Nesting Ecology of Spectacled and Common Eiders

on Kigigak Island, Yukon Delta NWR, 2001

by

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Introduction

Field work at Kigigak Island, Yukon Delta NWR (YDNWR), Alaska continued for the eleventh consecutive year as recommended by the Spectacled Eider Recovery Team. Spectacled eiders (*Somateria fischeri*) were listed as threatened in May 1993 and the refuge's population of common eiders (*S. mollissima*) may also be declining. Their status was monitored by collecting productivity information at a field camp staffed by three personnel from 3 May - 6 July. Study objectives included:

1) monitor spectacled and common eider nesting chronology and productivity.
2) capture and mark female spectacled eiders to estimate annual and brood survival.
3) capture and mark spectacled eider ducklings to document natal philopatry.

In addition, one member of this year's team was Dr. Diana Solovieva, a Russian biologist from the Lena Delta Reserve. She was interested in expanding her knowledge of eiders by documenting prenesting time budgets of pairs and mass changes of male spectacled eiders.

Study Area

Kigigak Island (32.5 km^2, 60º 50' N, 164º 59' W) is on the west coast of YDNWR near the mouth of Baird Inlet and bordered by the Ninglick River and the Bering Sea. The island contains many shallow ponds, lakes, and a network of tidal sloughs. Habitat consists of low coastal tundra, sedges, and grasses and is affected by spring and fall floods.

Methods

A. Spring Arrival and Time Budgets

Prior to nest initiation, known spectacled eider use areas were monitored to document first and peak arrival periods. Time budgets were measured by recording various behaviors of pairs, singles, and flocks up to 5 birds. Behavior of each bird was recorded at 30 seconds intervals using a tape recorder. Each observation session lasted for 20 minutes or until birds disappeared from view after a minimum of 7 minutes (short session). Observation sessions were randomly distributed throughout diurnal periods. Behavior categories included: feeding (bill-dipping, head dipping, and up-ending), resting, sleeping, alert, walking, comfort movements (preening, wing stretch, etc.), courtship (complex of displays), flying, and aggression. Daily time budgets were calculated as a percent of time devoted to each behavior for all sessions.

B. Nest Searches

We searched for spectacled and common eider nests on 0.17 km^2 plots selected from approximately 9 km^2 of the island stratified for spectacled eider nesting habitat (Harwood and Moran 1993, Fig. 1). Four, 0.32 km^2 eider production plots (Bowman et al. 2001) were also searched. Nests were revisited every 10 days and nests found incidentally during daily activities were treated the same as those found on plots.
Data were recorded according to guidelines for spectacled eider research used by the

USGS-BRD, Alaska Biological Science Center (Grand 1993). Nests were mapped on aerial photos and each nest was marked with a white flag placed 3 m north of the nest. Eggs were numbered to monitor partial predation and candled (Weller 1956) and floated (Westerkov 1950) to monitor incubation and predict hatch dates. For each nest we recorded date, nest number, species, egg length and width, presence of a male, incubation stage, abundance of down (none, some, abundant), condition of nest (laying, incubating, flooded, depredated, abandoned), and habitat type (upland, intermediate, grassflat). Maximum vegetation density and dominant vegetation abundance (up to 4 dominant species) within 1 m of the nest bowl were also recorded. Nest site categories included sloughbank, lake shore (>3 m wide), pond shore (<3 m wide), peninsula, island, mudflat, grassflat, and mud island. During each revisit, female status (flushed, present near nest, or absent), presence of a male, incubation stage, condition of nest, and number of eggs were recorded.

C. Trapping and Marking

Three, 20 m long mist nets were used to trap pe-nesting spectacled eider pairs and groups. Nets were held 0.5 m above the water surface by intersecting wooden sticks to minimize capture of flying birds. Nets were placed in lakes where birds had been observed for at least one day.

Bownet traps (Sayler 1962) were used to trap spectacled eider females on nests 1-5 days before hatch. Egg laying sequence, float angle, candling data, and 24 day incubation period (Dau 1974) were used to predict hatch date. Birds were banded with U.S. Fish and Wildlife Service metal leg bands (left leg) and letter/number coded, yellow plastic tarsal bands (right leg) and fitted with alpha numerically coded, yellow plastic nasal disks (Lokemoen and Sharp 1985). We also recorded wing, culmen, and tarsus measurements and mass for each bird and took 3 cc's of blood for subsequent lead contamination and DNA analyses.

D. Analyses

Nest initiation dates were estimated by backdating clutches to the onset of egg laying from float angle information. Only nests that survived to incubation were used to calculate clutch sizes. Clutch size was defined as the total number of eggs laid in a nest, partial depredation as the number of eggs missing from nests that remained active, and successful nests as those in which at least one egg hatched. Grand means were reported for egg widths and lengths and egg volume was calculated by multiplying egg length by the square of egg width and dividing the product by one thousand (Petrula 1994). Egg hatching success (apparent) was determined for all nests with known fates. Eggs with unknown fates or destroyed by biologist activity were omitted from analysis.

MAYDATES program (Grand and Flint 1993) was used to calculate Mayfield nest success estimates and 95% confidence intervals. The program and data entry were modified to accommodate successful nests visited after hatch. When exact hatch date was unknown, probable exposure of the final interval was 50% of that interval. Nests visited after failure were treated similarly. Constant daily mortality was assumed. Overall exposure periods for spectacled and common eiders were 29 and 28 days (Harwood and Moran 1993), respectively. Return rates were calculated by multiplying survival rate, estimated using capture-recapture methods (Grand et al. 1998), by the number that were resighted in year $\geq i + 1$, then dividing by number of birds marked or sighted in year *i*.

E. Post-breeding Male Departure

Number of males observed was recorded daily to document departure date.

Results

A. Spring Arrival and Time Budgets

Spectacled and common eiders were first observed on 13 May and 11 May, respectively. Peak arrival was 23-25 May for spectacled and 17-22 May for common eiders. One pair of king eiders (*S. spectabilis*) was observed during migration and a nest, subsequently depredated, was located.

Diurnal time budget observations totaled 8.5 hours (Fig. 2). Sleeping and feeding occurred most frequently for both sexes and totaled 64% of the time for females. The third-most frequent activity for males was female guarding.

B. Nest Survey

Nest searches began 27 May and ended on 19 June. Up to 5 plots were searched per day for a total of 43, including 24 which were searched twice. Four eider production plots were also searched once during mid-incubation. We located 171 eider nests, including 63 spectacled and 108 common.

C. Nesting Chronology

Spectacled eider nest initiation occurred between 26 May - 17 June (_ = 5 June, n = 40), and peaked between 2-7 June (Fig. 3). Hatch occurred between 26 June and 3 July (n = 4, Fig. 4). Common eider nest initiation occurred between 21 May - 23 June (_ = 4 June, n = 91) and peaked between 31 May and 3 June (Fig. 5). Hatch occurred between 18 June and 3 July (_ = 27 June, n = 17; Fig. 6).

D. Nest Sites

Most spectacled eiders nested on islands (32%, n = 20), lakeshores (29%, n = 18), and peninsulas (22%, n = 14) and commons nested on islands (63%, n = 68) and sloughbanks (12%, n = 13; Fig. 7). Spectacled and common eiders nested mean distances of 2.1 ± 0.6 m (n = 59) and 1.4 ± 0.3 m (n = 90) from water, respectively.

E. Clutch Size and Egg Size

Spectacled and common eiders laid mean clutches of 4.0 ± 0.2 eggs (range = 2-6 eggs, n = 22) and 4.7 ± 0.2 eggs (range = 1-10, n = 53), respectively (Tables 1-3). Mean egg dimensions and volume for spectacled and common eiders were: length - 67.5 ± 0.2 mm (n = 134) and 74.3 ± 0.2 mm (n = 348), width - 45.2 ± 0.1 mm and 49.8 ± 0.1 mm, and volume - 138.4 ± 1.0 cc and 184.4 ± 0.9 cc, respectively (Tables 4-5).

F. Nest and Egg Hatching Success

Mayfield nest success estimates for spectacled and common eiders were 6.3% (95% C.I.: 2.5 - 15.6%) and 13.8% (95% C.I.: 8.6 - 21.9%), respectively (Tables 6-7).

Apparent egg hatching success estimates for successful spectacled and common eider nests were 7.7 and 21.5%, respectively (Tables 8-9). Partial depredations did not occur at any spectacled eider nests and 4.3% of common eider nests. These nests lost an average of 2.0 ± 0.2 eggs. No spectacled or common eider nests contained unviable eggs.

G. Trapping and Marking

Prior to nesting, 3 male and 6 female spectacled eiders were captured during 14 days of trapping (Table 10). All males and one female were new captures and they were banded and released. Of the 5 female recaptures, 4 died and a new nasal disk was attached to the sole survivor. Two spectacled eider females were trapped on nests. One was a recapture and a new nasal disk was attached.

Overall body condition of 4 female mortalities was poor (Table 11). None had laid eggs, and 2 birds had begun follicular lysis. The remaining 2 birds had poorly developed follicles and all four birds were considered to be in non-breeding status. Stomachs were empty for 3 birds and the fourth contained unidentified grass and seeds.

Seven female common eiders, including one recapture, were nest trapped and banded. Five male and 2 female long-tailed ducks were trapped prior to nesting. None were banded due to the banding office's incorrect identification of band size. Four female long-tailed ducks, including one recapture, were nest trapped.

A total of 16 (11 on nests) female spectacled eiders were identified (Table 12). An additional 8 color marked females were observed but the symbols were unread. Seven females did not have a nasal disk and the presence or absence of a nasal disk was undetermined from observation of 9 females. The remaining 28 females were not observed.

H. Post-Breeding Male Departure

The last male spectacled eider was observed on 19 June. Male common eiders were present throughout nesting.

I. Mortality

No spectacled eiders were found dead on the island. Four marked females died as a result of mist net capture during migration arrival.

Discussion

Migration arrival and break-up were slightly earlier than 2000, but within the range of dates considered "average" over the long term. A 5 day period of cold weather in the middle of May delayed nest initiation and resulted in a nesting chronology that was slightly later than 2000. Total number of spectacled eider nests was dramatically lower than recent years. While the late spell of cold weather may have been a factor, pairs may have foregone nesting due to the larger than normal number of fox on the island. Five or 6 were present throughout nesting and an additional 4 may have been present during migration arrival, but were found dead during nest searches. Common eiders and especially Steller's eiders are known to be able to estimate predator numbers and activity and to forego nesting under unfavorable conditions (Parker and Mehlum 1991, Bjorn and Erikstad 1994, Solovieva 2000). Ovarian development of 4 vivisected females indicated they were not in breeding condition upon arriving on the nesting grounds. At this time of year, females normally have well developed follicles without the presence of lysis. For females which haven't laid eggs during the current breeding season, lysis indicates nonbreeding status.

Clutch and egg sizes were also at or near the low end of the range of values for both species. Nests were only included in the clutch size calculation if it could be determined from successive nest visits that egg laying had ended. This represented a departure from the procedure described in the Methods section and greatly reduced the sample size since most nests were depredated prior to reaching this stage. Clutch size decreased 0.6 egg for both species if all nests were included. Factors perhaps contributing to a reduced clutch size include increased partial depredation due to a larger than normal number of fox on the island, weather delayed nest initiation, and a nesting population that may be becoming younger due to many years of excellent production and survival (Moran 2000).

Analyses of pre-nesting time budgets showed little time was spent feeding, especially for males, after arriving on the nesting grounds. Normally pre-nesting eiders spend 30-40% of their time feeding (Solovieva 2000, unpubl. data). It's possible that spectacled eiders nesting on Kigigak Island rely on marine food resources and generally don't feed on the island (Schmutz and Hobson 1998). Pairs might divide their daytime activity between defending their nesting territories and feeding. After clutch initiation, pairs appear to spend the entire day near the nest. Because males depart the nesting area soon after females complete their clutches, spectacled eider males utilize the marine environment nearly exclusively throughout their annual cycle. This species employs a different nesting strategy in the Russian arctic (Kondratiev and Zadorina 1992). Here eiders have to both feed in fresh water and rely on internal energy resources during the nesting period because shore-fast sea ice remains present until early July.

Waterfowl production throughout the coastal fringe was reduced by the high number of fox which resulted from a microtine population high in 2000 as determined from numerous qualitative assessments by biologists working in this area. Despite the hope that waterfowl production on Kigigak Island might for some unexplained reason be immune from such fluctuations, it turned out not to be the exception and mirrored the general coastal pattern. Qualitative assessments indicated microtines were present in more normal numbers in 2001 and it is hoped that this resulted in reduced fox production. It is anticipated that winter survival will subsequently bring the fox population and 2002 waterfowl production back within normal bounds.

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Table 1. Eider clutch size frequencies, Kigigak Island, AK, 2001.

Species	Clutch Size 1	2	3	4	5	6	7	8	9	10
Spectacled (n=22)	0	2	3	10	6	1	0	0	0	0
Common (n=53)	1	4	6	8	22	8	2	0	1	1

Table 2. Mean spectacled eider clutch sizes, Kigigak Island, AK.

Year	n	_	SE
1992	64	5.5	0.10
1993	74	5.2	0.13
1994	70	5.4	0.11
1995	92	4.7	0.11
1996	106	5.1	0.08
1997	132	4.9	0.07
1998	104	4.5	0.08
1999	121	4.8	0.08
2000	117	5.0	0.10
2001	22	4.0	0.21

Table 3. Mean common eider clutch sizes, Kigigak Island, AK.

Year	n	_	SE
1992	60	5.5	0.10
1993	69	5.0	0.14
1994	77	5.5	0.14
1995	64	5.2	0.15
1996	67	5.6	0.12
1997	112	5.3	0.13
1998	69	5.4	0.13
1999	134	5.0	0.11

2000	115	5.4	0.09
2001	53	4.7	0.22

Table 4. Mean length, width, and volume of spectacled eider eggs, Kigigak Island, AK.

		Length (mm)		Width (mm)		Volume (cc)[a]	
Year	n	_	SE	_	SE	_	SE
1993	72[b]	67.7	0.21	45.5	0.14	140.2	1.08
1994	362	67.9	0.25	45.5	0.11	140.6	0.88
1995	405	68.2	0.21	45.4	0.13	140.0	1.39
1996	470	68.2	0.26	45.4	0.14	-	
1997	624	67.9	0.19	45.3	0.10	139.6	0.85
1998	448	67.6	0.27	45.1	0.13	137.6	0.83
1999	580	67.4	0.18	45.0	0.11	136.6	0.83
2000	593	67.4	0.17	45.2	0.10	137.7	0.70
2001	134	67.5	0.22	45.2	0.13	138.4	1.00

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

Table 5. Mean length, width, and volume of common eider eggs, Kigigak Island, AK.

		Length (mm)		Width (mm)		Volume (cc)[a]	
Year	n	_	SE	_	SE	_	SE
1994	277	75.1	0.27	49.9	0.12	187.5	1.29
1995	414	74.8	0.26	50.0	0.15	187.1	1.37
1996	343	74.9	0.28	50.1	0.14	-	
1997	593	75.0	0.24	50.4	0.11	190.7	1.17
1998	383	74.6	0.26	49.7	0.12	184.8	1.29
1999	500	74.7	0.23	49.9	0.13	186.7	1.23
2000	626	74.9	0.22	50.3	0.11	189.3	1.10
2001	348	74.3	0.17	49.8	0.09	184.4	0.86

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

Table 6. Nest success of spectacled eiders, Kigigak Island, AK.

Year	n	DSR[a]	Exposure Days	Apparent Success %[b]	Mayfield Success %	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	395.5	7.7	6.3	2.5-15.6

[a] Daily Survival Rate.
[b] Estimates do not included nests whose fates were suspected of being influenced by visitor impact, specifically trapping.

Table 7. Nest success of common eiders, Kigigak Island, AK.

Year	n	DSR[a]	Exposure Days	Apparent Success %[b]	Mayfield Success %	95% Mayfield C.I.
1992	94	0.995	1647.5	91.1	87.3	79.2-96.1
1993	72	0.973	972	64.4	47.0	34.9-63.1
1994	79	0.988	1267	81.0	71.6	60.3-85.1
1995	66	0.993	1018.5	74.2	62.4	53.7-78.0
1996	66	0.983	1127	87.9	81.9	71.1-94.3
1997	124	0.989	2167	80.8	73.2	64.4-83.1
1998	72	0.985	1216	75.0	65.9	54.1-80.1
1999	144	0.960	2142	68.8	55.2	46.2-65.9
2000	120	0.988	2108.5	79.2	71.6	62.6-81.8
2001	90	0.932	1054.5	20.0	13.8	8.6-21.9

[a] Daily Survival Rate.
[b] Estimates do not include nests whose fates were suspected of being influenced by visitor impact, specifically trapping.

Table 8. Fates of spectacled eiders eggs, Kigigak Island, AK.

Egg Fate (%)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hatched	76.3	62.3	54.5	52.0	69.7	63.0	81.9	73.8	70.5	7.7
Depredated	5.4	22.6	13.3	25.7	6.4	12.8	9.0	17.9	10.9	88.8
Abandoned (natural causes)	7.9	2.1	1.8	0.4	4.5	1.3	0.4	3.2	0.1	3.5
Abandoned (human induced)	0.6	0.0	9.3	2.9	3.5	5.1	2.7	2.2	0.0	0.0
Addled/Dead Embryo	1.7	2.8	4.8	7.1	5.5	9.9	4.2	5.5	9.2	0.0
Damaged from trap	0.6	1.0	1.1	2.7	3.4	0.1	0.4	1.0	0.3	0.0
Collected	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	6.8	0.1	10.4	12.1	10.3	7.8	1.0	3.5	7.2	0.0
Total eggs laid	354	390	442	479	594	690	480	602	587	143
Total nests	64	75	84	103	120	147	111	134	119	43

Table 9. Fates of common eider eggs, Kigigak Island, AK.

Egg Fate (%)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hatched	77.2	49.5	59.8	59.0	65.9	61.4	74.3	64.0	74.2	21.5
Depredated	6.8	28.9	10.6	21.2	7.7	10.7	12.3	21.6	10.1	70.6
Abandoned (natural causes)	5.0	4.5	5.5	3.2	5.3	6.9	6.0	7.4	0.7	5.3
Abandoned (human induced)	0.6	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	0.0
Addled/Dead Embryo	-	2.4	1.4	1.5	8.2	3.8	3.7	4.5	3.7	0.0
Damaged	0.4	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.2	0.0
Unknown	9.5	14.7	15.9	14.8	11.9	9.0	0.8	3.0	3.9	2.7
Total Eggs Laid	518	374	435	344	378	665	382	667	624	377
Total Nests	95	78	83	67	70	126	74	145	120	

Table 10. Measurements of adult spectacled eiders, Kigigak Island, AK, 2001.

Measurements	$\bar{x}$	SE	Range
Prenesting Females (n=6)			
Mass (g)	1642	52	1390-1750
Wing (mm)	257	2	251-262
Culmen (mm)	24.9	0.7	22.2-26.3
Total Tarsus (mm) (n=5)	59.0	1.3	56.1-63.4
Prenesting Males (n=3)			
Mass (g)	1410	89	1280,1370,1580[a]
Wing (mm)	266	3	260,266,272[a]
Culmen (mm)	24.7	0.5	23.7,24.8,25.5[a]
Total Tarsus (mm)	57.3	1.1	55.1,58.2,58.5[a]
Nesting Females (n=2)			
Mass (g)	970	-	950,990[a]
Wing (mm)	258	-	250,267[a]
Culmen (mm)	24.7	-	24.3,25.1[a]
Total Tarsus (mm)	53.8	-	52.4,55.2[a]

[a] Actual values.

Table 12. Adult female spectacled eider resightings on Kigigak Island, AK.

Banding Year	# Banded	Number Resighted								
		1993	1994	1995	1996	1997	1998	1999	2000	2001
1992	26[a]	15(10)[b]	12(10)	10(7)	11(11)	7(7)	6(6)	8(8)	4(4)	2(0)
1993	37	-	18(17)	22(21)	16(16)	21(18)	13(12)	14(12)	6(6)	1(1)
1994	27	-	-	16(12)	14(14)	13(11)	6(6)	5(5)	7(7)	1(1)
1995	37[c]	-	-	-	23(22)	14(14)[d]	12(12)	10(9)	11(10)	1(0)
1996	34	-	-	-	-	19(18)	11(10)	16(14)	8(8)	1(1)
1997	49	-	-	-	-	-	26(26)	22(22)	14(14)	4(2)
1998	29	-	-	-	-	-	-	9(7)	13(12)	1(1)
1999	26[e]	-	-	-	-	-	-	-	12(12)	0(0)
2000	31[f]	-	-	-	-	-	-	-	-	5(5)
2001	2	-	-	-	-	-	-	-	-	-
Total[g]	298	15(10)	30(27)	48(40)	65(64)	74(68)	74(72)	84(77)	75(73)	16(11)

[a] Forty-two ducklings were also banded but not sexed. One returned as a nesting female from 1994-1997. A second female nested in 1995 and a third female nested in 1996 and 1997. They are not included in this table.
[b] Numbers in parentheses indicate females observed on nests.
[c] Ten ducklings were also banded, including 5 males and 5 females.
[d] Three females recaptured on nests in 1997 and banded in 1995 as ducklings were not included in this table.
[e] One hundred and two ducklings were also banded, including 50 males and 52 females.
[f] One hundred and thirty-four ducklings were also banded, including 68 males and 66 females.

[g]Totals do not included females banded as ducklings in 1992, 1995, 1999, and 2000.

Table 11. Body condition of pre-nesting female spectacled eiders on Kigigak Island, AK.

Date	Thickness of belly fat deposit (mm)(10 mm above cloaca)	Internal fat characterization	No. of lysitic follicles	No. of eggs laid	Diameter of consecutive follicles (mm)	Wt. of consecutive follicles (g)
5/22/01	13.2	little	3	none	27.1,20.6,13.5	7.7,3.8,1.3
5/28/01	10.3	little	none	none	12.0	-
5/28/01	14.5	moderate	none	none	2.1	-
6/1/01	8.0	little	4	none	5.3,2.5,0.8	-