

USE OF IMPLANTED SATELLITE TRANSMITTERS TO LOCATE SPECTACLED EIDERS AT-SEA¹

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Population estimates of Spectacled Eiders (*Somateria fischeri*) on the Yukon-Kuskokwim Delta (YKD), Alaska, suggest that by 1992 the number of birds nesting on this major nesting area had declined to 1,721 pairs, 4% of that estimated in the 1970s (Stehn et al. 1993). Consequently, Spectacled Eiders were listed as threatened under the Endangered Species Act. As nesting habitats for this species are believed to have changed little over the past 100 years, hypotheses concerning the cause of this decline include factors away from nesting areas. The non-nesting distribution of this eider is unknown, but birds are believed to molt and winter in the Bering and Chukchi seas (Dau and Kistchinski 1977). Systematic aerial surveys to locate areas where birds concentrate are expensive because of the vast area to be surveyed and dangerous because of restricted daylight and extreme weather conditions. Surveys from ships along the ice margin in the Bering Sea failed to locate concentrations of birds (Irving et al. 1968, Everett et al. 1989). We initiated a study to determine if at-sea areas used by Spectacled Eiders could be identified using satellite telemetry.

MATERIALS AND METHODS

Satellite platform transmitting terminal (PTT) transmitters have proved successful in locating large birds in remote areas (i.e., Davis and Miller 1992, Weimerskirch et al. 1993, Ely et al. 1993). However, transmitter packages were large (>45 g) and attached by back-pack harness (Jouventin and Weimerskirch 1990, Nowak 1991), glued to the feathers (Davis and Miller 1992), or attached to neck collars (Ely et al. 1993). External transmitters placed on diving ducks have resulted in deleterious changes in their behavior (e.g., Woakes and Butler 1975, Perry 1981). Because of this behavioral response, we used the implant technique developed by C. E. Korschgen et al. (National Biological Survey, P.O. Box 2226, La Crosse, Wisconsin) to deploy PTT transmitters on Spectacled Eiders. This involved placing the transmitter in the peritoneal cav-

ity of the bird with the percutaneous antenna exiting caudally. We used a transmitter 10 mm deep, 55 mm long, and 35 mm wide that weighed 30 g (<3% body weight) (Telemetry 2000®, Columbia, Maryland) that was encased in a hermetically sealed package with a teflon-coated multistrand stainless-steel antenna. Each transmitter was programmed and calibrated to provide body temperature and remaining battery potential with each transmission.

We captured adult Spectacled Eiders between 1 June and 29 July 1993, on the lower Kashunuk River (164°35'W, 61°20'N), YKD, Alaska. We used mist nets to catch birds before and after nesting and bow traps when hens were incubating. Adult males were captured on 1 June ($n = 4$); adult females on nests were captured on 22–23 June ($n = 3$), and females with broods on 28–29 July ($n = 5$). Birds were held in a large dog kennel with water available to them for 1–2 hr post surgery. Eiders were then released on a lake where they could be observed undisturbed from camp or, if captured with a brood ($n = 5$), on the lake where the brood was captured. Most birds ($n = 6$) remained on the pond overnight and into the next day. One bird remained on the pond two nights. We observed no direct mortality or abnormal behavior attributable to the surgery after their release.

PTT transmitters were programmed to transmit for 6 hr every 72 hr or for 6 hr every 120 hr. These signals were analyzed using the Argos® (Landover, Maryland) Data Collection and Location System and a Telonics® Local User Terminal (LUT). The transmitter signals were received by polar-orbiting NOAA weather satellites, and locations were calculated from Doppler-shifts of the signal frequency (Fancy et al. 1988, Harris et al. 1990).

We used Argos Standard and Animal-Tracking data processing services (Harris et al. 1990). Argos reports the precision of Standard locations to be typically <1 km; precision of Animal-Tracking locations is variable and acceptance or rejection of the location is at the discretion of the investigator. We used only one location per 6-hr transmission period for our analysis. The location for a single day from a series of Animal-Tracking locations was determined from an average of three or more Animal-Tracking locations if they were within the same 10° block of latitude and longitude. Single Animal-Tracking locations were rejected if not confirmed by Standard locations in previous or subsequent days. LUT locations were considered accurate

¹ Received 13 May 1994. Accepted 14 September 1994.

TABLE 1. Frequency of PTT information from 12 Spectacled Eiders, 1993. All transmitters were implanted abdominally with external antennas.

PTT	Sex	Hours on/off	Duration functioned	No. days with locations		
				Maximum	Actual (%)	Accepted (%)
A	Male	6:66	112 days	37	35 (94.6)	33 (94.3)
B	Male	6:66	123 days	41	38 (92.7)	21 (55.3)
C	Male	6:114	123 days	24	23 (95.8)	15 (65.2)
D	Male	6:114	157 days	31	22 (71.0)	11 (50.0)
E	Female	6:66	165 days	55	27 (49.1)	23 (85.2)
F	Female	6:66	144 days	48	41 (85.4)	38 (92.7)
G	Female	6:66	94 days	32	31 (96.9)	27 (87.1)
H	Female	6:66	97 days	32	12 (37.5)	3 (25.0)
I	Female	6:66	29 days	12	12 (100.0)	4 (25.0)
J	Female	6:66	52 days	17	14 (82.4)	5 (29.4)
K	Female	6:66	120 days	41	17 (41.5)	10 (58.8)
L	Female	6:66	152 days	50	41 (82.0)	34 (82.9)
Total				420	313 (74.5)	224 (71.2)

only if they were within the general area of other locations or confirmed by subsequent location data.

RESULTS

Twelve transmitters (four males and eight females) provided a total of 224 locations (Table 1); 52 (23.2%) were Standard locations. PTTs provided location data for 29 to 165 days (median 123 days). Locations determined at 3- and 5-day intervals provided sufficient data to determine general areas used by males and females during their respective molting periods and to locate a general region used by males and females in early winter (Figs. 1A, B). Location data of PTTs ($n = 7$ females) indicated a concentration of eiders in Nor-

ton Sound. This was confirmed by an aerial survey during which several hundred birds were located in the area identified from the PTT data (W. Larned and B. McCaffery, pers. comm.). Probable concentration areas along the eastern Chukotka Peninsula coast in summer ($n = 4$ males) and south of St. Lawrence Island in early winter ($n = 5$ females, 1 male) (Figs. 1A, B) could not be surveyed due to political constraints. However, repeated location data over an extended period of time suggest these are also areas where eiders concentrate.

DISCUSSION

The quantity of movement data was limited by the life of the transmitter battery. Because Spectacled Eiders

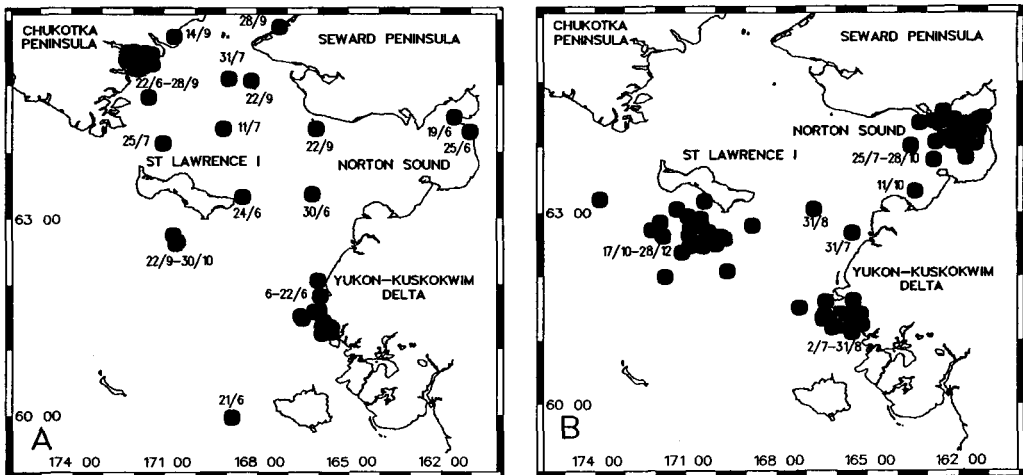


FIGURE 1. At-sea locations of Spectacled Eiders marked on the Yukon-Kuskokwim Delta, Alaska, as indicated by satellite PTT transmitters. Dates at locations are day/month. A—Adult males with radios functioning from 6 June 1993 to 30 October 1993. B—Adult females with radios functioning from 2 July 1993 to 28 December 1993.

are a relatively small bird ($\geq 1,000$ g), small transmitters were required which limited the size of the battery; battery life limited the duty cycle of the PTT. Adult male Spectacled Eiders are only accessible to be captured on the YKD from 15 May to 20 June. To locate areas used by adult males in autumn, winter, and spring, transmitters need to be functional for at ≥ 10 months. Female Spectacled Eiders nesting on the YKD may remain on nesting/brood rearing areas through July (birds with unsuccessful nests) to early September (birds with young that fledge), thus transmitters need to function for ≥ 8 months. Programming PTTs involves an inherent trade-off between battery life and transmission frequency.

Spectacled Eiders that migrated from their capture site on the YKD remained in the same area at-sea for 4–6 weeks, indicative of a possible flightless period, and then migrated to potential wintering areas. Once birds left the nesting area, no direct visual observations were possible. However, based on their movements and body temperatures, birds were alive and probably migrated normally. Implanted PTT transmitters are an effective tool for locating concentrations of eiders in remote areas.

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