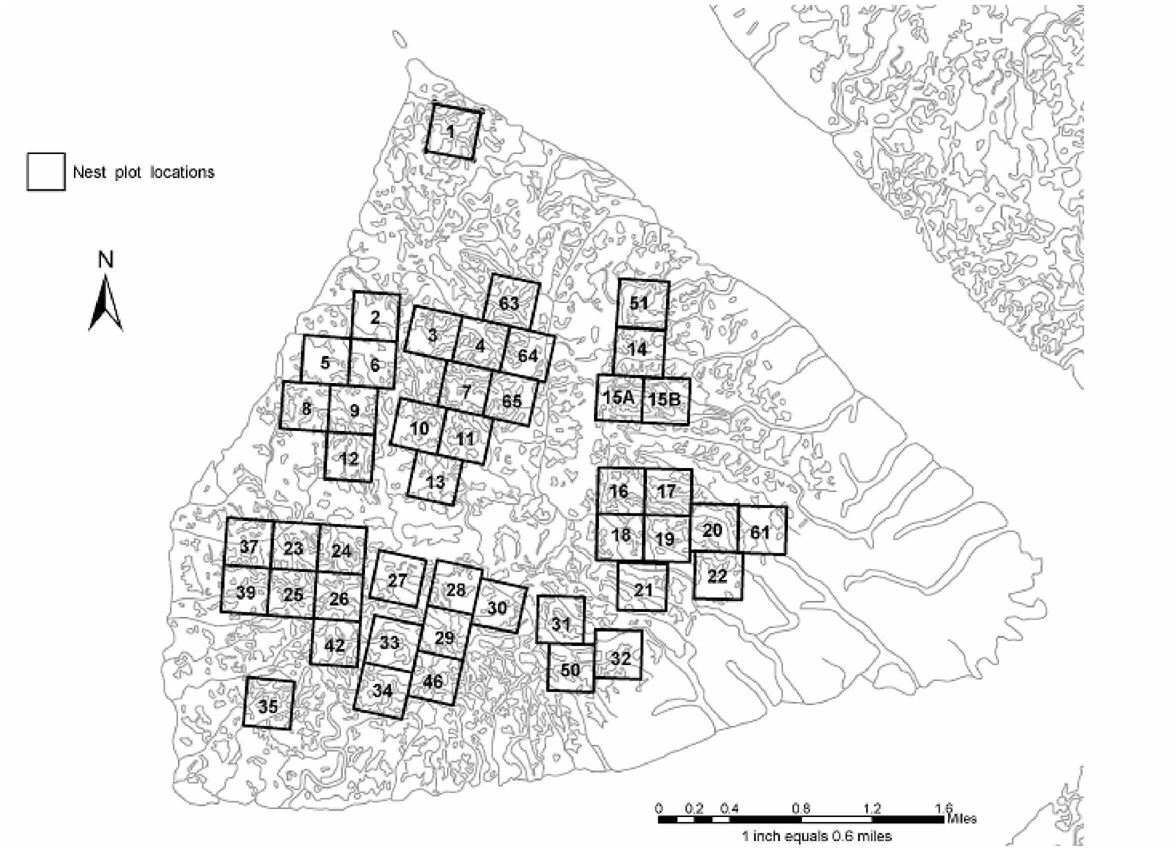

Fig. 1. Locations of plots (N = 48) searched for eider nests on Kigigak Island, Alaska (plots 66 and 68 are not shown [66 is to the east of 11 and 68 is to the east of 13]).

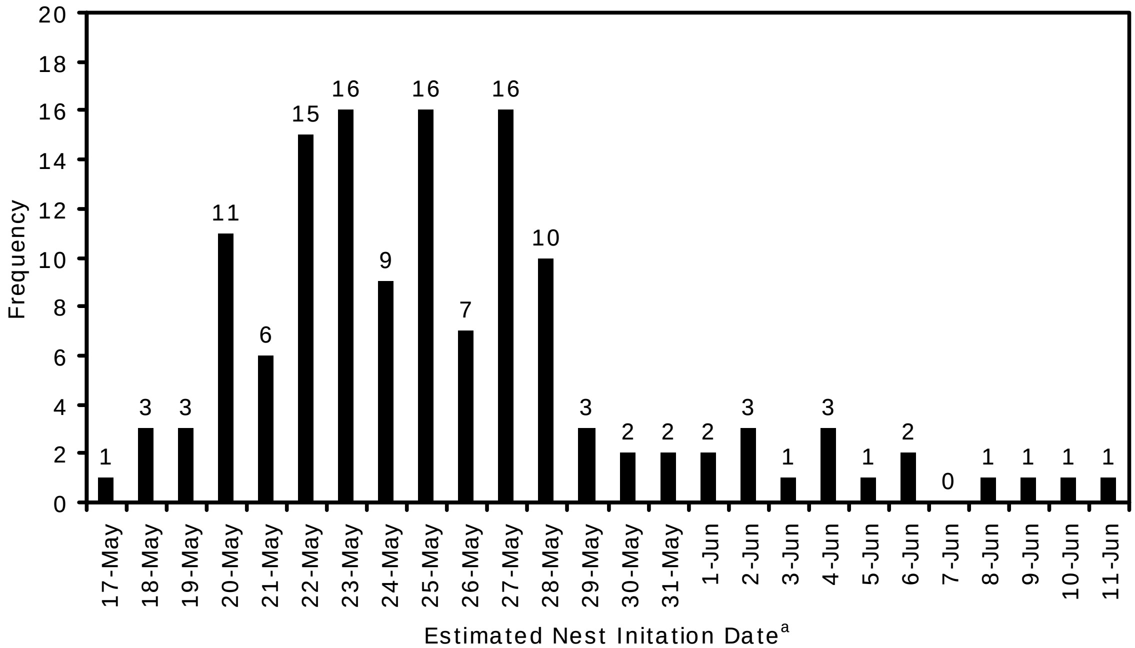

Fig. 2. Estimated nest initiation dates for spectacled eider nests. [a]Estimates assume an incubation period of 24 days and a laying rate of one egg per day.

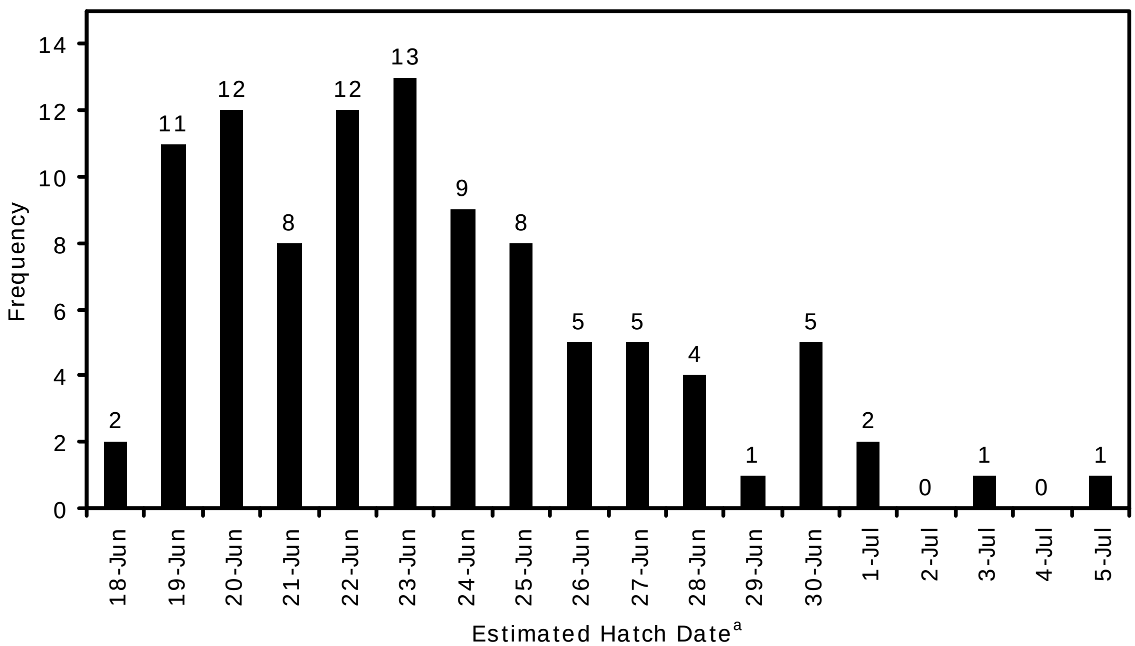

Fig. 3. Estimated hatch dates for spectacled eider nests. [a]Estimates assume an incubation period of 24 days.

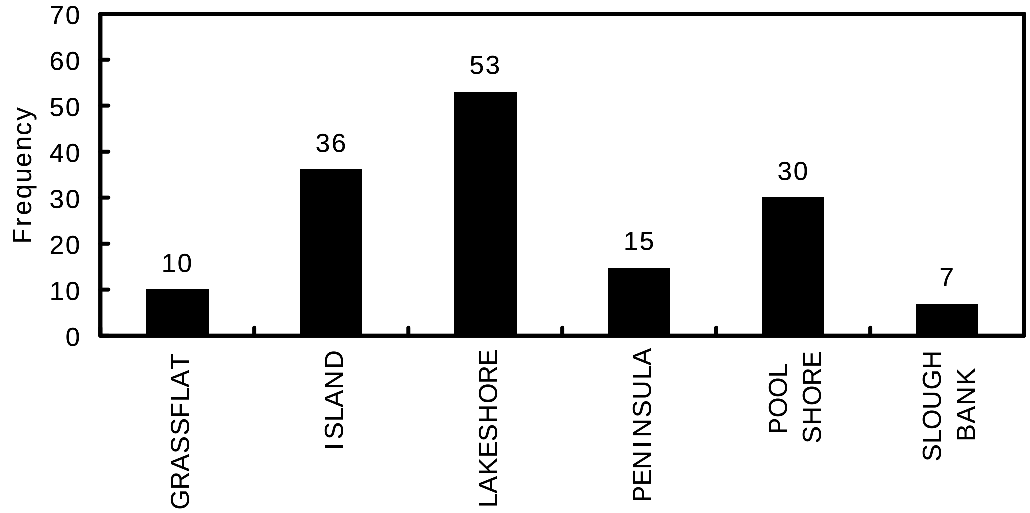

Fig. 4. Nest site frequencies for spectacled eider nests.

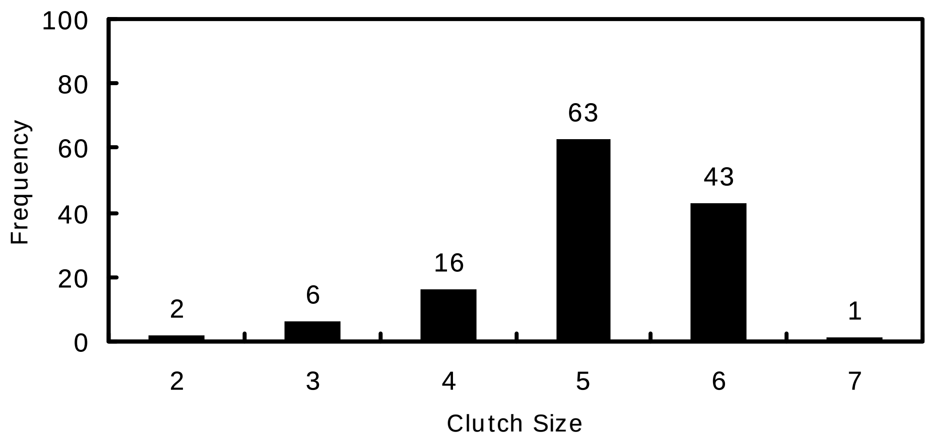

Fig. 5. Clutch size frequencies for spectacled eider nests.