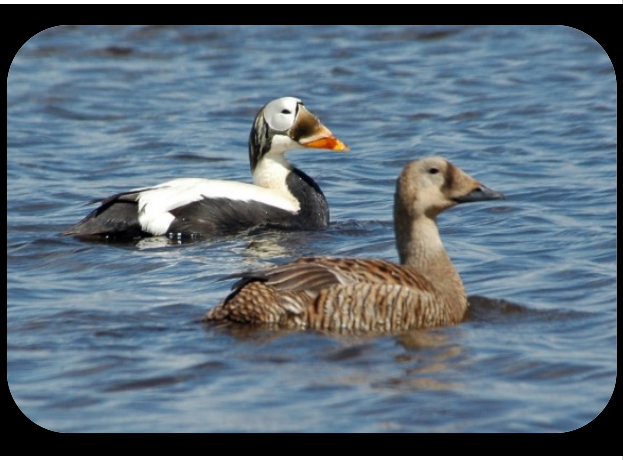
Nesting Ecology of Spectacled and Common Eiders on Kigigak Island, Yukon Delta NWR, Alaska, 2007



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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 16th consecutive year of sampling was conducted at Kigigak Island, Alaska. A total of 183 spectacled eider nests (n = 160 on traditional study plots) were located in 40 days. Mean nest initiation and hatch dates were 24 May and 22 June, respectively. Few nests were depredated (n = 7) or abandoned (n = 3) and nest success to 29 days was estimated as 91.4% (95% CI; 85.0-95.3). A total of 105 adult females were recaptured or visually identified, 34 of which were originally banded as ducklings.

Numbers of Pacific common eiders on the Yukon-Kuskokwim Delta declined >90% and this species was recently selected as a *focal species*. In 2007, 139 common eider nests were located and monitored on Kigigak Island. Mean nest initiation and hatch dates were 20 May and 21 June, respectively. Nest success to 32 days was 85.7% (95% CI; 76.2.0-91.6). 67 previously marked common eider females were recaptured or visually identified.

INTRODUCTION

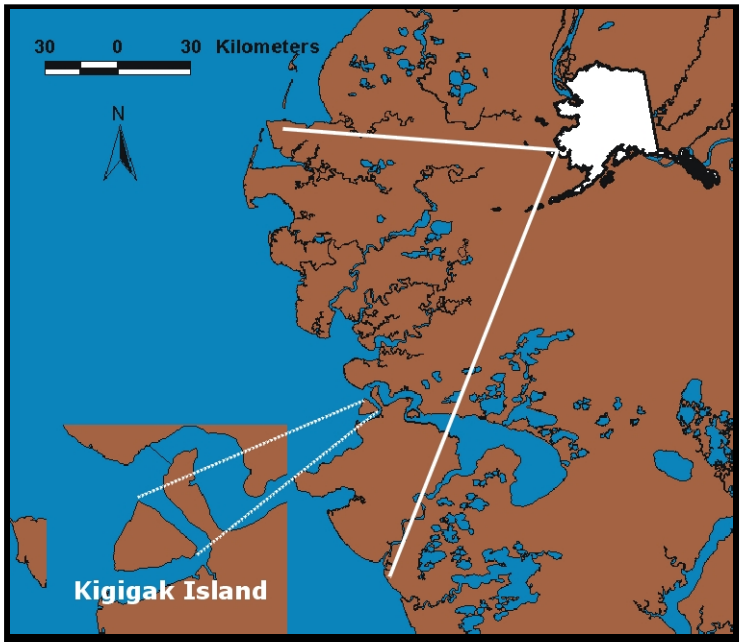
As recommended by the spectacled eider recovery team (USFWS 1996), fieldwork on Kigigak Island continued for the 16th consecutive year. Five researchers monitored spectacled eider (*Somateria fischeri*) nests between 24 May and 1 July. Pacific common eiders (*Somateria mollissima v-nigra*) were recently selected as a *focal species* (USFWS 2006) and nests of this species were also located and monitored. Spectacled eider broods were captured from 23 to 25 July.

Study Objectives:

1. Monitor clutch size, nest hatch date, and final nest status of spectacled and common eiders for estimation of nesting productivity.
2. Resight, capture, and mark adult female eiders for estimation of annual survival.
3. Capture and mark spectacled eider ducklings just prior to fledging for estimation of recruitment, natal fidelity, age-specific fecundity, and age of first breeding.
4. Remove arctic fox (*Alopex lagopus*) prior to nest initiation.

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

Five researchers searched for eider nests on 48-0.17 km^2 plots 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 of spectacled eiders were located opportunistically while moving between plots.

Data were recorded according to guidelines for spectacled eider research 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. 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 unsuccessful, females were captured.

Bownet traps (Salyer 1962) and mist nets were used to trap eider 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 for spectacled eiders (Dau 1974) and a 26-day incubation period for common eiders. 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 spectacled eiders (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 each captured female 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).

Brood drives were conducted to capture spectacled eider ducklings at approximately 35 days of age. This was accomplished by gently flushing ducklings and attending spectacled eider 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 recorded. 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 for spectacled eiders (Dau 1974) and a laying rate of one egg per day (Grand and Flint 1997). A 26-

day incubation period was assumed for common eiders. 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 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 for spectacled eiders (Harwood and Moran 1993) and 32 days for common eiders. 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 had hatched, cold egg(s) 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 nest or egg fate was unknown, egg fate was classified as unknown.

139 common eider nests were located and monitored. 67 previously marked adult females were recaptured or visually identified. 17 unmarked females were banded.

RESULTS

Nesting chronology, location

During 40 days of nest searching and monitoring, 183 spectacled eider nests were located, of which 160 were on traditional study plots. Estimated nest initiation dates ranged from 12 May to 12 June, with mean nest initiation date on 24 May (Fig. 2).

Estimated hatch dates ranged from 11 June to 10 July, with mean hatch date on 22 June (Fig. 3). Most nests were located along lakeshores and poolshores (Fig. 6).

139 common eider nests were located on traditional study plots. Estimated nest initiation dates ranged from 10 May to 13 June, with mean nest initiation date on 20 May (Fig 4). Estimated hatch dates ranged from 11 June to 12 July, with mean hatch date on 21 June (Fig 5). Most nests were located along lakeshores and islands (Fig 7).

Clutch and egg size

Spectacled eider clutch size ranged from 2 – 7 eggs (Fig. 8), with mean clutch size of 5.2 eggs (Table 1). Mean egg length, width, and volume were 67.9mm, 45.1mm, and 138.2cc, respectively (Table 2).

Common eider clutch size ranged from 2-11 eggs (Fig. 9), with mean clutch size of 5.7 eggs. Mean egg length, width, and volume were 74.7mm, 50.0mm, and 187.1cc, respectively.

Nest success and apparent egg fate

Fate of 173 spectacled eider nests was used in estimation of nest success (Table 3). Of these nests, 7 were depredated, 3 were abandoned, and 163 hatched. Estimated nest success to 29 days was 91.4% (95% CI; 85.0-95.3; Table 3). Fate of 954 eggs was determined, and apparent egg hatching success was 63.0% (Table 4). Of 954 eggs, 12.0% were inviable or addled, 4.0% were depredated, and fate of 17.0% was unknown. 0 eggs (0.0%) were abandoned from human cause, and 10 were damaged during handling, trapping, or when the attending female flushed from the nest (1.0%; Table 4).

Fate of 130 common eider nests was used in estimation of nest success. Of these nests, 9 were depredated, 3 were abandoned, and 118 hatched. Estimated nest success to 32 days was 85.7% (95% CI; 76.2.0-91.6).

Female and brood capture, male departure

Of 183 spectacled eider nests, 112 (61.2%) were attended by marked females, 63 by unmarked females, and the marked status of 8 females was not determined. 105 (93.8%) of 112 marked females were identified (33 nest trapped, 72 visually). 34 (33.3%) identified females were originally banded as ducklings, of which 15 of these were observed for the first time in 2007 (Table 5). 27 of 63 unmarked nesting females were trapped and marked.

Of 139 common eider nests, 75 (54.0%) were attended by marked females, 51 by unmarked females, and the marked status of 13 females was not determined.

In 2007, 15 females marked as ducklings were observed nesting for the first time. 56 females marked as ducklings have now been observed nesting at Kigigak Island.

67 (89.3%) of 75 marked females were identified (37 nest trapped, 30 visually). 17 of 51 unmarked nesting females were trapped and marked.

Between 23 and 25 July, 111 ducklings (59 males, 52 females) from 26 broods were captured and banded. 22 adult females were captured or visually identified with broods.

The last male spectacled eider was observed on 25 June, and the last male common eider on 26 June.

Mortality

No adult females or ducklings died as a result of biological activity.

DISCUSSION

The 2007 estimate of nest success for spectacled eiders was the second highest in 16 years of study on Kigigak Island. This result coupled with an increased clutch size and good nest numbers is suggestive of excellent production. Accordingly, during duckling captures, many broods were encountered, but duckling growth was reduced and was the lowest observed since captures began in 1999. Spectacled eider duckling growth has been linked to habitat conditions (Flint et al. 2006), which vary, in part, due to salinity levels and food availability. Perhaps conditions on Kigigak Island have changed since 1999. The effects of pond salinity and food availability on duckling growth and survival deserve further study.

No foxes were removed from Kigigak Island in 2007. 40 traps were deployed in late March and remained until late May. Tracks around a known den site indicated at least one fox persisted throughout nesting and brood rearing, but there was no evidence of breeding activity. Few fox tracks were observed elsewhere, suggesting that fox numbers were low. Anecdotal observations indicated few to no small mammals, an important food source. There was no evidence of fox impacts to nesting eiders, although depredated Cackling Goose (*Branta hutchinsii minima*) nests were suggestive of fox predation.

Interspecific differences in productivity were evident for spectacled and common eiders. Nest success was greater for spectacled eiders, whereas clutch size was greater for common eiders. Reasons for greater nest success of spectacled eiders are unknown, but clutch size of common eiders was likely greater due to intraspecific "dump nesting" (Robertson et al. 1992).

The number of nesting spectacled eiders marked as ducklings increased from 27 in 2006 to 34 in 2007. Of the females in 2007, fifteen were observed for the first time. These data will allow for estimation of recruitment, age-specific reproductive rates, and relationships between early growth and life-history. Data analyses are ongoing.

ACKNOWLEDGEMENTS

Funding was provided by YDNWR, Migratory Bird Management (USFWS), and the Black Brant Group. Trenton Haffley, Michelle Sopoliga, Josh White, and Jamison Winter assisted with field data collection. Their ability to traverse through mud, tundra, and ponds in between bouts of rain made this year's data collection possible. Additionally, Josh White and Jamison Winter participated in capture of ducklings. Tom Fondell and Dave Ward (Alaska Science Center) also assisted with data collection. Pilots George Walters, Robert Sundown, Isaac Bedingfield, Hollis Twitchell, and Mike Rearden provided many hours of safe flying, kept us well supplied with fresh water and food, and facilitated camp set-up and break-down. Photos courtesy Jamison Winter and Josh White.

2007 Field Crew. From left to right: Josh White, Jamison Winter, Michelle Sopoliga (seated), Bryce Lake, Dave Ward, Trenton Haffley (seated), Tom Fondell.

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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

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

[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

[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.

	Egg Fate (%)									
Year	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

[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	Total
1999	---	---	0	6	3	0	1	0	0	10
2000	---	---	---	0	1	2	1	0	0	4
2002	---	---	---	---	---	4	7	6	1	18
2003	---	---	---	---	---	---	2	2	2	6
2004	---	---	---	---	---	---	---	6	10	16
2005									2	2
Total	---	---	0	6	4	6	11	14	15	56

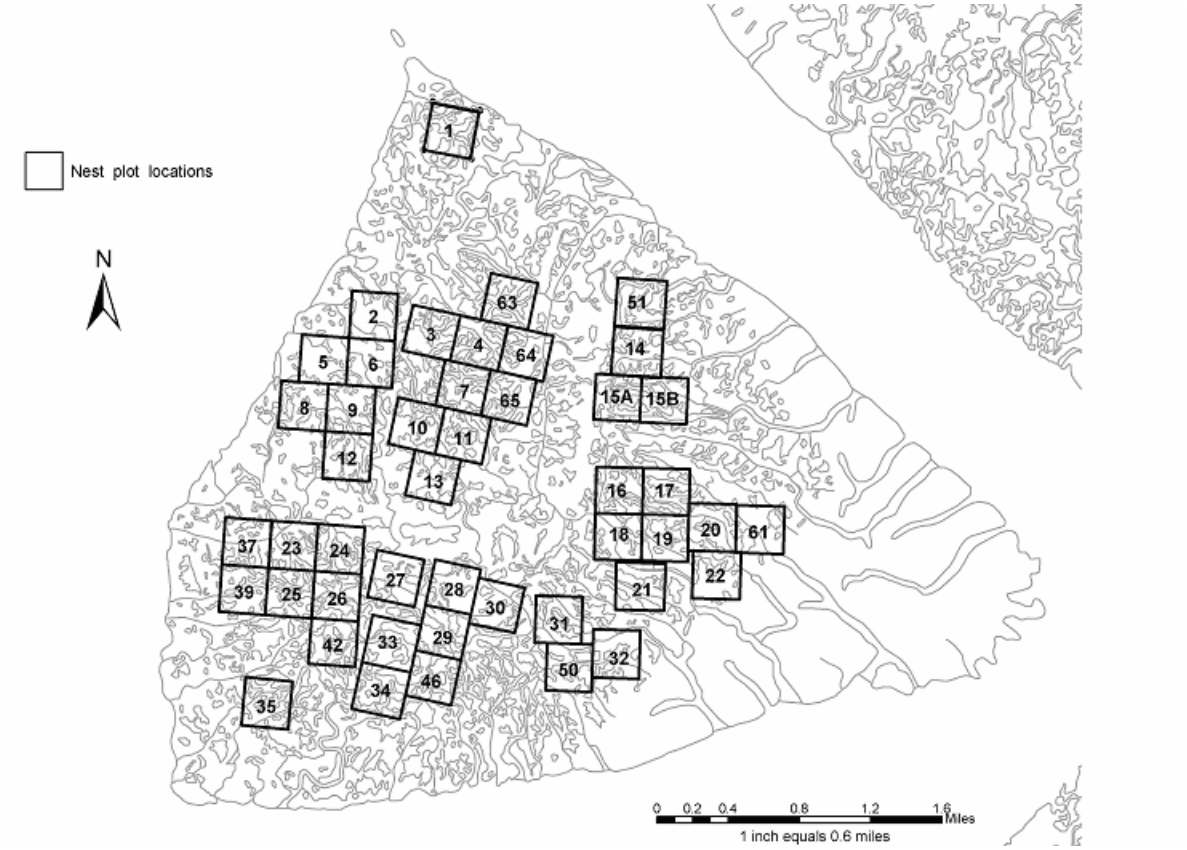

Fig. 1. Locations of plots (N = 48) searched for eider nests on Kigigak Island, Alaska (plots 66 and 68 are not show [66 is to the east of 11 and 68 is to the east of 13]).

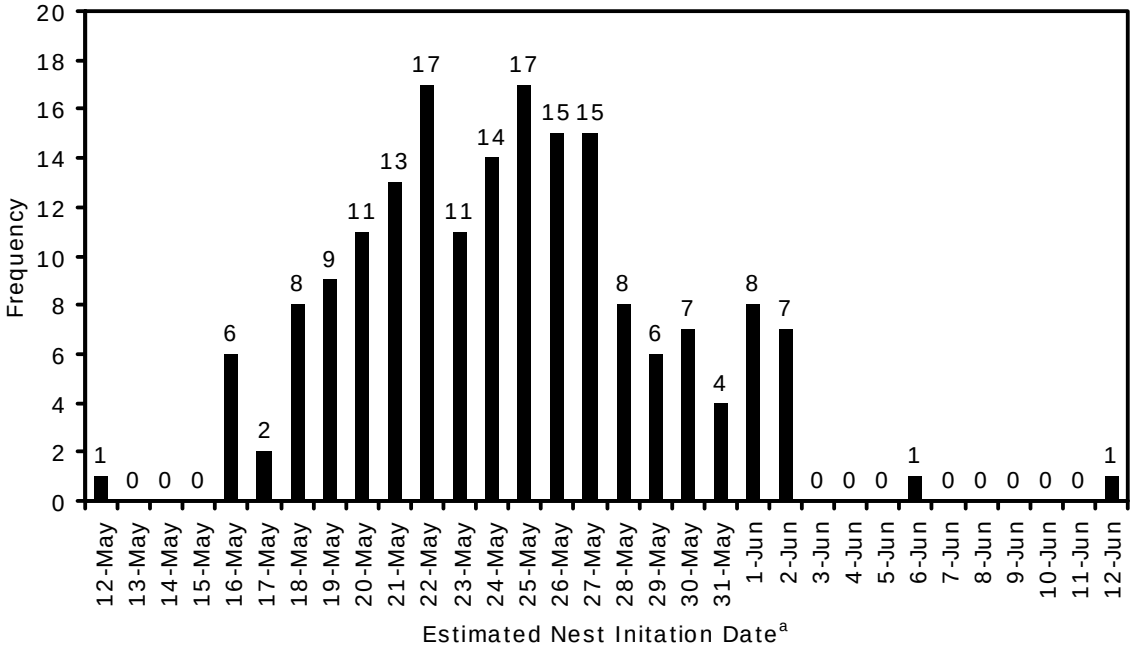

Fig. 2. Estimated nest initiation dates for spectacled eider nests. [a]Estimates assume an incubation period of 24 days and a laying rate of one egg per day.

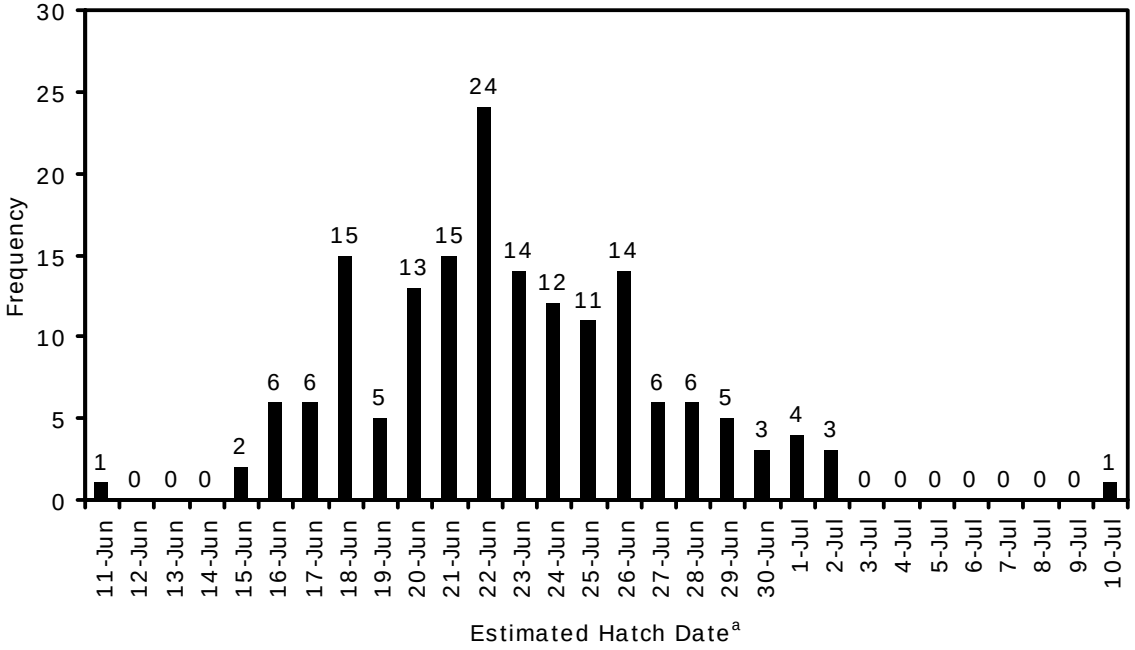

Fig. 3. Estimated hatch dates for spectacled eider nests. [a]Estimates assume an incubation period of 24 days.

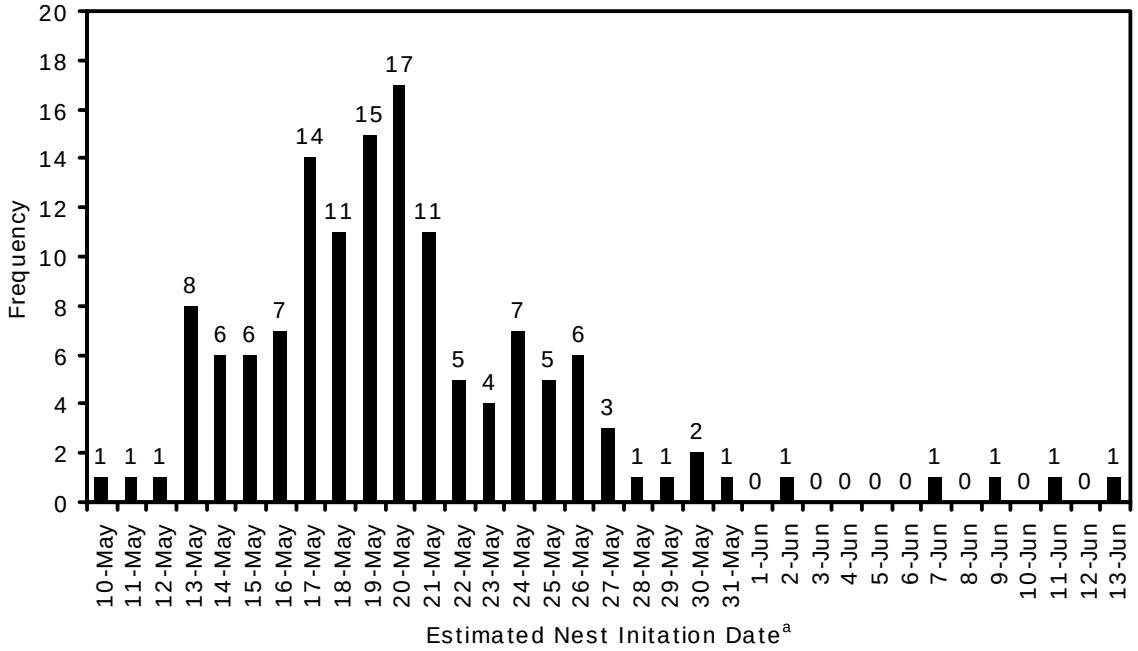

Fig. 4. Estimated nest initiation dates for common eider nests. [a]Estimates assume an incubation period of 26 days and a laying rate of one egg per day.

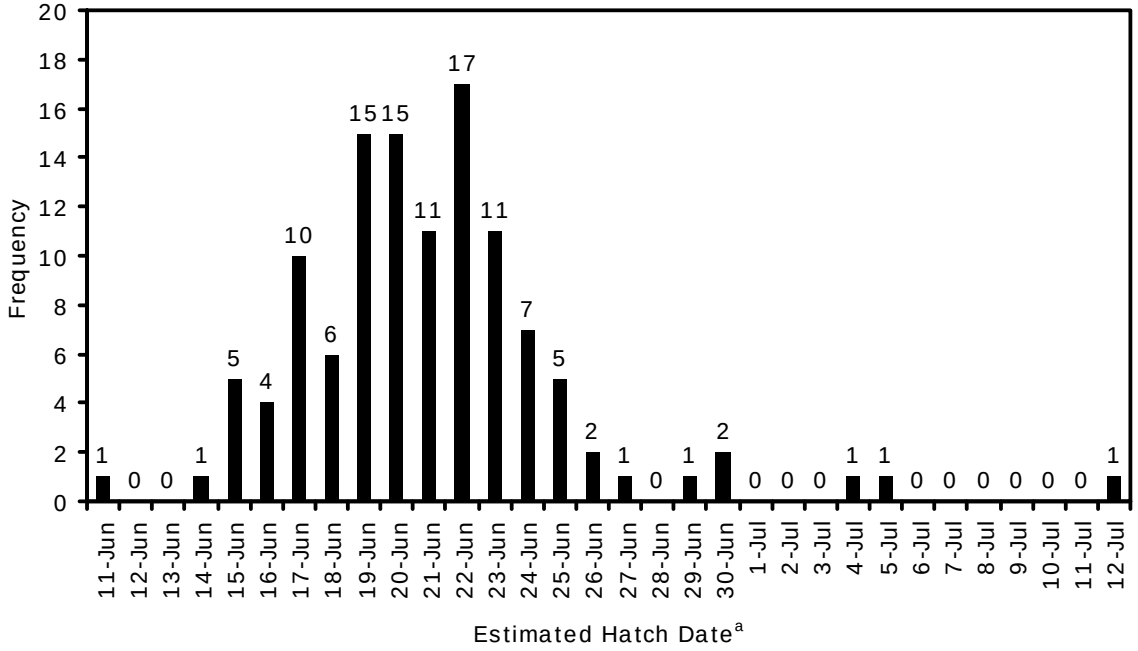

Fig. 5. Estimated hatch dates for common eider nests. [a]Estimates assume an incubation period of 26 days.

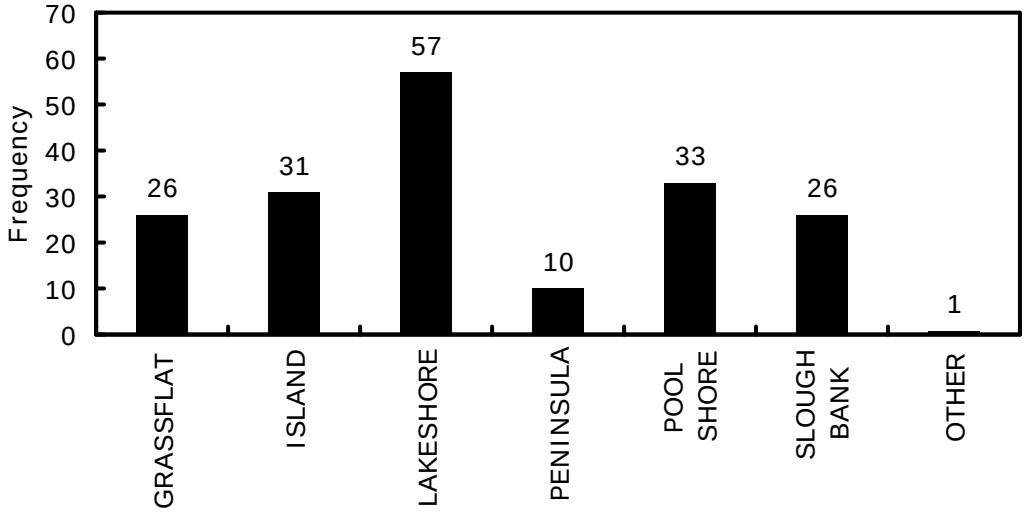

Fig. 6. Nest site frequencies for spectacled eider nests.

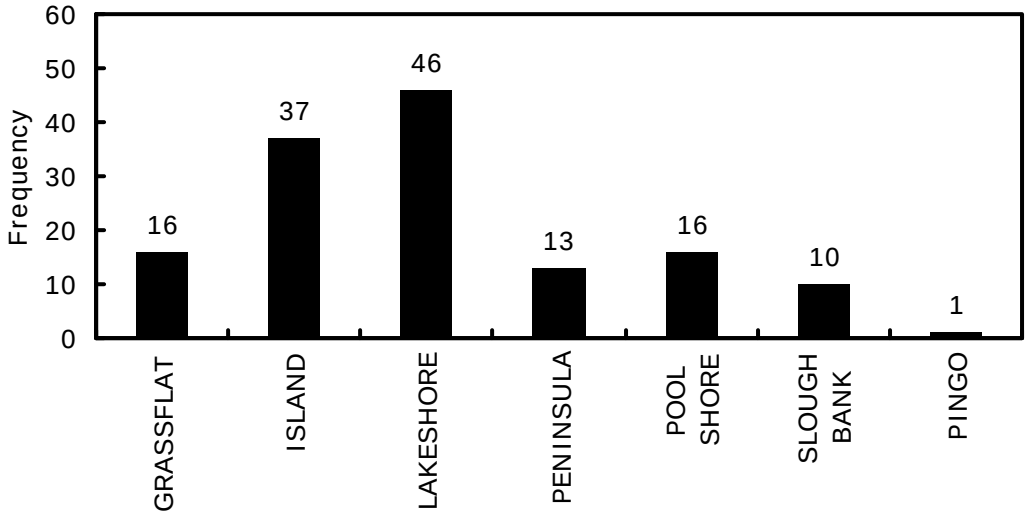

Fig. 7. Nest site frequencies for common eider nests.

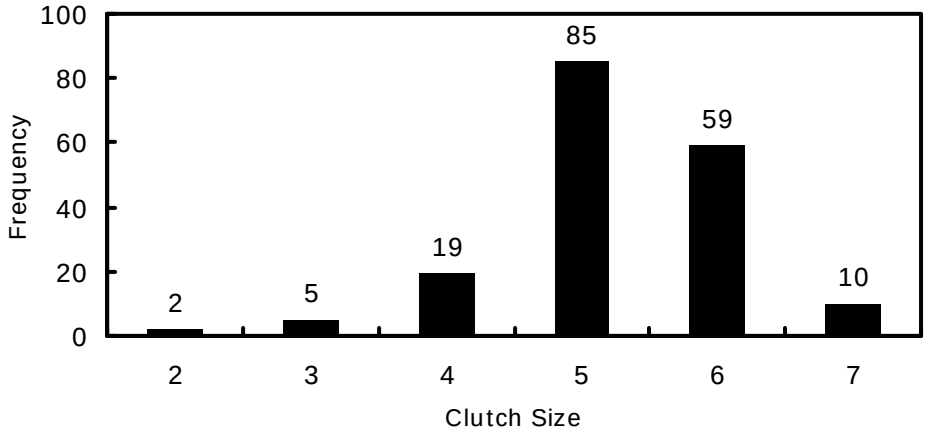

Fig. 8. Clutch size frequencies for spectacled eider nests.

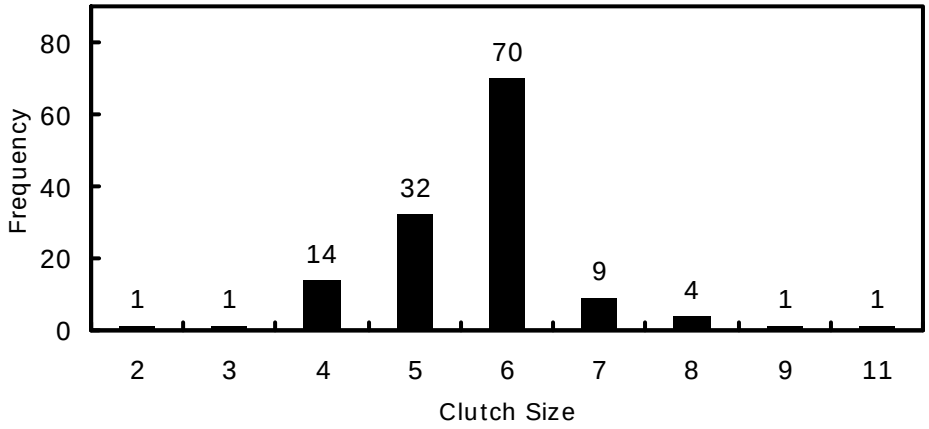

Fig. 9. Clutch size frequencies for common eider nests.