Nesting Ecology of Spectacled Eiders on Kigigak Island, Yukon Delta NWR, Alaska, 2006

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Summary: In order to continue monitoring nesting productivity and annual survival, and estimate recruitment and age-specific demographics of spectacled eiders, the 15th consecutive year of sampling was conducted at Kigigak Island, Alaska. A total of 179 nests (n = 160 on traditional study plots) were located in 41 days. A moderate number of nests were depredated (n = 25) or abandoned (n = 6) and nest success to 29 days was estimated as 71.6% (95% CI; 62.2-79.1). Mean nest initiation and hatch dates were 1 June and 30 June, respectively. A total of 88 adult females were recaptured or visually identified, 27 of which were originally banded as ducklings.

INTRODUCTION

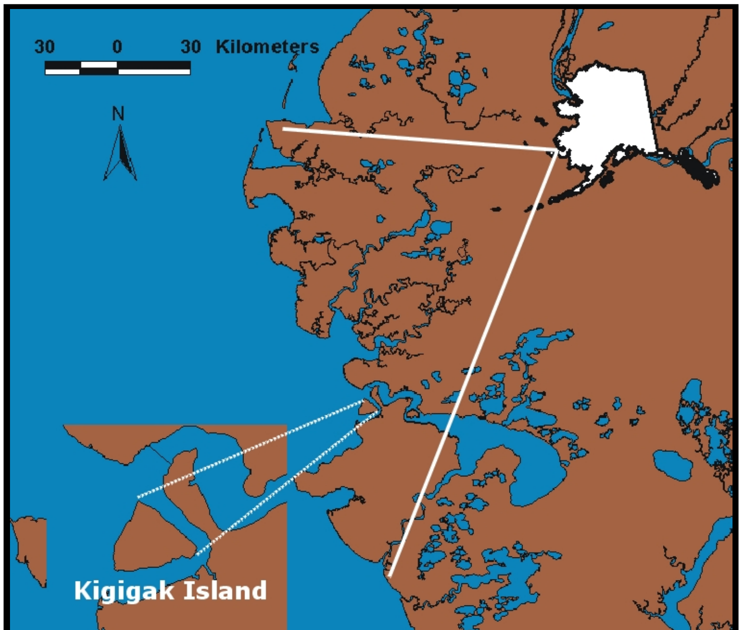
As recommended by the spectacled eider recovery team (USFWS 1996), fieldwork on Kigigak Island continued for the 15th consecutive year. Five researchers monitored spectacled eider (*Somateria fischeri*) nests between 31 May and 10 July. Broods were captured from 1 to 3 August.

Study Objectives:

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 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. 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 spectacled 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 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. We swabbed fecal material deposited on eggs the first time the female defecated upon flushing (IAIWG 2006). 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 all eggs 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 spectacled 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 (Dau 1974). Females were marked with a U.S. Fish and Wildlife Service metal leg band and a yellow, plastic, alphanumeric leg band and nasal disk (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, and the cloaca of each captured female was swabbed (IAIWG 2006). In 2006, Alaska Sea Life Center personnel assisted with trapping in order to obtain 3cc's of blood from 15 females with clutches of all viable eggs and 15 females that were incubating ≥ 1 inviable egg.

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 was recorded.

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, I backdated egg float and candling data, 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 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 had hatched, cold egg(s) were assumed to be abandoned. If abandonment occurred after trapping the female, we assumed it was human caused. If eggs damaged during trapping did not hatch they were classified as damaged in trapping. We documented inviable or addled eggs. When nest or egg fate was unknown, egg fate was classified as unknown.

This adult female was banded as a duckling in 2002 and observed nesting for the first time in 2006. She was observed attending four ducklings on 1 August, all of which were captured and banded. Two ducklings were females.

RESULTS

Nesting chronology, location

During 41 days of nest searching and monitoring, 179 nests were located, of which 160 were on traditional study plots. Estimated nest initiation dates ranged from 21 May to 25 June, with mean nest initiation date on 1 June (Fig. 2). Estimated hatch dates ranged from 21 June to 21 July, with mean hatch date on 30 June (Fig. 3). Most nests were located along lakeshores and poolshores (Fig. 4).

Clutch and egg size

Clutch size ranged from 2 – 8 eggs (Fig. 5), with mean clutch size of 4.9 eggs (Table 1). Mean egg length, width, and volume were 67.9mm, 45.1mm, and 138.3cc, respectively (Table 2).

Nest success and apparent egg fate

Fate of 171 nests was used in estimation of nest success (Table 3). Of these nests, 25 were depredated, 6 were abandoned, and 140 hatched. Estimated nest success to 29 days was 71.6% (95% CI; 62.2-79.1; Table 3). Fate of 840 eggs was determined, and apparent egg hatching success was 57.2% (Table 4). Of 840 eggs, 7% were inviable or addled, 17.4% were depredated, and fate of 13.5% was unknown. Zero eggs (0.0%) were abandoned from human cause, but six were damaged during handling or trapping (0.7%; Table 4).

Female and brood capture, male departure

Of 179 nests, 106 (59.2%) were attended by marked females, 43 by unmarked females, and the marked status of 30 females was not determined. Eighty-eight (83.0%) of 106 marked females were identified (32 nest trapped, 56 visually). Twenty-seven (25.5%) identified females were originally banded as ducklings, of which 14 of these were observed for the first time in 2006 (Table 5). Twenty-six of 43 unmarked nesting females were trapped and marked.

In 2006, 14 females marked as ducklings were observed nesting for the first time. 41 females marked as ducklings have now been observed nesting at Kigigak Island.

Between 1 and 3 August, 91 ducklings (42 males, 49 females) from 23 broods were captured and banded. Twenty-three adult females were captured or visually identified with broods.

The last male spectacled eider was observed on 20 June.

Mortality

Zero adult females and one duckling died as a result of biological activity. Two banded adult females were found dead and sent to the regional USFWS office in Anchorage. No obvious external trauma was observed on one female and the other had lesions to the pectoralis.

DISCUSSION

More nests were located in 2006 than in any other year of this project. This result contradicted expectations based on a late break-up that ranked as the fourth latest since 1992. Several factors may have contributed to high nest numbers, such as good pond water levels, two searches of the nest plots, and good nest survival. The high number of nests in 2006, along with several other years of high nest numbers, may lead to the notion that nest numbers have increased over time at Kigigak Island. However, unbiased estimation of numbers of nest initiated is not possible without correcting for nest detection and nest daily survival (McPherson et al. 2003, Grand et al. 2006).

Nest success in 2006 was intermediate relative to previous years and lower than 2005. As in 2005, eight arctic foxes were removed prior to nesting, but in 2006 at least one non-breeding fox was observed several times throughout nesting and brood rearing. Observations at depredated nests indicated some apparent fox predation, but also that avian predators and mink (*Mustela vison*) were equally or more important. Perhaps predation by other species is partially compensatory to arctic fox predation in some years.

Increasing numbers of adult females marked as ducklings have been observed in recent years. This result is encouraging and data from a decent sample of known-age individuals is developing. Additional years of nest monitoring at Kigigak will increase this sample through collection of data from females hatched in 2005 and 2006. Data from these known-age individuals allow for estimation of recruitment and age-specific demographics, which are necessary for accurate population modeling, and improve the ability of managers to make informed decisions. In addition, other things are being learned from these data. For instance, trends are emerging that suggest duckling size limits recruitment and possibly fecundity. Such a result has relevance to the fox removal effort at Kigigak if duckling size declines from increased density-dependent effects.

ACKNOWLEDGEMENTS

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2006 Field Crew. From left to right: Bryce Lake, Dave Safine, Dustin Perry (seated), Tom Fondell, Jeff Renier (seated), Grace Leacock, and Mat Sorum.

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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

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

[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

[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 in Trapping	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

[a] includes those damaged during handling

Table 5. Numbers of adult females detected first nesting that were banded as ducklings.

Year Banded	Year First Detected								
	1999	2000	2001	2002	2003	2004	2005	2006	Total
1999	---	---	0	6	3	0	1	0	10
2000	---	---	---	0	1	2	1	0	4
2002	---	---	---	---	---	4	7	6	17
2003	---	---	---	---	---	---	2	2	4
2004	---	---	---	---	---	---	---	6	6
Total	---	---	0	6	4	6	11	14	41

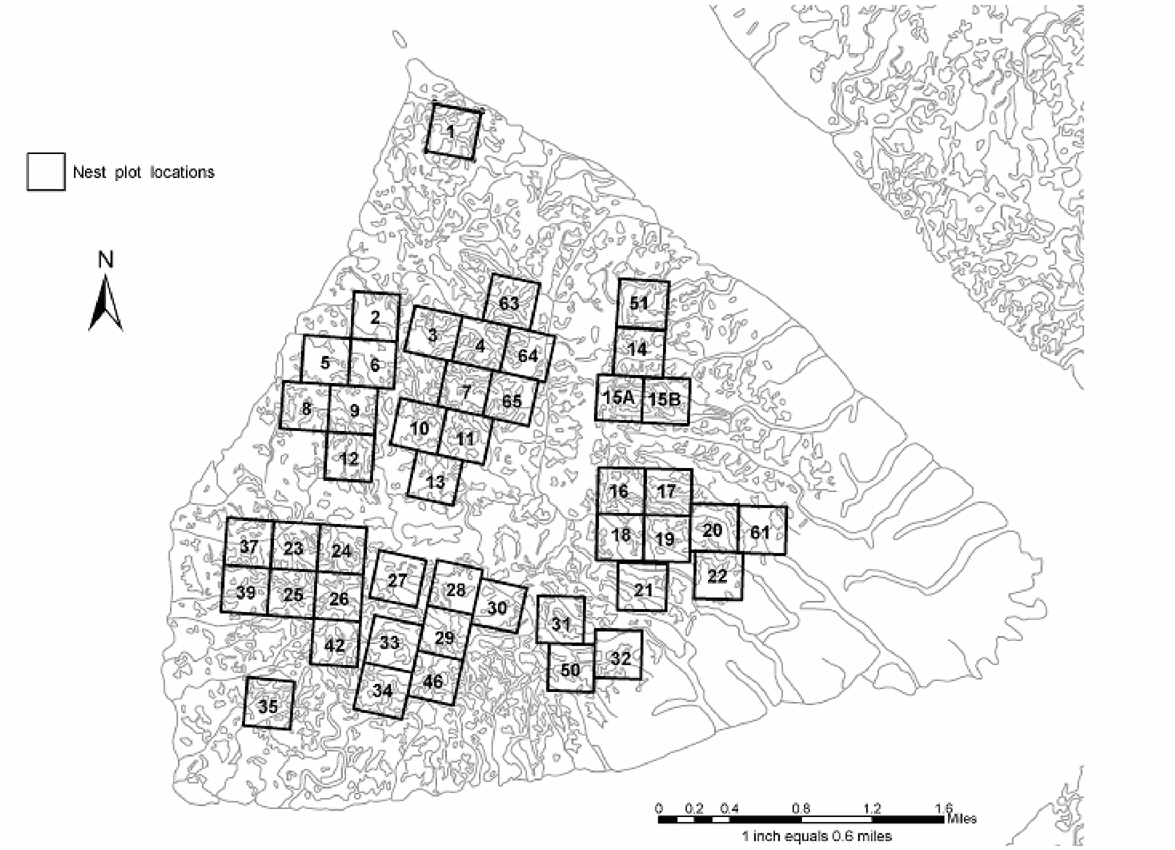

Fig. 1. Locations of plots (N = 48) searched for spectacled eider nests on Kigigak Island, Alaska (plots 66 and 68 are not show [66 is to the east of 11 and 68 is to the east of 13]).

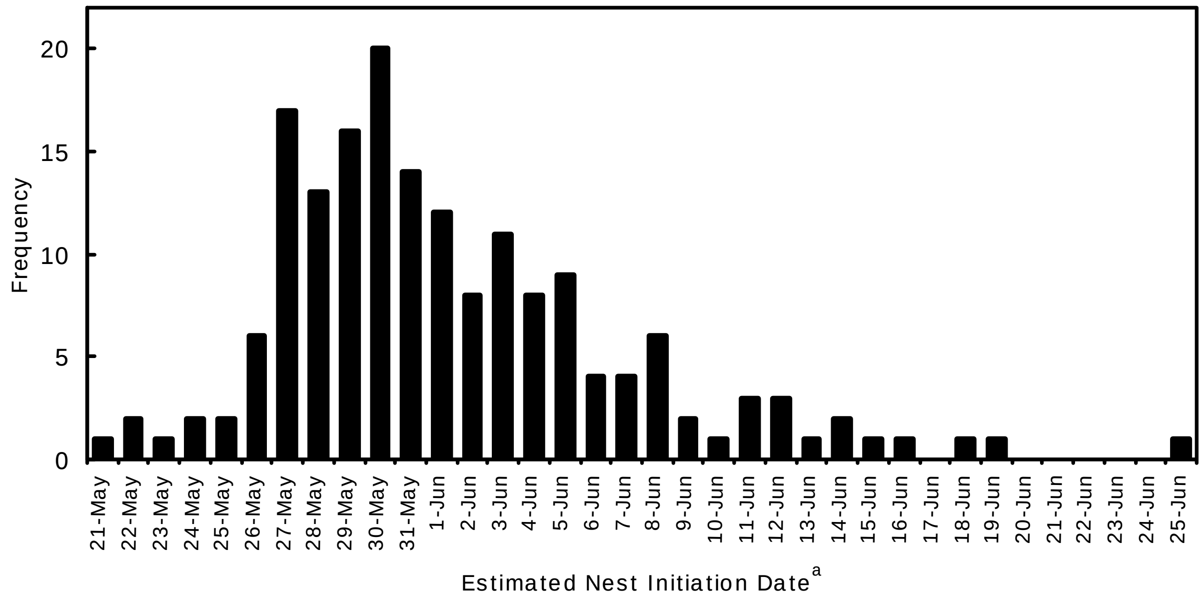

Fig. 2. Estimated nest initiation dates for spectacled eider nests. [a]Estimates assume an incubation period of 24 days and a laying rate of one egg per day.

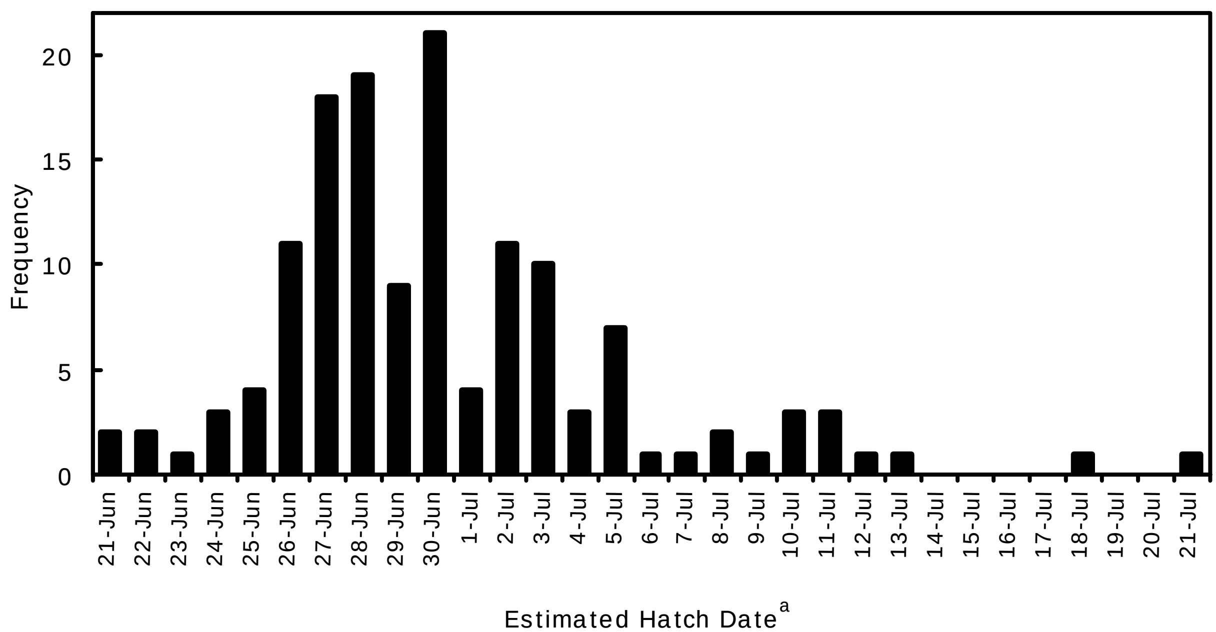

Fig. 3. Estimated hatch dates for spectacled eider nests. [a]Estimates assume an incubation period of 24 days.

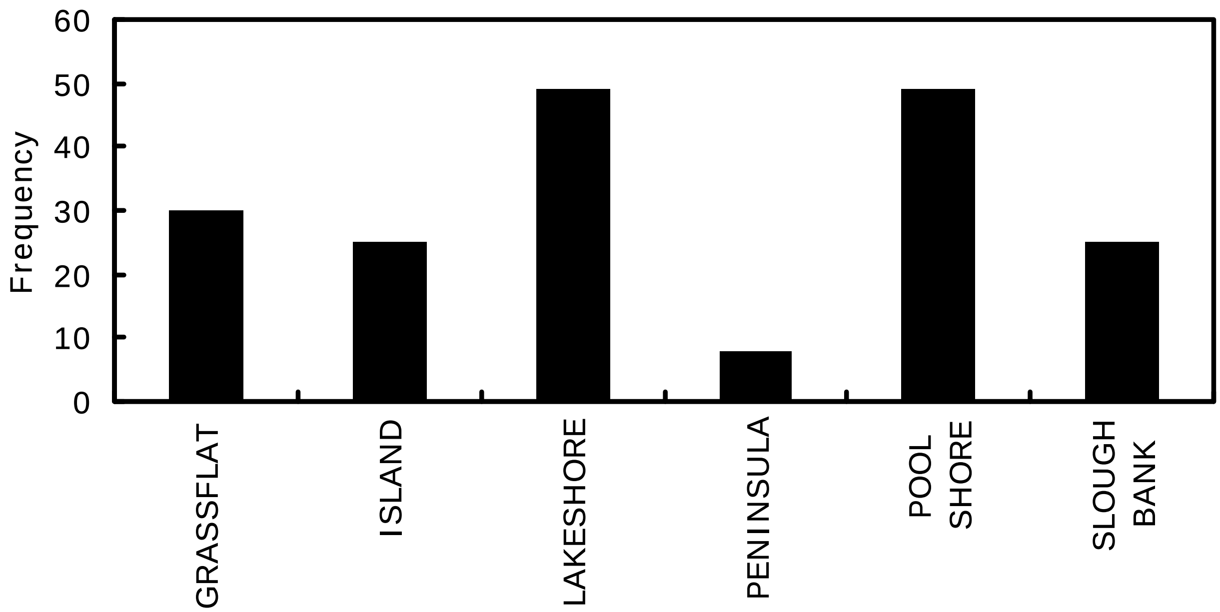

Fig. 4. Nest site frequencies for spectacled eider nests.

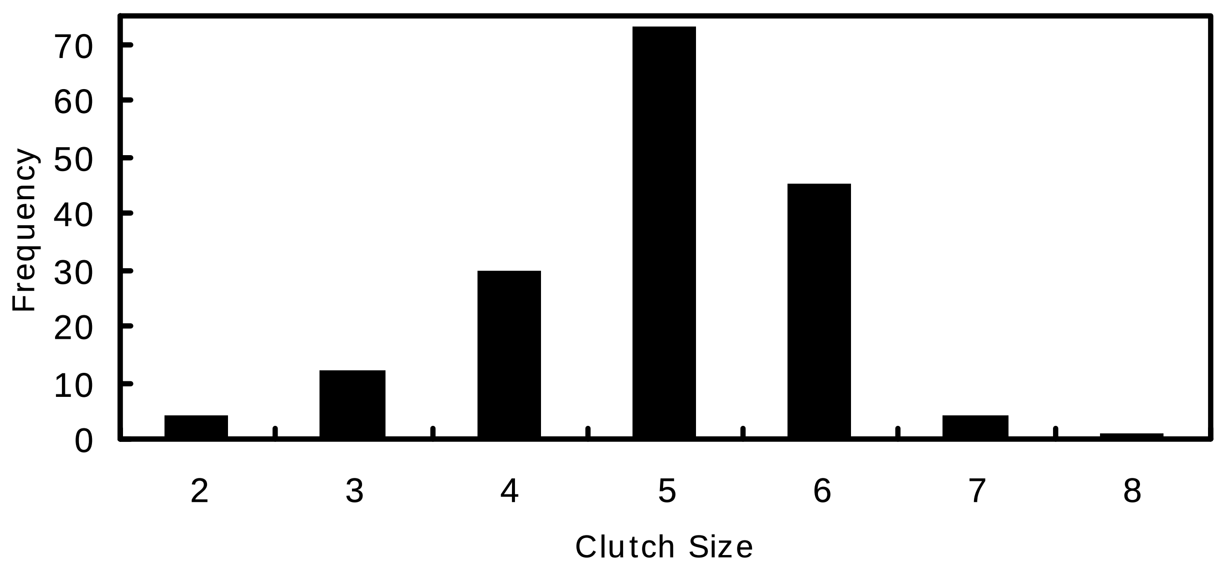

Fig. 5. Clutch size frequencies for spectacled eider nests.