

Post-breeding distribution of Long-tailed Ducks *Clangula hyemalis* from the Yukon-Kuskokwim Delta, Alaska

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Breeding populations of Long-tailed Ducks *Clangula hyemalis* have declined in western Alaska, particularly on the Yukon-Kuskokwim (Y-K) Delta, and the species is currently considered a species of particular concern by the U.S. Fish & Wildlife Service in Alaska. Potential factors that may have contributed to this decline that occurred away from the breeding grounds could not be considered since moulting and wintering areas for this population were unknown. A study was conducted in 1998 and 1999 to locate the moulting and wintering areas of the Y-K Delta breeding population. VHF and satellite transmitters were deployed to identify areas used by moulting birds. Based on the locations identified by satellite telemetry, aerial surveys were flown to locate birds marked with VHF transmitters, then low-level aerial surveys were designed and conducted to determine the number of birds using these and adjacent areas. Moulting locations of 54 marked female Long-tailed Ducks were identified: 13 marked females were found in wetlands and large lakes on the Y-K Delta, 11 in coastal lagoons at St Lawrence Island, Alaska, and two along the coast of the Chukotka Peninsula, Russia. A autumn staging area was identified along the east coast of the Chukotka Peninsula which was used by seven of 10 birds with satellite transmitters providing locations during that period. Birds wintered in coastal waters of the North Pacific Ocean north of 50°N and between 150°E and 130°W. The wide distribution of birds in winter suggests little probability of a single factor in winter contributing to the decline.

Key Words: moult distribution, satellite telemetry, VHF telemetry, winter distribution

Many species of waterfowl migrate from their breeding grounds to moulting areas (moult migration), where individuals become flightless and regrow primary feathers [Salomonsen 1968]. All species of sea ducks (Mergini) undergo such a moult migration [Owen & Black 1990]. Separation of nesting and moulting areas is believed to reduce competition with adult females and ducklings for food resources on the breeding grounds, provide safety from predation during this vulnerable period and provide access to areas with an abundance of available, high quality foods [Salomonsen 1968]. The locations and timing of moult (flightless period) can vary depending on breeding phenology, breeding location, age, sex and reproductive status [Joensen 1973; Frimer 1994; Petersen *et al.* 1999]. In Long-tailed Ducks *Clangula hyemalis*, some individuals become flightless on their breeding grounds, occurring either singly or in small flocks, while others migrate to distant coastal lagoons and large lake areas and undergo the primary moult in large aggregations [Salomonsen 1968; King 1973; Bergman *et al.* 1977; Derksen *et al.* 1981; Johnson 1985; Johnson & Herter 1989]. Descriptions of the timing and patterns of migratory movements throughout the annual cycle are essential for understanding potential factors influencing population dynamics.

Breeding Long-tailed Ducks in Alaska are considered a species of particular concern by the U.S. Fish &

Wildlife Service [1999] because of long-term declines of breeding populations [Hodges *et al.* 1996], particularly in western Alaska. One documented factor contributing to the decline of these breeding populations includes lead poisoning on the nesting grounds [Flint *et al.* 1997]; however, problems on the moulting and wintering areas where birds concentrate may also have contributed to this decline. Recently, an epizootic viral outbreak caused mortality of Long-tailed Ducks moulting along the Beaufort Sea [Hollmén *et al.* 2003]; however, the breeding origin of this moulting population is unknown. Further, it is unknown if similar mass mortalities may be occurring at other moulting areas. Thus, evaluation of potential problems for these breeding populations during the non-breeding season necessitates identifying moulting and wintering areas.

Moult and wintering distribution information of Long-tailed Ducks in western Alaska is based on a study of birds ringed during their moult at Takslesluk Lake (61°00'N, 162°85'W), Alaska [King 1973]. King's [1973] results suggested that the breeding origin of these moulting birds was primarily in Russia and that they wintered in the Bering Sea and Sea of Okhotsk. Moulting areas of Long-tailed Ducks that nested in western Alaska on the Yukon-Kuskokwim (Y-K) Delta, however, were unknown. The primary objectives of this study were to identify moulting areas of adult female Long-tailed Ducks nesting on the Y-K Delta

and determine the numbers of birds at these areas. A secondary objective was to identify staging and wintering areas.

Methods

Nesting female Long-tailed Ducks were marked at four locations along the coastal fringe of the Yukon Delta National Wildlife Refuge, Alaska [Figure 1], within the area identified to have a declining breeding population [U.S. Fish & Wildlife Service 1999]. These marking sites were along the lower Kashunuk River (61°32'N, 165°60'W), near the Aphrewn River (61°10'N, 165°30'W), near the Aknerkochik River (61°12'N, 165°14'W) and at Kigigak Island (60°83'N, 165°00'W) [Figure 1]. Nests of Long-

tailed Ducks were located during concurrent studies of Spectacled Eiders *Somateria fischeri* in these areas.

A combination of satellite transmitters and VHF (radio) transmitters was used to identify areas frequented by adult female Long-tailed Ducks after they left their nesting areas. Satellite transmitters were surgically implanted in adult females, five on 17 June 1998 (lower Kashunuk River) and nine on 16-17 June 1999 (lower Kashunuk River and Kigigak Island), using the technique developed by Korschgen *et al.* [1996] and refined for sea ducks by D. Mulcahy (pers. comm.). Each satellite transmitter weighed about 35g and was programmed to transmit signals at 60-second intervals for a six-hour time period every 73 hours throughout an expected battery life of about 700 hours

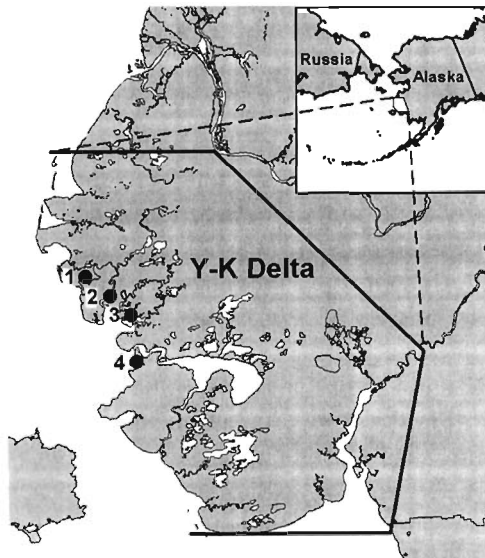


Figure 1. Marking locations of adult female Long-tailed Ducks and area surveyed on the Yukon-Kuskokwim Delta, Alaska. 1 - lower Kashunuk River; 2 - Aphrewn River; 3 - Aknerkochik River; 4 - Kigigak Island. Aerial survey area is bordered by the black margin.

[June through March]. Data were received through the ARGOS data collection and location system in Landover, Maryland (Service Argos 2001), and complete data tapes were purchased monthly. Preliminary data sets were obtained daily. Preliminary locations were limited to a nine day period, but provided an 'instant' (within two hours of transmitting) fix on birds with satellite transmitters. Locations were determined by selecting the highest quality locations or by the redundancy of lower quality locations. A single, final accepted location for each six-hour time period for each individual was based on location quality and redundancy and determined from the final data tapes (Petersen *et al.* 1995, 1999; Petersen & Flint 2002). Sample sizes of ducks with satellite transmitters varied throughout the year because of temporary or permanent transmitter failure (Petersen & Flint 2002).

Twenty-six 15g VHF transmitters, each with an estimated battery life of 60 days, were anchored subcutaneously (Pietz *et al.* 1995) on the backs of nesting adult females between 17 June and 3 July 1998. Birds with VHF transmitters were located on the Y-K Delta from aircraft flown at 350-1,500m (telemetry surveys) within a 43,270km² area that extended south of 62°00'N and to the coast west of 163°50'W (**Figure 1**). Subsequently, 16 very large lakes and lake complexes that were previously identified as supporting moulting birds (King 1973), where marked ducks (both VHF and satellite transmitters) were located, and where moulting ducks

were suspected to occur were surveyed in 1998 and 1999 at 30-50m (low-level surveys). Surveys were conducted weekly as weather allowed; seven telemetry and seven low-level surveys were conducted between 14 July and 22 August 1998. Birds within 200m of one side of the aircraft were counted by a single observer.

St Lawrence Island was also surveyed on 11 August 1998 and 15 August 1999 for VHF transmitters, and coastal areas of the island were searched to locate additional flocks. Areas along the Chukotka Peninsula where birds marked with satellite transmitters occurred were not surveyed.

Although the duration of flightlessness of an individual Long-tailed Duck was unknown, daily movement was assumed to be restricted to short distances within a wetland system, and the duration of flightlessness was assumed to be similar to that of other waterfowl of similar size, about 21-28 days (Hohman *et al.* 1992). An individual marked with a satellite transmitter was considered flightless when movements between locations were <5km for more than 21 consecutive days. Based on the movement data from birds marked with satellite transmitters (this study) and dates on which birds were found flightless in other years (King 1973), Long-tailed Ducks with VHF transmitters that were located between 26 July and 1 September were assumed to be at their moulting areas.

An area was identified as a staging location if one or more individuals were present for at least one week during

migration. Wintering areas were defined as locations where birds were present by 1 December and subsequently confirmed present by three or more accepted locations.

Results

Moult

Moulting areas (**Figure 2**) for 13 of 14 individuals with satellite transmitters (10.6 ± 1.30 S.E. locations/bird) were determined; one bird died 15-18 days after implantation. Birds arrived at moulting areas in mid to late July and remained there into September (**Table 1**). Probable moulting areas for 11 of 26 adult females marked with radio transmitters were determined in 1998 (**Figure 2**); one bird was found dead 10 days after its radio was attached, nine birds were found only before the moulting period and five birds were never relocated.

Six birds with satellite transmitters were located during their moult at St Lawrence Island, Alaska, and five on the Y-K Delta. Five individuals with radio transmitters in 1998 were located on St Lawrence Island and seven on the Y-K Delta. Of areas surveyed for both types of transmitters, there was no significant difference ($\chi^2=0.381$, *d.f.*=1, *n.s.*) between transmitter type and moulting location. Two birds with satellite transmitters moulted along the Chukotka Peninsula, Russia.

The median distance that marked birds moved from their nest site to their

moult location was 19.5km ($n=12$, range 2.6-147km) for birds remaining on the Y-K Delta, 323km ($n=11$, range 280-409km) for birds that moved to St Lawrence Island, and 585km and 625km for the two birds that moulted along the Chukotka Peninsula.

Numbers of birds estimated from aerial surveys at lagoons along St Lawrence Island ranged from 620 (15 August 1999) to 1,030 (29 August 1998). In both years, most groups there contained few birds (median=10, range 1-500, $n=35$), but 70% of birds were in flocks of 100 or more individuals. Flock sizes of ducks located on the Y-K Delta at the 16 large lakes surveyed during late July 1998 ranged from one to 400 birds (median=2, $n=62$). Of the 1,240 birds estimated in the 26-29 July surveys, most (73%), however, were on one large lake (Dall Lake). Only six birds were detected there on 18 August.

Staging

Eight of 10 birds whose satellite transmitters provided regular locations stopped on St Lawrence Island either prior to or following moult. One staging area near the eastern Chukotka Peninsula coast (**Figure 3**) was used by seven of 10 birds whose radios functioned during autumn migration. Based on the location data, individuals were present for at least 11 days, primarily during late September to early November. Staging birds were found within 10km of the coast. Two birds were located in Bristol Bay, south of the Y-K Delta, after moult: one bird staged

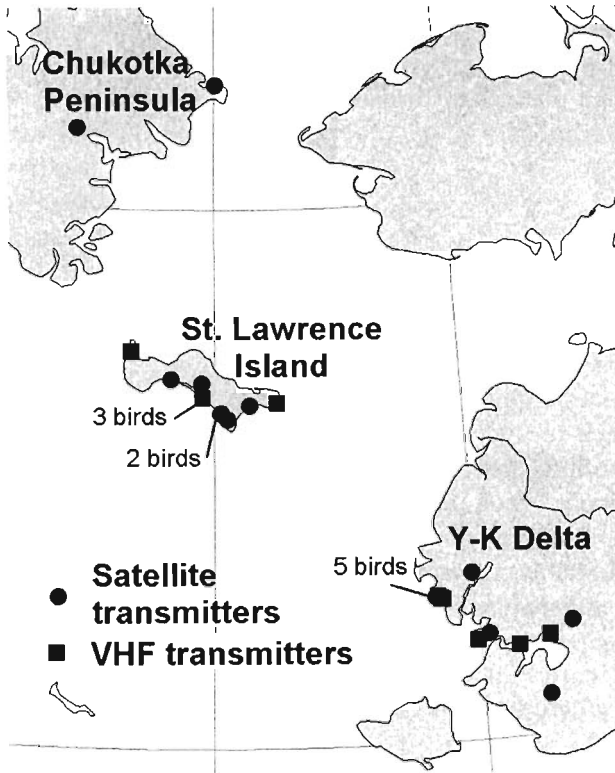


Figure 2. Locations of 25 moulting Long-tailed Ducks marked as nesting females on the Yukon-Kuskokwim Delta, Alaska. Each symbol represents one individual; however, some symbols overlap and the number of birds is noted.

Table 1. Arrival and departure dates¹ of adult female Long-tailed Ducks on the Yukon-Kuskokwim Delta marked with satellite transmitters, 1998-1999.

	n	Median	Interquartile range	Earliest	Latest
Arrived moult site	13	23 July	19 July-26 July	17 July	3 August
Departed moult site	12	8 Sept	1 Sept-27 Sept	20 August	5 Oct
Arrived winter area	8	1 Nov	27 Oct-12 Nov	22 Oct	26 Nov

¹Dates represent minimums since locations were not determined on consecutive days and are based on first [arrived] and last [departed] recorded locations at moulting and wintering areas.

near the eastern Chukotka Peninsula coast as well as in Bristol Bay, one moved >100km between consecutive locations and no staging area was identified. Three birds provided insufficient data during the staging period to identify staging areas.

Winter

Birds arrived at wintering locations in October and November (Table 1) and remained there until the last locations were received (23 December to 20 March). Six individuals provided sufficient location data to identify their wintering areas. All marked females win-

tered at different locations, and all were in coastal waters (Figure 3). None of the locations from two other birds known to be alive in winter met the strict criteria for acceptance; however, examination of lower quality locations suggested that these two birds wintered in coastal waters of southeast Alaska and British Columbia (Figure 3). Five additional individuals were known to be alive throughout the winter; however, no locations could be determined.

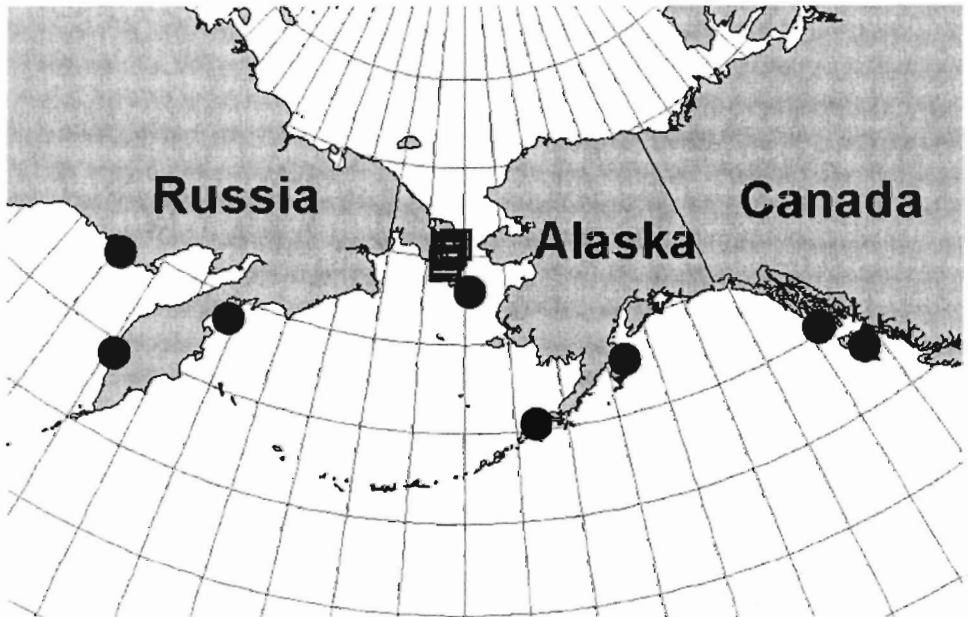


Figure 3. Location of Chukotka Peninsula staging area [squares] and wintering areas [circles] used by Long-tailed Ducks marked as nesting females on the Yukon-Kuskokwim Delta, Alaska.

Discussion

Moulting

Failed breeding females from the Y-K Delta population used the distribution strategies of moult previously described for Long-tailed Ducks (Salomonsen 1968). Individuals and small groups of Long-tailed Ducks were found within the breeding grounds on the Y-K Delta and larger aggregations (100s) in large, freshwater lakes on the Y-K Delta and in freshwater lakes and coastal lagoons at St. Lawrence Island. Moulting migrations ranged from only a few to several hundred kilometres, and birds probably mix (see King 1973) with Long-tailed Ducks from other breeding areas during the moult.

None of the areas surveyed in 1998-1999 contained tens of thousands of moulting birds similar to the numbers reported in Beaufort Sea and Chukchi Sea lagoons and large lakes in northern Alaska (Bergman *et al.* 1977; Portenko 1981; Derksen *et al.* 1981; Johnson 1985; Johnson & Herter 1989). Rather than a single habitat or location, a mix of estuaries and coastal wetlands on the Y-K Delta and St Lawrence Island is important for moulting female Long-tailed Ducks that nest on the Y-K Delta. The importance of lagoons along the Chukotka Peninsula for birds from the Y-K Delta breeding population may have been underestimated, as use by birds with VHF radio transmitters could not be assessed. However, given the

conclusion by King (1973) that most of the moulting birds marked on the Y-K Delta were from the Siberian breeding population, it seems likely that few Y-K Delta birds would moult on the western side of the Bering Sea.

The distribution pattern observed for moulting Long-tailed Ducks differs from that reported for Spectacled and Common *S. mollissima* Eiders nesting on the Y-K Delta. Although moulting locations differed between these two species, most nesting females moulted together in the same general area away from the breeding grounds: Spectacled Eiders in eastern Norton Sound, north of the Y-K Delta (Petersen *et al.* 1995, 1999), and Common Eiders along the coast of the Y-K Delta (Petersen & Flint 2002).

Staging

St Lawrence Island is an important area used by Long-tailed Ducks breeding on the Y-K Delta. After moult was completed, eight of 10 birds carrying satellite transmitters and several birds marked with VHF transmitters went to St Lawrence Island for a period of time; however, several stayed for just a few days and thus did not meet the criteria for staging in this area. Identification of the staging area used by adult female Long-tailed Ducks along the eastern Chukotka Peninsula is based on a small sample size ($n=10$), thus the magnitude of use of this area by birds nesting on the Y-K Delta is uncertain. Although these staging areas may only be used for a short period of time, such

habitats may be important for birds to put on reserves in preparation for autumn migration and winter (Leafloor *et al.* 1996).

Wintering

The population of Long-tailed Ducks that nest on the Y-K Delta dispersed widely in winter along the northwest coast of North America and the northeast coast of Russia. Long-tailed Ducks have been reported wintering in all areas used by the birds marked for the present study (Gabrielson & Lincoln 1959; Fay 1961; King 1973; Bellrose 1976; Palmer 1976; Portenko 1981). No association between nesting and wintering areas for Long-tailed Ducks from the Y-K Delta was detected, other than that all wintering areas were in the North Pacific. Common Eiders from different breeding populations winter in specific areas with little overlap (Petersen & Flint 2002). Spectacled Eiders also winter in a confined area, but birds from multiple breeding populations are mixed in this single, discrete area in the Bering Sea (Petersen *et al.* 1999). If the pattern of dispersed wintering areas of Long-tailed Ducks nesting on the Y-K Delta holds for the species, then wintering populations would be expected to contain a mix of birds from different breeding areas, and breeding populations would include birds from different wintering areas. If, as with some other waterfowl species, pair formation occurs in winter (Owen & Black 1990), when populations are apparently mixed, gene flow among

breeding areas seems likely. Accordingly, managers must be careful in defining specific breeding and wintering populations. Since the Y-K Delta breeding population disperses widely during winter, it is unlikely that perturbations resulting in Long-tailed Duck mortality at a single staging or wintering area have had a major impact on this breeding population.

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