2015 SUMMARY REPORT

MONITORING OF NESTING SPECTACLED EIDERS ON KIGIGAK ISLAND, YUKON DELTA NWR

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SUMMARY

In 2015, nesting spectacled eiders (*Somateria fischeri*) were monitored for the 24th consecutive year on Kigigak Island, Yukon Delta National Wildlife Refuge, Alaska. Clutch size, hatch date, and final nest status were collected and used to estimate nesting success. A reduced crew size this season stressed the need to focus on two priority activities: 1) resight previously marked females to collect critical information needed to calculate annual survival, and 2) collect nest monitoring data to estimate annual nesting success. When time permitted, new females were captured on the nest and marked with standard metal leg bands and with a metal federal leg band and an alpha-numerically coded, yellow plastic tarsal band. Spectacled eider broods were also captured later in the season to monitor changes in body mass, recruitment, and duckling survival. Protocols for brood captures remained consistent with previous years and included collecting habitat characteristics of brood capture sites.

Thirty-five of 48 plots on Kigigak Island were searched, resulting in the detection of 71 spectacled eider nests that were subsequently monitored through hatch (63 on plot, 8 off plot). Mean clutch size was 4.0 ± 1.4 (SD) eggs. Mean nest initiation and hatch dates were 6 days later than 2014, but were 6 days earlier than 2013. The estimated Mayfield nest success of 64 nests, where fates could be determined, was 4.5% (95% CI; 1.5-10.3%), resulting in the lowest nesting success on record. Twenty-five adult females were identified during the nesting season: 10 nest-trapped and 15 visually resighted. Thirteen new females were captured on the nest and banded. The mean culmen of nesting adult females was 25.1 mm ± 1.4 (SD) and mean tarsus length was 54.5 mm ± 2.1 (SD). Nesting female mass was not collected during nest captures.

Brood capture efforts resulted in the capture of thirteen spectacled eider broods (11 adults and 32 hatch year birds). Seven of the 11 adult females caught during brood captures were previously marked, however only 4 were previously encountered during the nesting period (*i.e.* 3 new recaptures for 2015). The mean duckling mass was 852.7 g ± 112.1 (SD), mean culmen was 21.8 mm ± 1.7 (SD), mean tarsus was 55.7 mm ± 1.5 (SD), and the mean 9th primary length was 71.4 mm ± 22.5 (SD). The mean mass of adult females captured during brood drives was 1,248 g ± 115.1 (SD), culmen was 27.6 mm ± 5.5 (SD), and mean tarsus was 54.9 mm ± 1.9 (SD). Broods were captured in ponds characterized as being surrounded by high sedge meadow habitat. The mean temperature (^{o}C) of brood ponds was 14.8 ± 1.6 (SD), the mean depth was 15.6 cm ± 11.8 (SD), and the mean salinity was 11.0 ppt ± 5.4 (SD).

Nesting chronology on Kigigak in 2015 was considered early and was likely a result of early breakup and above average temperatures throughout the winter and into spring. As a result of these uncharacteristically warm weather patterns, nest initiation and incubation for most waterfowl species was well under way when technicians arrived on the Island. Nest success of spectacled eiders in 2015 was the lowest on record and fell well below the long-term average. Analyses of this long-term dataset, project methods, and primary objectives are needed in order to assess the effectiveness of this project and future work on Kigigak Island.

KEY WORDS

Spectacled Eider, Somateria fischeri, Nest Success, Survival, Recruitment, Mark-Resight, Salinity, Brood Capture, Mist-net, Bow-trap, Nasal Disc, Tarsal Band, Yukon Delta NWR, Kigigak Island,

INTRODUCTION

After a steep population decline between the 1970's and 1990's, the spectacled eider (*Somateria fischeri*) was listed as a threatened species under the Endangered Species Act in 1993 (Fed. Register 1993). In an effort to assess possible reasons for their decline, the U.S. Fish & Wildlife Service enacted a long-term population monitoring study on Kigigak Island, Yukon Delta National Wildlife Refuge, Alaska. Over the last 24 years, data collected from Kigigak Island has been used to monitor nesting ecology (clutch size, nesting phenology, and final status of eggs and nests), adult female annual survival (capture, mark, and resight marked adult females), duckling survival, and recruitment of spectacled eiders.

In 1996, the Spectacled Eider Recovery Team produced the Spectacled Eider Recovery Plan, which outlined detailed management strategies necessary to facilitate the recovery of this population (U.S. Fish & Wildlife Service 1996). Revisions to the priorities addressed in the original Recovery Plan have been made periodically since its inception. The research carried out on Kigigak Island directly or indirectly addresses several priorities identified in the most recent (2014) task list associated with the plan: monitor productivity of spectacled eider females (task 20b); estimate annual survival of adult female spectacled eiders (tasks 7 and 27b); and evaluate factors affecting duckling growth and survival and monitor recruitment (tasks 18 and 20a).

An additional component was added to field work in 2015. In a collaborative effort with the Steller's Eider Reintroduction Program, personnel from the Fairbanks Fish and Wildlife Field Office and the Alaska Sea Life Center joined the crew on Kigigak Island to assist with brood captures. The Steller's Eider Recovery Plan (U.S. Fish & Wildlife Service 2002) includes a high priority task to develop a plan for reintroduction of the Steller's eider breeding population on the Yukon Delta National Wildlife Refuge (YDNWR) (task 1.6, 2014 task list). Kigigak Island was identified as one possible site for reintroduction efforts. In 2015, biological samples were collected from waterfowl broods to assess the disease and contaminant levels at Kigigak Island. Refuge brood capture efforts normally target only spectacled eiders, but four additional species were added in 2015: Pacific common eider (*Somateria mollissima*), greater scaup (*Aythya marila*), long-tailed duck (*Clangula hyemalis*) and northern pintail (*Anas acuta*). The additional target species were included to broaden the scope of sampling as spectacled eiders alone may not provide enough information that would be relevant to the Steller's eiders.

USFWS STUDY OBJECTIVES

1. Determine clutch size, hatch date, and final nest status of spectacled eider females to estimate nesting success.
2. Resight or capture and mark adult females to generate estimates of adult female annual survival.
3. Capture and mark ducklings prior to fledging to estimate recruitment and duckling survival.

STUDY AREA

Kigigak Island (60°50'N, 165°50'W) is a 32.5-km^2 island located along the central coast of YDNWR near the mouth of Baird Inlet (Figure 1). The island is bordered by the Ninglick River on the east and south sides and the Bering Sea to the west. It contains many shallow ponds, lakes, and a network of tidal sloughs. Habitat types include high-sedge meadow, high-graminoid meadow, dwarf-shrub upland, and intermediate-sedge meadow (Grand et al. 1997). Spring and fall storm tides regularly inundate the island, except for upland areas which are flooded only during severe tidal storms.

METHODS

Data Collection

Nest Monitoring

A three-person field crew searched for spectacled and Pacific common eider(*Somateria mollissima)* nests on 35 of 48 long-term monitoring plots that were identified as ideal spectacled eider nesting habitat by Harwood and Moran (1993; Figure 2). Each plot, 412 m x 412 m in size, were thoroughly searched once between 1 and 22 June 2015. Each plot took between three and eight hours to search depending on its distance from camp, the number of islands to be searched, nest density, and the amount of water within the plot. Some nests were discovered opportunistically while walking between plots and were also monitored through hatch. Unlike previous years, no black brant (*Branta bernicla nigricans*) nests were monitored during the 2015 field season due to time constraints and lack of field personnel.

In 2015, the field crew tested the effectiveness of rope dragging through grassland areas. Neon flagging tape streamers were tied approximately every two feet on a 40 foot piece of lightweight rope. Wooden dowels were used as handles on both ends. Once technicians mastered this technique, it was obvious that it was an effective and efficient way to search these types of areas.

Data were collected and recorded according to methods developed by USGS Alaska Science Center (Grand 1993). On the initial nest visit, a white or yellow flag was placed approximately 3 m north of the nest whenever possible; if the flag was placed elsewhere it was recorded on the nest card. Nest locations were recorded on topographic maps and with a Garmin eTrex HC GPS unit. All nest location data were collected in WGS 1984. A sharpie permanent marker was used to label each egg with a number to determine new and/or missing eggs found on subsequent visits. Incubation status of each nest was determined by floating (Westerkov 1950) and candling (Weller 1956) three eggs per nest to estimate days of incubation and viability. On days when conditions were poor, eggs were only candled to prevent rapid cooling from occurring by placing the eggs in water.

Nests were visited 2-6 times to check the status of the nest, resight or trap the adult female, and to determine final nest fate. On all nest visits, nest status (incubating, laying, depredated, abandoned, hatched) and egg status (number present, new, missing, inviable, depredated) were recorded on the data card. Technicians attempted to identify marked spectacled eider females on all nest visits by reading nasal and tarsal band codes with spotting scopes and binoculars. If a bird was identified as marked, its identification code(s) was recorded on the nest card.

Bownet traps (Salyer 1962) with a manual trigger were used to trap all unmarked spectacled eider females and marked females for which the marker codes were not successfully read. In an effort to minimize the chance of nest abandonment, all trapping activities occurred 1-4 days before the estimated hatch date. Anticipated hatch dates for each nest were calculated based on egg float angle and candling data, assuming a 24-day incubation period for spectacled eiders. Upon capture, unbanded birds were marked with a metal federal leg band and an alpha-numerically coded, yellow plastic tarsal band (Lokemoen and Sharp 1985). In 2015, we did not mark birds with nasal discs as these markers have had poor retention rates at the Kigigak study site (Gabrielson 2012). Morphological measurements of all trapped spectacled eiders (culmen and tarsus) were recorded following the guidelines of Dzubin and Cooch (1992).

Final nest checks were completed after the anticipated hatch date to determine final nest fate. Ten contour feathers were collected from all nests (post hatch or failure) that contained them for future genetic and stable isotope analyses. All feather samples are stored at the YDNWR headquarters.

Brood Captures
A crew of six returned to Kigigak Island on 19 July, when ducklings were approximately 25-35 days of age. They searched for and captured broods from 20-25 July. Different areas of the island were searched each day. Mudflats and tidal areas were excluding from brood searches. When a brood was spotted, the crew placed a mist net in a strategic location for capture of the brood. Ducklings and the attending female(s) were gently corralled into the mist net by field personnel. Dip nets were used to capture small broods that were tucked up under a bank when it was deemed appropriate by the field crew. All unmarked birds were banded with standard federal leg bands. Female spectacled eiders were also fitted with yellow alphanumeric bands with black characters (Lokemoen and Sharp 1985). The mass, tarsus, and culmen of all captured individuals were measured for assessment of body condition and growth rates (Dzubin and Cooch 1992). In addition, the 9^{th} primary feather was measured for ducklings. Samples collected by the Alaska Sea Life Center included blood, feathers, and cloacal and fecal swabs and will be analyzed by them. In addition, pond characteristics (pond size, salinity, temperature, depth, etc.) were collected using a YSI monitoring meter at most brood capture sites.

Banding data was entered into the BANDIT software program and electronically submitted to the USGS Bird Banding Laboratory at the end of the field season. All encounters of banded spectacled eiders and additional target species were entered online (www.reportband.gov).

Data Analysis

Nest Monitoring
Egg candling and floating data were used to estimate clutch age and hatch dates for spectacled eiders. Subsequently, these dates were used to determine appropriate timing of nest trapping. Nest initiation dates for spectacled eider nests were calculated by subtracting one day for each egg present in the nest (assuming one egg is laid per day; Grand and Flint 1997) and backdating using clutch age information. Hatch date was estimated in a similar manner using egg float angle and candling data and assuming an incubation period of 24 days.

The apparent egg fate (#eggs/total eggs) was classified as hatched, depredated, destroyed or unknown. Eggs were classified as hatched if detached membranes or ducklings were found in the nest. Cold eggs or wet nests were assumed to have been abandoned. If a female abandoned her nest after trapping activities, the fate of the eggs was classified as human-induced abandonment. During data collection, eggs that disappeared from a nest were classified as missing eggs. For summary and analysis purposes, all missing eggs were assumed to be depredated. If the fate of an egg could not be determined because the nest was still active when the crew departed from the island, it was classified as unknown.

Apparent nest success (# successful nests/total nests) was calculated for all nests found. Nests were defined as successful if one or more eggs hatched. Mayfield nest success was calculated using Program Mark (Dinsmore et al. 2002). Nests with unknown fates, found depredated on initial visit, or nests abandoned due to human disturbance were excluded from our analysis. A constant daily survival rate was derived from a 29-day exposure period (Harwood and Moran 1993).

All morphological data and other means are reported as mean ± 1 SD.

RESULTS

Nesting Chronology

Lack of snow pack and early spring weather resulted in an early breakup of the Ninglick River, allowing a three-person research crew to arrive on Kigigak Island between 29 May and 1 June. Upon arrival, the island was completely free of snow and ice and the first spectacled eiders were observed (a small group of males and females).

Personnel began nest searching on 1 June, one day earlier than 2014. The crew searched 35 of 48 plots between 1-22 June 2015. Each plot was searched one time. A total of 71 spectacled eider nests were found, 63 on and 8 off plot.

Once nest searching began, we determined that a number of eiders were mid-way through incubation, while others had just begun laying. Our calculations indicate that spectacled eider nest initiation in 2015 occurred between 8 May and 20 June (Figure 3), with a mean initiation date of 25 May. Mean initiation in 2015 was 6 days later than 2014, but 6 days earlier than 2013. Hatch occurred between 7 June and 17 July (Figure 4), with mean hatch date of 22 June. Mean hatch in 2015 was 6 days later than 2014, and 8 days earlier than 2013.

The nesting period (number of days between calculated dates for first egg laid and last egg hatched) for spectacled eiders during the 2015 breeding season was 11 days longer than 2014 and 2013. This indicates that the nesting period was considerably longer than the past two years.

Clutch Size

Spectacled eider clutch size ranged from 1 to 6 eggs (Figure 5), with a mean of 3.9 ± 1.4 eggs per clutch (Table 1). The mean clutch size for 2015 fell lower than the 2014 mean and the long-term mean (4.7 ± 1.0 eggs per clutch). Clutch size over the years shows a decline in clutch size during the course of the study, but the decline is not statistically significant ($p = 0.30$; Figure 6).

Apparent Egg Fate

The apparent fate of 282 eggs was determined, including: 62 hatched (21.9%), 192 depredated (68.1%), 4 abandoned due to natural causes (1.4%), 7 abandoned due to human activities (2.5%), 0 inviable or addled (0.0%), 2 damaged during handling (0.7%), and 15 unknown (5.3%;Table 2).

The percent of depredated eggs in 2015 (68.1%) is the second highest recorded on Kigigak Island with the exception of 2001 which had approximately 90% of the eggs depredated. No trend in percent depredated eggs over time is apparent on Kigigak Island (Figure 7). Excluding the four years of exceptionally high egg predation (2001, 2003, 2013 and 2015), the 19-year average of depredated eggs is 15.3 (range = 4.0-25.7, Table 2).

Nest Success

The fate of 67 of 71 spectacled eider nests was determined, including 21 hatched (29.6%) and 46 unsuccessful (64.8%). The remaining four nests were classified as fate unknown (5.6%) because hens were still incubating when the crew departed the island. The estimated Mayfield nest success of 64 spectacled eider nests that could be accurately aged and had a known fate was 4.5% (95% C.I. 1.5 – 10.3; Table 3). This represents a 57.5% decrease compared to the long-term average of 62.0% (Figure 8).

Female Resight/Capture

A total of twenty-five spectacled eider females were resighted during the 2015 nesting season. Fifteen were identified visually by technicians, while the remaining 10 were recaptured at the nest. Approximately 62% of the nests found in 2015 were initiated by females that were previously marked on Kigigak Island. For captured females, the mean culmen length was 25.2 mm ± 1.4 and the mean total tarsus length was 53.8 mm ± 2.0 (Table 4).

Brood Capture

All Species

The crew captured, banded, and took blood, cloacal, and feather samples from 24 broods of four species on Kigigak Island including: 13 spectacled eider (see below), 5 common eider (3 adults, 5 juvenile), 3 greater scaup (2 adults, 1 juvenile), and 3 northern pintail broods (7 juvenile). For morphological measurements of all secondary target species see Table 5. No long-tailed duck broods were captured because adults were very wary and ducklings were too small to capture in the mist net used.

Spectacled Eiders

Thirteen spectacled eider broods were captured at Kigigak Island, including 11 adult females and 32 ducklings (18 female, 14 male). The mean duckling mass was 852.7 g ± 112.1, mean culmen was 21.8 mm ± 1.7, mean tarsus was 55.7 mm ± 1.5, and mean 9th primary length was 71.4 mm ± 22.5. Seven of the 11 adult females were recaptures of marked birds. Three of the seven recaptures had not been observed during the nesting period and would not have been resighted if brood captures had not occurred. One recaptured female was encountered for the first time since she was banded as duckling in 2002. The mean mass of captured adult females was 1,248 ± 115.1g, mean culmen was 27.6 ± 5.5 mm, and mean tarsus was 54.9 ± 1.9 mm.

Broods were predominantly discovered in irregularly-shaped ponds surrounded by high sedge meadow. The mean water temperature of capture ponds was 14.8 ^{o}C ± 1.6, the mean depth was 15.5 cm ± 11.8, and the mean salinity was 11.0 ppt ± 5.4.

Observed Mortality

No adult female spectacled eiders died as a direct result of our field efforts; however, one adult female spectacled eider mortality was documented during the 2015 field season. This bird was encountered on 8 June while searching eider nest plots. The bird was found floating in a shallow pond and appeared to have been dead for some time. There were no visible signs to indicate the cause of death and the female had no bands.

Fox Observations

Arctic fox (*Vulpes lagopus*) were observed several times over the course of the field season at Kigigak Island. No more than one individual was observed at any one time during nest searching and brood captures. No den(s) or recent cache sites were located by the field crew. Tracks, clumps of fur and old, apparently inactive den sites were observed in several locations around the island with the greatest concentrations occurring south of camp lake.

The old campsite, which acted as the primary den site on the island in 2014, was inactive during the 2015 season. It appears the platform was somehow propped up and the den beneath is now exposed. It is unknown if this was a result storm damage or human activity. No pups were observed in 2015.

DISCUSSION

The field crew was deployed at the end of May. By this time, the island was free of snow and ice and the sea ice had broken up around the island. Although it is unknown when nesting sites became snow-free and available, most species on the island had already started egg laying or incubation by the time the crew had arrived. Using estimated spectacled eider nest initiation dates, we assume that suitable nesting habitat became available during the second and third week of May.

Due to a decreased crew size, the primary focus of the 2015 field effort was to search for spectacled eider nests on as many study plots as possible and resight as many banded females as possible. The crew successfully searched 73% of the plots. Following the recommendations of Gabrielson and Spragens (2013), emphasis was placed on resighting females using cameras, binoculars, and spotting scopes rather than trapping females on nests. This resulted in fewer trips to nests, reduced female and nest disturbance, and required less effort.

Nest initiation was similar to 2014 and about 2 weeks earlier than 2012 and 2013. All nests were initiated by 10 June in 2012 and 2013, while 7-12% of nests were initiated after 10 June in 2012 and 2013. Both 2014 and 2015 were warm springs with low sea ice extent in the Bering Sea and early breakup of rivers. Birds arrived early on the breeding grounds and had the opportunity to initiate their nests at earlier dates. In contrast, 2012 and 2013 were cold springs with extensive sea ice in the Bering Sea and late arrival dates for the migrants. Some birds probably initiated late as a result of the late start of the season. Onset of initiation was very similar in 2015 compared to 2014, but nests continued to be initiated up to a week later in 2014. It is possible that winter environmental conditions in the Bering Sea had an impact on body condition of the females and their readiness to nest. The late onset of nesting in 2012 and 2013 compressed the breeding season and accounted for the narrower spread in initiation dates for those years.

One interesting observation of the season included a late nest with two eggs that was found on 22 June. The nest contained bits of broken egg shells that were the color of goose eggs. It looked like the eider was reusing a goose nest. Unfortunately, the age of the eggs in this nest was not determined before it failed. Perhaps it was a late nester that decided to save time by reusing a nest.

Mean clutch size was the lowest recorded for the course of this study, slightly lower than that recorded for 2001 (4.0 ± 0.2 eggs; n = 22). Both were years of high predation and it is possible that some eggs were stolen from nests before they were found by the field crew, altering the clutch size. It is more likely that females were generally in poorer body condition and were not able to produce as many eggs. Clutch size was also low throughout the central coast as observed in the 2015 in the waterbird nest plot surveys (Fischer et al. 2016) indicating that this was a regional issue. Many waterfowl species rely on nutrient reserves for egg formation (Klaassen et al. 2006). The smaller clutch sizes could indicate that females arrived on the breeding grounds with lower nutrient reserves due to poor conditions on the wintering grounds. There is also a declining trend in annual mean clutch size over the course of this study but the significance of this trend is unknown and needs further study.

Nesting success in 2015 was the lowest recorded during all years of the study with a Mayfield estimate of only 4.5%. Nest success was also poor throughout the central coast (Fischer et al. 2016). The majority of eggs at Kigigak were lost to depredation. We suspect that egg depredation was mainly due to glaucous gulls (*Larus hyperboreus*), mew gulls (*Larus canus*), and Arctic fox (*Alopex lagopus*). No spectacled eider egg depredation events were witnessed in 2015, but fox and gulls have been observed removing intact eggs from nests in other years. Although some broken or pecked eggs were found, evidence of depredation usually consisted of empty nest bowls, missing eggs, and down pulled outside of the nest. It was difficult to attribute most of the depredation events to a specific type of predator, since nests lacked sufficient clues to make this determination. More research is needed on how predators affect nest success. Human-caused nest abandonment was below the long-term average (2.8%) and did not significantly decrease total nest success. The fate of four nests was unknown because they had not hatched before the crew had left the island.

May and June were exceptionally warm and dry months in 2015. The mean monthly temperature at the Bethel weather station was 4.8°F above normal in May and 4.6°F above normal in June for the warmest combined May/June on record (https://accap.uaf.edu/dispatches). Snow melt was early, allowing the ground to dry out sooner. Precipitation was well-below normal (only 16% of the normal level of precipitation) for June. The atypical warm, dry conditions likely had an impact on nesting success and chick survival of waterbirds nesting on Kigigak Island.

Spectacled eiders are an arctic-nesting species and are not adapted for warm climates. Heat stress may have contributed to poor nesting success in 2015. For example, a late-nesting female was spotted from a distance on 20 June, sitting on her nest with her head up and she appeared to be panting. This is unusual behavior as eiders typically lay tight to their nest and consequently are very difficult to spot from a distance. A female that is sitting upright and panting could be spotted more easily by a predator as well. It is also possible that females spent more time off the nest, cooling off on a nearby pond. Unattended nests are more vulnerable to predators. Investigating annual nesting success and weather patterns during the nesting season to determine if the two are correlated might be an important component of future population models of spectacled eiders on the Yukon Delta.

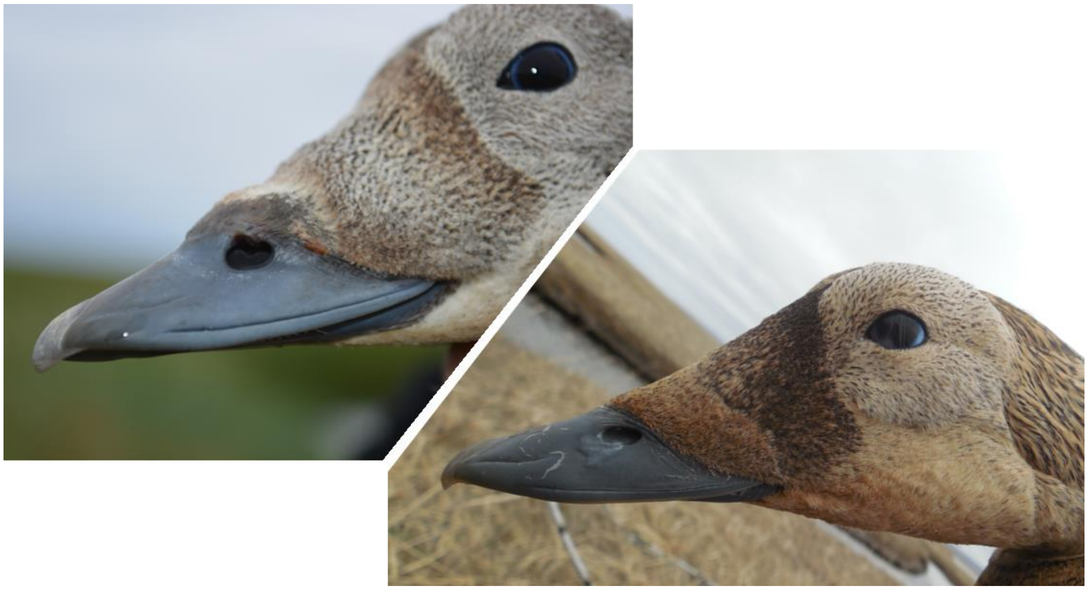
Despite the poor overall nesting success, mean duckling body mass was the fourth highest on record and well above the long-term average. The warm temperatures might have enhanced invertebrate productivity, providing a more abundant food supply for the ducklings. Poor nesting success might have meant fewer broods were competing for the same food resources, providing a competitive release for the population that favored the surviving broods. Lower water levels meant broods were concentrated on the deeper ponds on the island. These ponds typically have lower salinity than the smaller ponds. The salt glands of small eider ducklings are not developed at hatch, so saline water can be detrimental to their growth and development (Devink et al. 2009).

One adult female was encountered for the first time since she was banded as a duckling in 2002. Between 1999 and 2008, 482 female ducklings were banded, sixty-four of which have been observed returning to Kigigak Island. Between 2009 and 2014, few females that were banded as ducklings have returned (6 returns out of 565 female ducklings banded from 1999-2008 and from 2012-14; no brood captures from 2009-11). Duckling body mass showed a decline between 1999 and 2008 and could have resulted in poor recruitment. In the future, it would be interesting to see if 2015 female ducklings have a higher subsequent resight rate.

The extended nesting season resulted in a wide range of duckling ages for our secondary target species during brood captures. For example, one northern pintail duckling had already fledged and could not be caught, while in some of the other broods (long-tailed, common eider and greater scaup) ducklings were too small to be captured in a mist net. Biological samples and morphometric data from the non-target species will be analyzed by the Alaska Sea Life Center.

A total of 28 previously marked adult females were resighted either visually or through recapture in 2015. This was fewer resights of marked individuals than were observed in the previous three seasons (72 in 2012, 53 in 2013, and 51 in 2014). Fewer resights could have been a consequence of fewer nests being found (71 nests in 2015 vs. 122 in 2012, 107 in 2013, and 100 in 2014). The crew had more days to search in 2015 (21 days vs. 20 in 2012, 7 in 107, and 10 in 2014), but was smaller in size and personnel were generally less experienced. However, the rope dragging proved effective, especially for flushing birds from nests on islands and pond shores or searching large, homogenous patches of graminoids, so should have provided some compensation for the inexperience the crew had in searching for nests. It is more likely that fewer nests were found in 2015 because fewer nests were initiated or a number of nests failed during laying. If females were in poor body condition, as perhaps indicated by the smaller mean clutch size, then some may have chosen not to nest. Given the poor overall nesting success, a number of nests may also have failed during egg laying. Nests that fail during the laying period are difficult to find because eiders generally do not start lining nest bowls with eider down until incubation has started. Nest searching did not began until 1 June 2015 and more than 80% of the found nests had been initiated at this point of the season, so nests that failed early were more likely to be missed. The majority of the nests found (62%) had previously marked females. This was a higher proportion of marked females than detected at nests in 2013 (43%) and 2014 (50%). This might indicate that females with previous nesting experience at the site were either more likely to nest or were likely to have nests survive for a longer period of time than unmarked females.

Nasal discs were not used to mark the females this season due to their low retention rates and concerns about the impacts of the nasal discs to the birds. An analysis by Gabrielson (2012) showed that nasal disc loss was frequent and that a number of females had their discs replaced 2-5 times. There were 33 adult females resighted or recaptured in 2015. Only 3 birds had retained their nasal discs, likely the lowest number observed without discs since their use was initiated. One of these females was observed on a nest with a loose disc (the discs were not up tight around her nares and were moving around). Technicians returned to the nest at a later date to capture the female and assess the status of the nasal disc, but the nest had been abandoned by the second visit. During brood captures, one female with a nasal disc was captured and her bill examined. It was obvious that the nasal disc was causing significant wear, scarring and swelling to the nares and culmen (see figure below). The crew removed the discs from the female to prevent further harm. Although nasal discs clearly aid in resighting individual birds, the long-term impacts to the birds need to be considered. Extra effort spent in resighting tarsal bands can be employed to enhance resighting rates in the absence of nasal discs.



Comparing the wear, scarring and swelling caused by a nasal saddle (left) to the normal culmen characteristics of a bird without a nasal saddle (right).

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Disclaimer: *The findings and conclusions in this article are those of the author(s) and do not necessarily represent the views of the U.S. Fish and Wildlife Service.*

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Table 1. Mean clutch size of spectacled eider nests on Kigigak Island, Yukon Delta NWR, AK between 1992-2015

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	1.1
2001	22	4	0.9
2002	143	5.2	1.1
2003	131	4.7	1.3
2004	147	5	1.1
2005	147	4.8	1
2006	169	4.9	1
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
2012	122	4.5	0.9
2013	92	4.8	1.1
2014	100	4.7	1.2
2015	71	4	1.4

Table 2. Apparent fate of spectacled eider eggs on Kigigak Island, Yukon Delta NWR, AK in 2015

			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	2.8	1	0	0	0
1994	442	84	54.5	13.3	1.8	2	4.8	1.1	0	0	10.4
1995	479	103	52	25.7	0.4	0	7.1	2.7	0	0	12.1
1996	594	120	69.7	6.4	4.5	5	5.5	3.4	0	0	10.3
1997	690	147	63	11.8	1.3	13	9.9	0	0	0	7.8
1998	480	111	81.9	9	0.4	0	4.2	0	0	0	1
1999	602	134	73.8	17.9	3.2	3	5.5	1	0	0	3.5
2000	587	119	70.5	10.9	0.1	0	9.2	0	0	0	7.2
2001	143	43	7.7	88.8	3.5	4	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	0.2	9.5	0	0	0	3.7
2004	754	157	71.6	15.5	1.5	1.1	4.1	0	4.9	0	1.2
2005	674	140	57.4	8.6	3.4	0.6	12	0	0	0	18
2006	840	174	57.2	17.4	4.2	0	7	0.7[a]	0	0	13.5
2007	954	183	63	4	3	0	12	1.0[a]	0	0	17
2008	698	139	61	23	2	0	9	0.4[a]	0	0	4
2009	450	98	65.1	19.1	3.8	1.3	4.4	0.7a	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	24.7	1.9	0.9	4.3	1.1[a]	0	0	3
2012	547	122	56.5	14.6	4	1.8	2.2	0.4[a]	0	0	20.5
2013	437	92	23.6	58.6	0	0.5	0.9	0.5[a]	0	0	16
2014	468	100	59	20.3	1.7	4.7	2.1	0.4[a]	0	1	11.1
2015	282	71	21.9	68.1	1.4	2.5	0	0.7[a]	0	0	5.3[d]

[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.
[d] Includes 15 eggs from 5 nests that did not hatch prior to crew departure from Kigigak

Table 3. Daily survival rate and Mayfield success of spectacled eider nests on Kigigak Island, Yukon Delta NWR, Alaska

Year	n	DSR[a]	Exposure Days	Apparent Success (%)	Mayfield Success (%)[b]	95% Mayfield C.I.		
1992	64	0.997	1043	95	92	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	-	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	-	80.6
2003	131	0.968	2104	48.9	39.1	29.8	-	48
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
2006[c]	171	0.989	---	81.9	71.6	62.2	-	79.1
2007[c]	173	0.997	---	94.2	91.4	85	-	95.3
2008[c]	134	0.984	---	75	63	52.1	-	72
2009[c]	90	0.986	---	75.6	65.7	52.2	-	76.3
2010[c]	98	0.99	---	84.7	75.6	63.3	-	84.2
2011[c]	103	0.981	---	73.8	57.9	45	-	68.7
2012[c]	106	0.987	---	86.9	67.7	55.5	-	77.2
2013[c]	75	0.931	---	31.5	12.5	6.2	-	21.3
2014[c]	94	0.969	---	75.5	37.9	23.2	-	52.6
2015[c]	64	0.899	---	30.8	4.5	1.5	-	10.3

[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. Mean morphological measurements of adult female spectacled eiders on Kigigak Island, Yukon Delta NWR Alaska

Year	Mass	SD	Culmen	SD	Tarsus	SD
1993	1191	102.4	25.8	1.9	57.1	1.9
1994	1151	90.3	25.9	1.6	56.1	7.2
1995	1126	79.7	27.5	4.6	55.1	5.2
1996	1154	76.2	26.6	1.5	57.4	2.3
1997	1208	113.9	26.5	1.4	56.6	2.8
1998	1096	158.8	26	1.3	56.9	2.8
1999	1127	86.7	26.9	1.6	56	6
2000	1204	99.5	27.1	1.4	56.8	1.6
2001[a]	1255	351.5	25	1.3	55	2.2
2002	1203	90.9	26.2	5.8	47.2	4.4
2003	1199	91.9	26.8	3.4	49.1	5.9
2004	1217	141.6	27.7	5.9	55.1	8.2
2005	1171	124.9	28	6	55.3	7.2
2006	1193	107.9	26.6	2.1	57.3	2.6
2007	1186	81.5	26.1	2.1	56.3	1.7
2008	1166	103.6	25.8	1.5	55.6	1.6
2009	-	-	-	-	-	-
2010	-	-	-	-	-	-
2011	-	-	-	-	-	-
2012	1145	72.8	24.7	4	54.5	5.6
2013	1239	83.9	24.8	2	54.3	2.6
2014[b]	-	-	25.5	1.3	55.6	1.9
2015[b]	-	-	25.2	1.4	53.8	2.0

[a] Sample size only 4 adult females

[b] Weights were not collected from females captured on nests.

Table 5. Mean morphological measurements of additional species brood captures on Kigigak Island Yukon Delta NWR, AK in 2015

Capture Date	Species Code	FWS Band Number	Age	Sex	Culmen	Total Tarsus	9th Primary	Mass (g)
7/20	COEI	1347-52195	ASY	F	42.9	58.7	.	1556
7/23	COEI	1347-52775	ASY	F	52.1	61.1	.	1479
7/20	COEI	2007-30009	HY	M	27.7	53.5	0.0	384
7/20	COEI	2007-30010	HY	F	28.4	51.4	0.0	440
7/20	COEI	2007-30017	HY	F	28.8	50.8	0.0	384
7/20	COEI	2007-30018	HY	M	28.1	47.0	0.0	364
7/20	COEI	2007-30019	HY	F	28.1	50.9	0.0	375
7/20	COEI	2007-30020	AHY	F	44.7	60.7	.	1596
7/20	GRSC	1176-41101	AHY	F	46.4	47.4	.	794
7/21	GRSC	1176-41102	AHY	F	46.2	40.8	.	634
7/24	GRSC	1176-41103	HY	M	31.4	41.1	0.0	391
7/21	NOPI	1076-08501	HY	M	49.7	58.7	119.2	778
7/21	NOPI	1076-08502	HY	F	47.4	59.4	103.1	860
7/22	NOPI	1076-08503	HY	M	42.5	49.1	44.9	565
7/22	NOPI	1076-08504	HY	F	39.8	50.5	58.9	497
7/23	NOPI	1076-08505	HY	F	40.1	49.1	67.1	547
7/23	NOPI	1076-08506	HY	M	42.0	52.0	47.6	617
7/23	NOPI	1076-08507	HY	M	43.9	51.0	46.5	610

[a] 9th Primary was not measure for AHY birds

[b] All measurements are recorded in (mm)

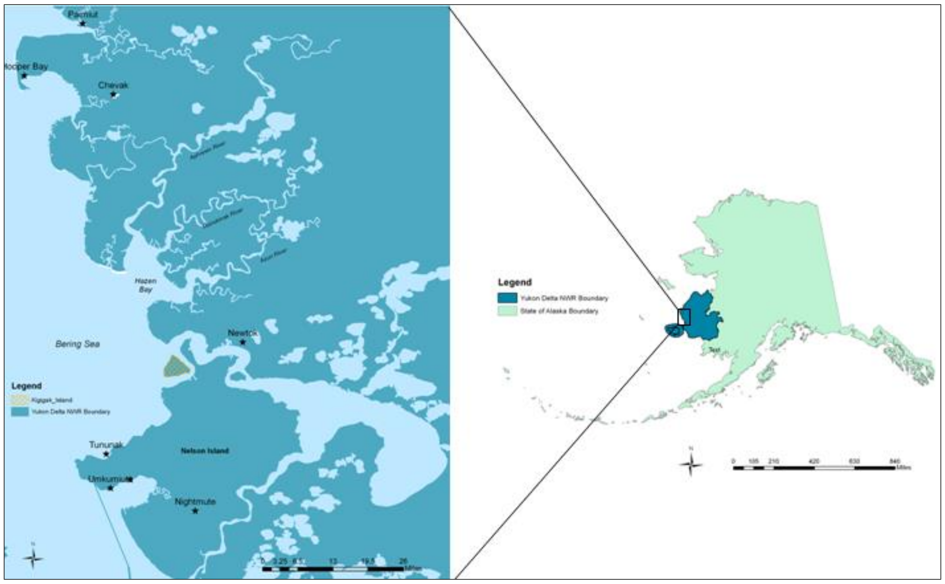

Figure 1. Location of the study area, Kigigak Island Yukon Delta NWR, Alaska.

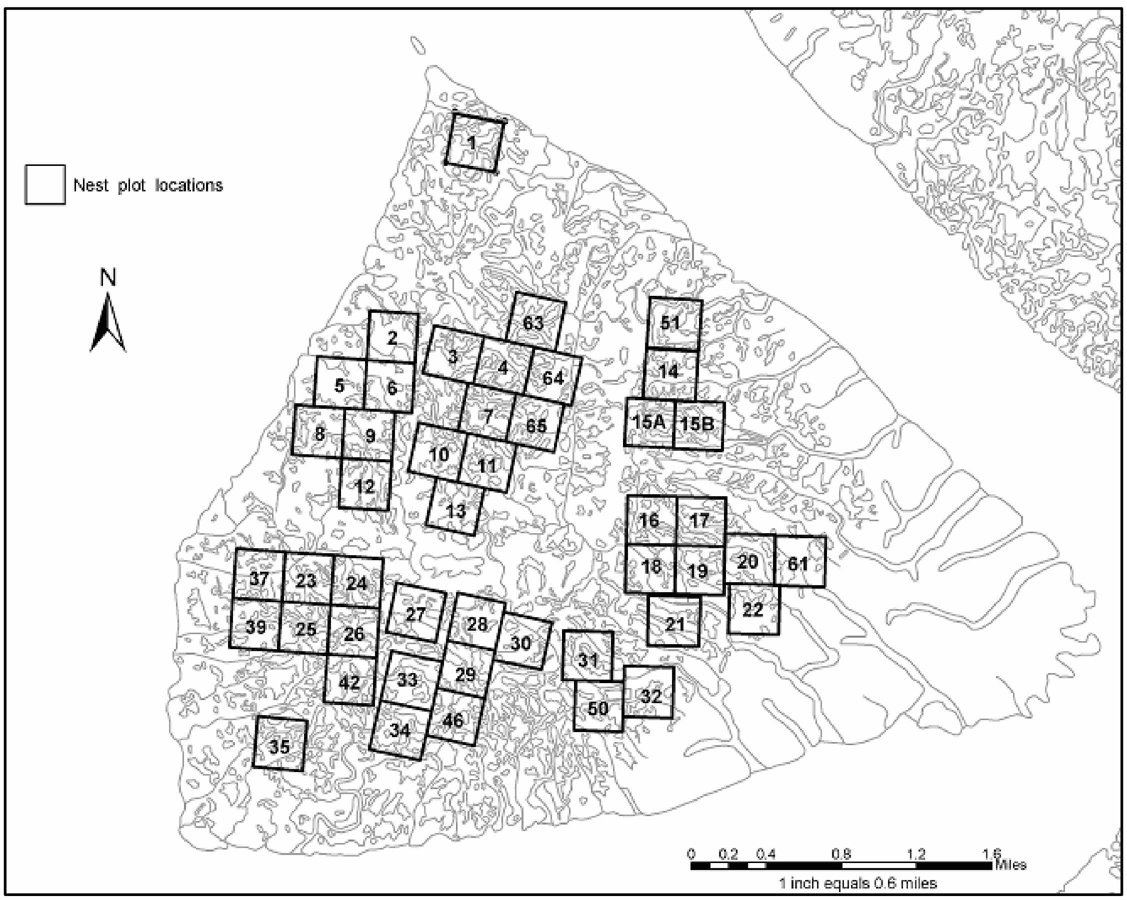

Figure 2. Location of long-term spectacled eider plots (n=48) on Kigigak Island, Yukon Delta National Wildlife Refuge, Alaska. Plots 66 and 68 are not shown (66 is east of 11 and 68 is east of 13).

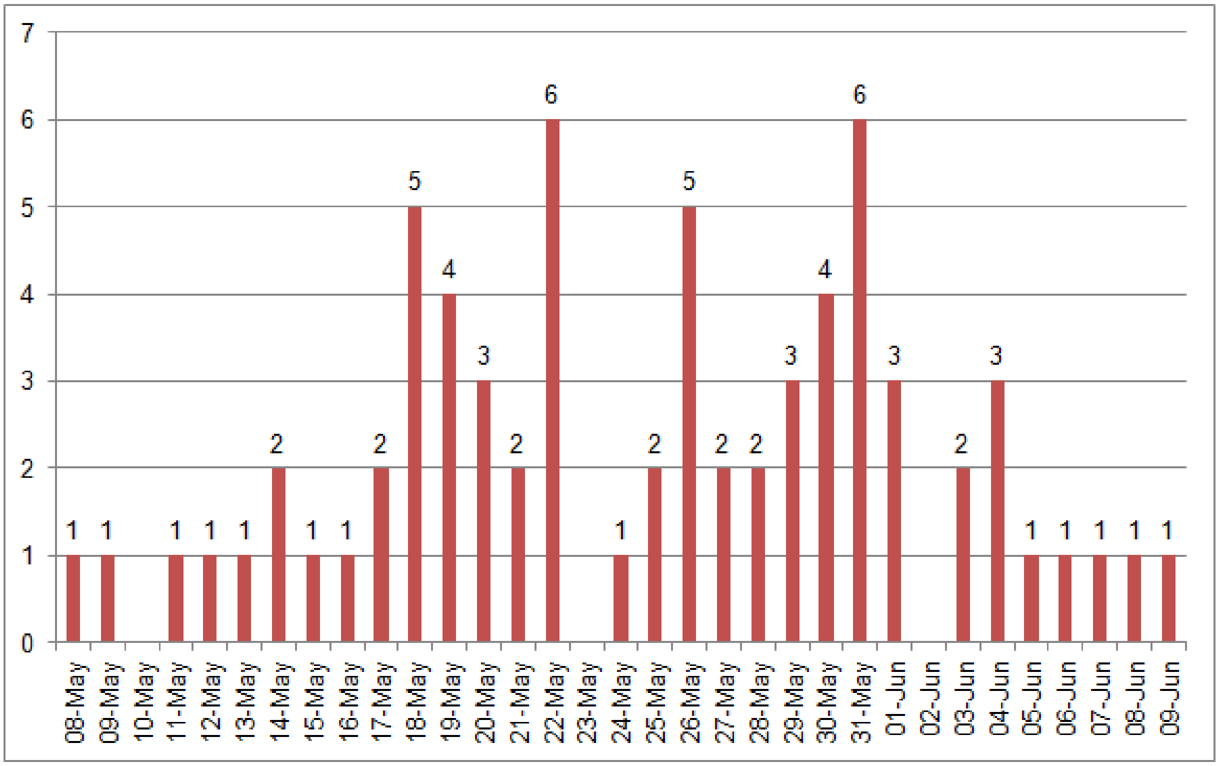

Figure 3. Estimated nest initiation dates for spectacled eider nests on Kigigak Island, Yukon Delta NWR, AK in 2015.
[a] Estimates assume an incubation period of 24 days and a laying rate of one egg per day.
[b] Two outliners are excluded from this chart (18 June & 20 June).

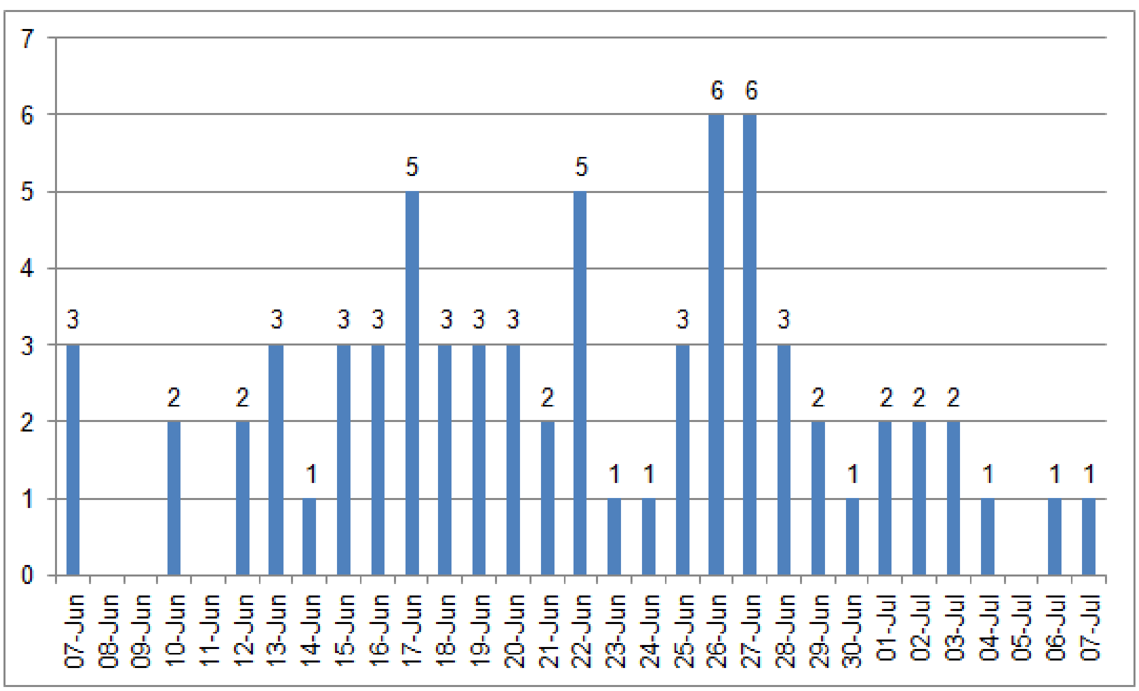

Figure 4. Estimated hatch dates for spectacled eider nests on Kigigak Island, Yukon Delta NWR, AK in 2015.
[a] One outliner is excluded from this chart (14 July)

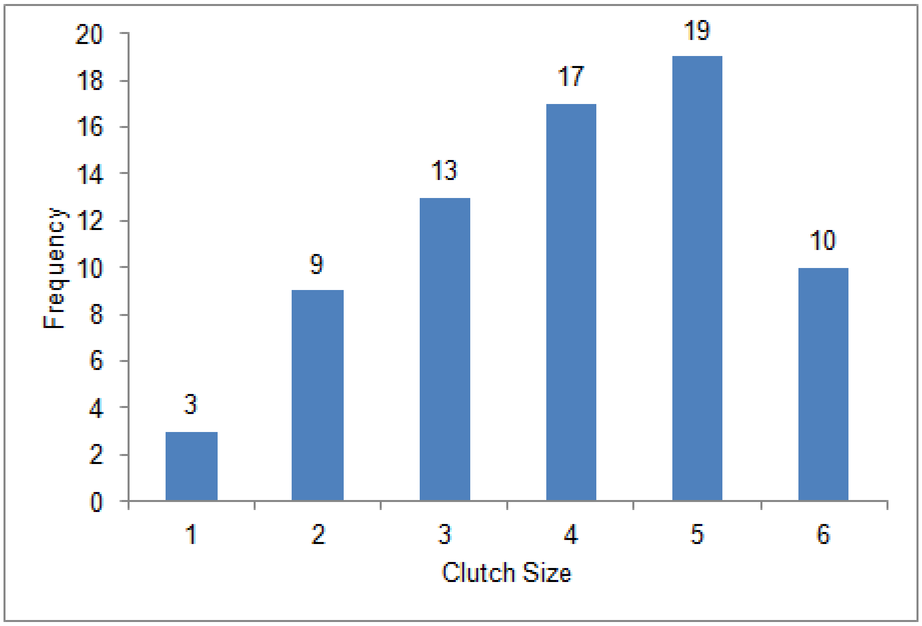

Figure 5. Clutch size frequencies for spectacled eider nests on Kigigak Island, Yukon Delta NWR, AK in 2015

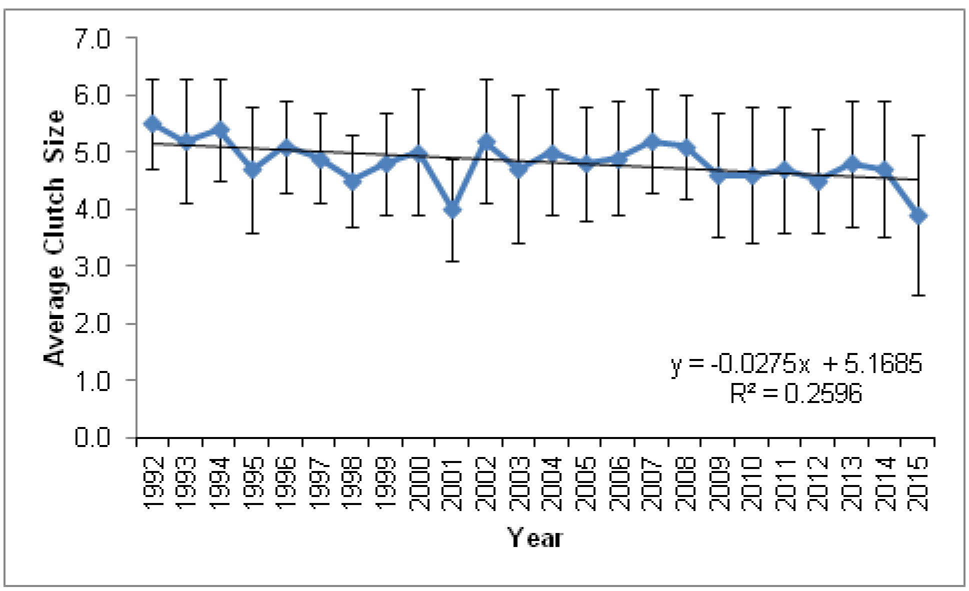

Figure 6. Estimated mean clutch size for spectacled eiders nesting on Kigigak Island. Includes 1992-2015. Error bars represent standard deviation occurring within each year.

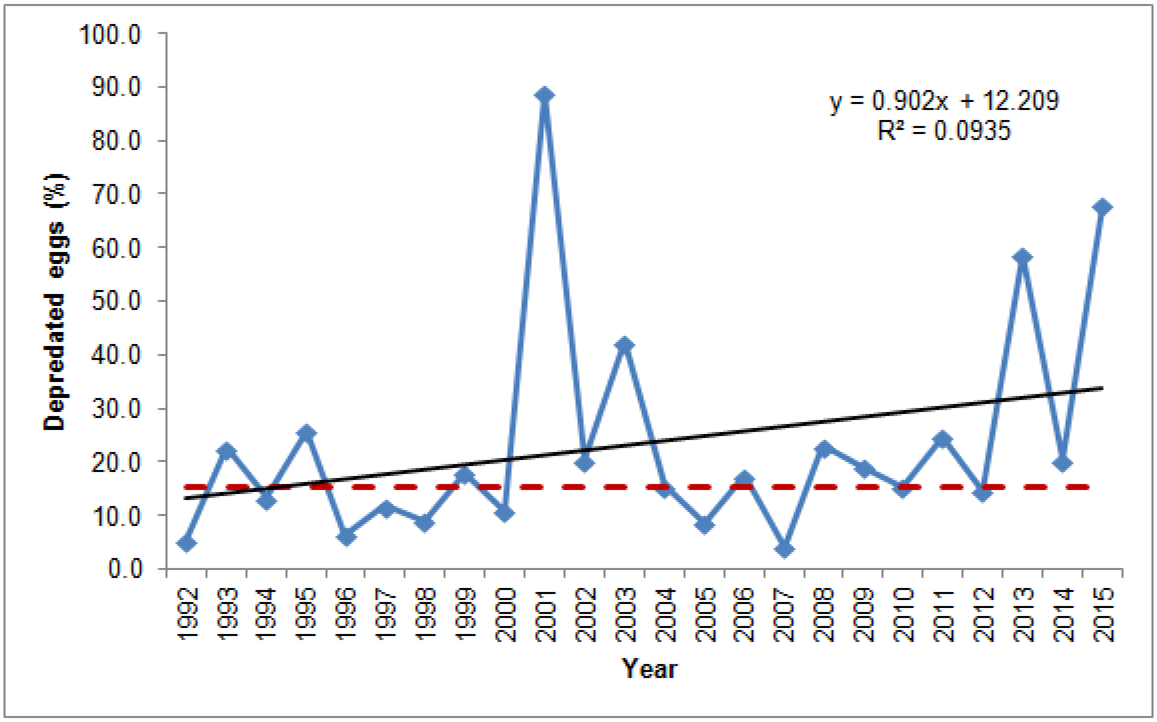

Figure 7. Spectacled eider egg depredation occurring on Kigigak Island. Data includes 1992-2015. 2001, 2003, 2013 and 2015 represent years of high nest failures. Solid black line represents best-fit trend line; however this line was influenced by 2001, 2003, 2013 and now 2015. Red-dashed line represents average percent of eggs depredated (15.3%) excluding outlier years (2001, 2003, 2013 and 2015).

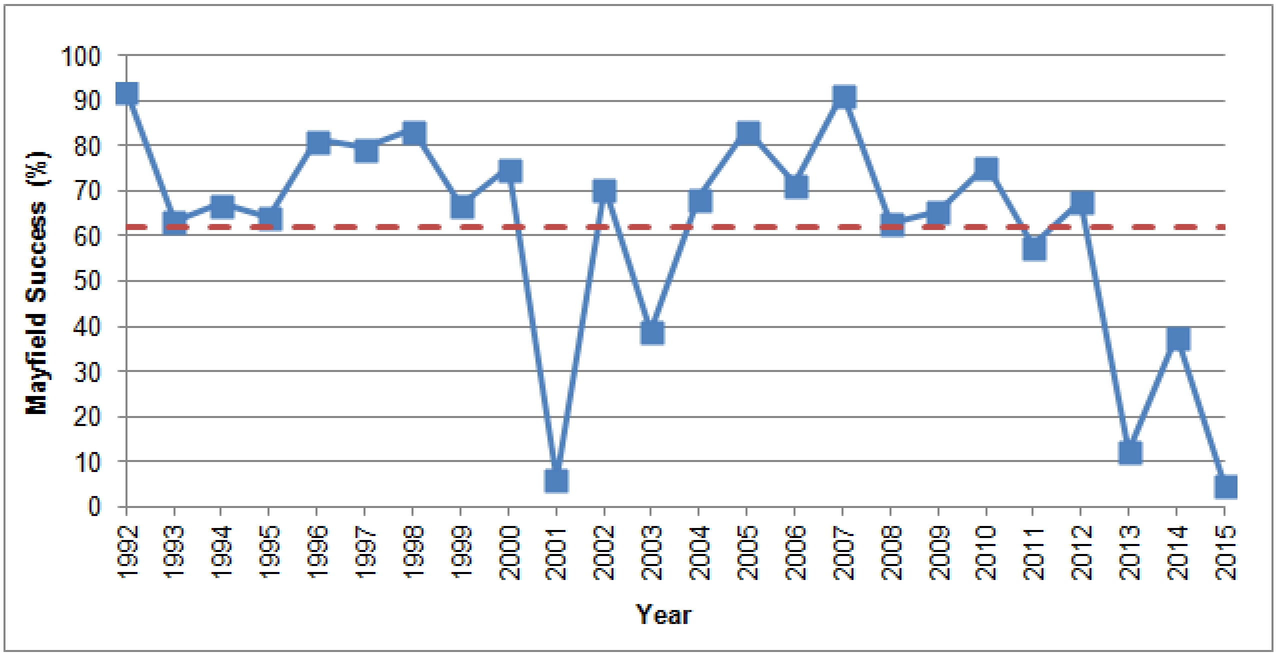

Figure 8. Yearly estimate of Mayfield Nest Success (%). Estimates exclude nests whose fates were suspected of being influenced by visitor impact, specifically trapping. All estimates were calculated using the model of Dinsmore et al. (2002). The red dashed line represents the long-term average (62.1%).

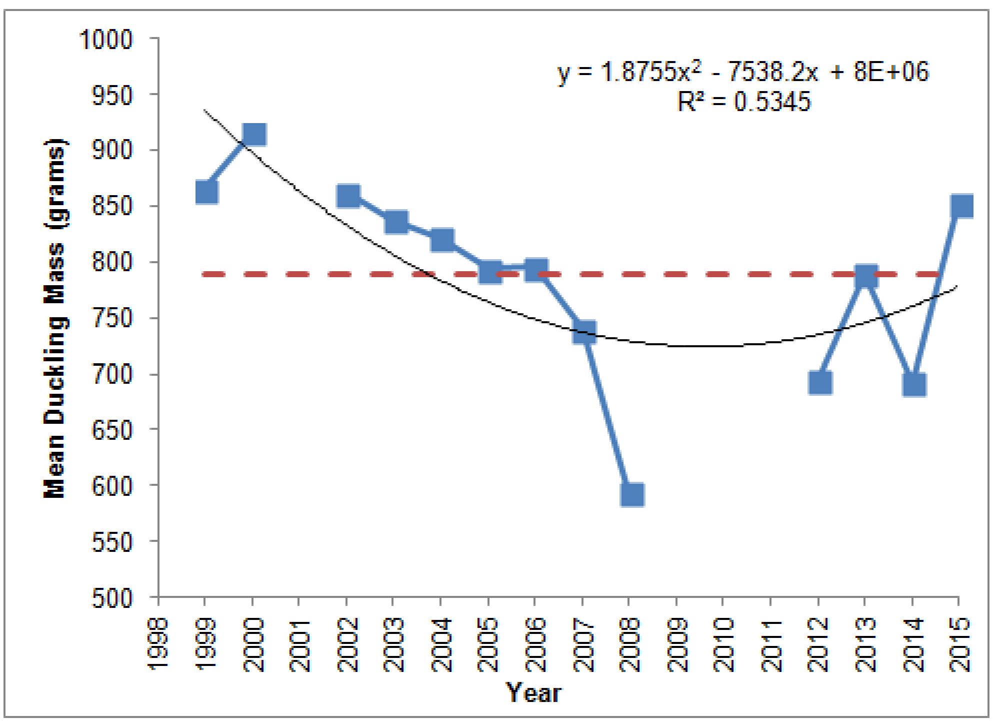

Figure 9. Average body mass (g) of ducklings at 34 days of age. Years include 1999-2008, and 2012-2015. The best fit trend line was a polynomial curve with an r^2 value of 0.62 (black line). Red-line represents average in body mass of ducklings (787.9 g).