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EFFECT OF IMPLANTED SATELLITE TRANSMITTERS ON THE NESTING BEHAVIOR OF MURRES[1]

PAUL M. MEYERS, SCOTT A. HATCH[2] AND DANIEL M. MULCAHY
Biological Resources Division, USGS, Alaska Science Center, 1011 E. Tudor Rd., Anchorage, AK 99503

Abstract. We implanted 6 Common Murres (*Uria aalge*) and 10 Thick-billed Murres (*Uria lomvia*) with satellite transmitters and compared subsequent presence at the colony, nesting status, and provisioning to a control group that underwent a simple surgical procedure. In the 10 days following implantation, we resighted 10 of 11 control birds at the colony and 6 of 16 implanted birds. Of the birds that returned, 7 of 10 control birds retained breeding status, whereas zero of six implanted birds retained breeding status. We conclude that abdominal implantations alter murre nesting behavior.

Key words: implantation, Murre, nesting behavior, satellite transmitter, seabird, Uria aalge, Uria lomvia.

The advent of satellite transmitters small enough for use on seabirds has generated many recent studies of seabird foraging and migration (Weimerskirch and Robertson 1994, Falk and Møller 1995, Peterson et al. 1995). Satellite telemetry offers a way to track individual animals anywhere in the world without the logistics involved in conventional VHF telemetry. Secure attachment of any device without causing behavioral changes, however, has been a persistent problem for biologists working with diving birds (Wilson et al. 1986, Wanless et al. 1988,1989). Abdominal implantation (Korschgen et al. 1984) is an alternative to various externally mounted telemetry packages and has been used successfully in diving birds (Peterson et al. 1995). Implantation results in no appreciable increase in the bird's surface area, does not compromise feathers, and leaves no chance of the bird losing the transmitter. However, no information is available on the behavioral effects of implantation. Interpretation of any telemetry study assumes that normal behavioral patterns are retained or that alterations in behavior can be adequately addressed. To assess possible changes in behavior, we implanted 16 murres with satellite transmitters and compared implanted birds and control birds on returns to the colony, nesting status, and returns with fish.

METHODS

Cape Lisburne (68°53′N, 166°04′W) is on the Chukchi Sea about 60 km north of Point Hope on Alaska's northwest coast. This area supports approximately 100,000 murres and is the northernmost Pacific murre colony of its size. Black-legged Kittiwakes (*Rissa tridactyla*) also nest there in large numbers. Other seabirds include Pelagic Cormorants (*Phalacrocorax pelagicus*), Black Guillemots (*Cepphus grylle*), Glaucous Gulls (*Larus hyperboreus*), and Horned Puffins (*Fratercula corniculata*).

Beginning 2 August 1996, we captured 9 Common Murres (*Uria aalge*) and 22 Thick-billed Murres (*Uria lomvia*) with a light cable noose attached to a 9-m telescoping fiberglass pole. We took nesting murres from lower ledges at the east end of the colony in areas that were accessible by foot from Cape Lisburne radar station. Capture areas consisted of three ledge complexes ≥ 0.5 km apart. The birds were transported in burlap bags to the station, where we banded them with colored tarsus bands. To assign birds to the implant or control group, we chose a bird at random, anesthetized it, and surgically sexed it. Our primary goal was to obtain an even sex ratio for both species in the transmitter group. Upon sexing a bird, it was assigned to a group depending upon the number of that sex and species already in the transmitter group. Because the first few birds were automatically assigned to the treatment group, control birds averaged longer times in the holding bins than implanted birds.

Experimental birds were sexed and implanted (Korschgen et al. 1984), and control birds were sexed and allowed to recover from anesthesia. For implantation, the transmitter was inserted into the air-sac cavity through a 4-cm mid-ventral, vertical incision. The antenna exited dorsally just above the tail and to the right of center, so that the antenna pointed upward when the bird was on the water. The antenna base was sutured to the skin at the exit point to help stabilize the transmitter. Birds were sexed by viewing the gonads with a rigid, fiber-optic endoscope inserted through the last two ribs on the left side or through the implantation incision. All surgery was performed by a veterinarian experienced in implantation techniques. Birds were released 1–3 hr after surgery. Processing time from capture to release was from 6.5–13.5 hr. We used 35-g platform transmitting terminals (PTTs) produced by Microwave Telemetry, Columbia, MD. These PTTs were rectangular and measured approximately 55 × 30 mm. Thickness was approximately 10 mm at the top and 14 mm at the base and formed a keyhole shape in cross section. The 200-mm antenna was bent at its base to form a 90° angle with the long axis of the transmitter. Transmitters averaged 3.9% of body weight.

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[2] Corresponding author. e-mail scott_hatch@nbs.gov

Beginning the day following surgery, we performed spot checks for presence of banded and transmittered birds. Each day from 5 August–14 August 1996, we conducted one 6-hr focal observation of a capture area, alternating areas each day. During the course of the study, we covered all hours of adequate daylight (06:00 to 24:00) at each capture area. We recorded arrival and departure times, nesting status, and returns with fish. Observations were done with binoculars and a spotting scope from a point that was out of the normal flight path of the birds. After each observation period, we performed spot checks of the other capture areas. A bird was considered nesting if we observed it taking over or leaving a nest, or bringing fish to a nestling. A bird was considered probably nesting if it was attending a nesting bird (e.g., standing very close, placing its bill where the chick would be) but was not actually seen taking over brooding.

For testing differences in proportions (e.g., percentage of birds resighted or still nesting after treatment), we used two-tailed Fisher's exact tests. Body measurements and other continuous variables were analyzed with two-tailed *t*-tests.

RESULTS

We implanted 16 of 31 captured murres (n = 10 Thick-billed Murres, n = 6 Common Murres). Thirteen birds were incubating, nine were attending chicks, and nine were nesting, but we could not determine nesting stage. Four of the birds suffered severe stress—three died and one was released 10 min after capture—and were excluded from the study. Three of these stressed birds, and possibly the fourth, had newly hatched chicks (≤ 3 day-old).

Average weight of treatment birds (901 g) was not significantly different (t_{25} = 0.70, P = 0.49) than average weight of control birds (882 g). Average wing length (219 mm) of the treatment birds was not significantly different (t_{25} = 1.24, P = 0.22) than average wing length (210 mm) of control birds. Processing time was longer (t_{25} = −2.52, P = 0.02) for the control birds (mean ± SD = 11.0 ± 2.3 hr) than for the implanted birds (8.9 ± 1.9 hr). We resighted significantly more control birds (10 of 11) than transmittered birds (6 of 16) (Fisher's exact, P = 0.02). Of the resighted birds, we tended to see individuals from the control group more often (3.1 ± 1.8 sightings bird^{-1}) than individuals from the implanted group (2.0 ± 1.5 sightings bird^{-1}), but the difference was not significant (t_{14} = −1.25, P = 0.23).

Of the 10 control birds resighted, 4 remained nesting and 3 probably remained nesting. Two control birds either lost or abandoned their nests, one control bird was not resighted either because it brooded continuously or it did not return to the colony, and nesting status could not be determined for another. Of the six transmittered birds resighted, none remained nesting, which was significantly fewer (Fisher's exact, P = 0.01) than birds in the control group when we included birds probably nesting. The proportions that remained nesting were not significantly different (Fisher's exact, P = 0.23) when we included only birds definitely nesting. We observed only four instances of birds returning with fish. All of these were in the control group.

The PTTs contained a temperature sensor that allowed us to track mortality. Subsequent telemetry signals indicated that 3 of the 16 implanted birds died, 7 lived and the transmitter remained active, and 6 suffered transmitter failure. Transmitter failures were recognized by a sudden loss of signal without concomitant loss of body temperature or battery voltage. The fates of these six individuals are unknown. Of the seven that remained in contact, four were resighted during observations. Of the nine that died or disappeared, two were resighted during observations. The proportions resighted were not significantly different (Fisher's exact, P = 0.30) from each other. The seven birds that lived and remained in contact stayed on the ocean, foraging northeast to northwest of the colony and remaining within about 200 km of the colony during the nesting season.

Within the treatment group, all Common Murres and all Thick-billed Murres abandoned nesting. However, 5 of 6 Common Murres returned to the colony, whereas only 1 of 10 Thick-billed Murres was resighted (Fisher's exact, P = 0.01). Within the control group, two of two Common Murres remained nesting (the third Common Murre was undetermined), and four of seven Thick-billed Murres remained nesting. Also within the control group, three of three Common Murres were resighted, and seven of eight Thick-billed Murres were resighted.

DISCUSSION

The largest difference between groups was the likelihood that birds would return to their former ledges—91% of control birds were resighted, compared to 38% of the transmittered birds. However, we may have underestimated the proportion of control birds returning, because tarsus bands were difficult to observe when the bird was brooding. Two of the control birds may have remained on the nest during entire observation periods and therefore were not recorded as present. We are reasonably certain that we did not miss any transmittered birds in this way, as antennae were clearly visible. Elimination of this potential bias could only increase the differences we observed, and therefore, not affect our conclusions.

Colony abandonment by so many of the implanted birds was unexpected. Although the proportion of resighted birds within groups was not significantly different between those that subsequently died or disappeared, power of our test was low (β = 0.29). Given that at least three individuals died within the observation period, the general health of the bird after surgery must be considered the most likely explanation for both colony abandonment and disruption of breeding by those birds that did return.

Of the murres that did return to the colony, fewer implanted birds than control birds remained nesting. Considering that control birds were removed from the nest for an even longer period of time than implanted birds, we cannot attribute nesting failure to time off the nest. Changes were likely due to the implantation procedure or to the transmitter itself. Greater nest-site fidelity was achieved in 1995 (S. A. Hatch et al., unpubl. data), when an estimated 25% of implanted murres from Cape Lisburne and Cape Thompson remained nesting. However, productivity in 1995 was higher than in 1996 (D. G. Roseneau, pers. comm.), and 1996 may have been a more stressful year.

Murres are probably the deepest diving alcid (Piatt and Nettleship 1985), and alcids in general have higher wing loads than other flying seabirds (Pennycuick 1987). Either of these factors (i.e., pressure on a new incision due to diving, or increased wing load) may have affected bird behavior. Smaller transmitters would help in both regards.

Between species, nest abandonment was similar within the treatment group, but Common Murres were more likely to return to the colony after abandoning the nest. The number of Common Murres in the control group was too small for adequate statistical analysis, but it appears that both species were equally likely to return to the colony. Differences in the likelihood of abandoning the nest cannot be determined with this sample.

Other seabirds may be better adapted than murres, both physically and behaviorally, for implantation. Spectacled Eiders *Somateria fischeri* are larger than murres ($\geq$ 1,000 g verses 896 $\pm$ 69 g) and remain inland several weeks after implantation, thus giving birds time to recuperate before the stresses of diving in a marine environment (Peterson et al. 1995). Harlequin Ducks (*Histrionicus histrionicus*) have been successfully implanted with VHF transmitters (D. Esler, pers. comm.), but the transmitters used are smaller and the depths the birds reach are probably much shallower. The effects of abdominal implantation may vary among species and also may depend upon transmitter design. Therefore, we suggest this method be assessed species-by-species. In the case of murres, we conclude that nesting behavior of implanted murres differs significantly from nesting behavior of nonimplanted murres. Data received after abdominal implantation must be interpreted with this in mind.

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CORRELATES OF CREEPING SPEED VARIABILITY IN TWO SPECIES OF TREECREEPERS[1]

TOMASZ S. OSIEJUK

Department of Animal Morphology, University of A. Mickiewicz, Szamarzewskiego 91A, 60-569 Poznań, Poland, e-mail: osiejuk@hum.amu.edu.pl

Abstract. Foraging behavior of Short-toed Treecreeper *Certhia brachydactyla* and Eurasian Treecreeper *C. familiaris* was examined to test how well it fits a simple foraging model using data on arthropod distribution on tree trunks. Field observations in general supported the model predictions. Short-toed Treecreeper crept, on average, slower than Eurasian Treecreeper. Both species crept more slowly on larger trees. Eurasian Treecreeper crept slower on thick English oaks than on thick Scotch pines. Both treecreepers moved slower when probing as compared to gleaning, which was expected as foraging technique strongly affects handling time.

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