BETALIGHTS: AN AID IN THE NOCTURNAL STUDY OF OWL FORAGING HABITAT AND BEHAVIOR

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ABSTRACT.—Due to difficulties in observing nocturnal owls, our understanding of their foraging habitat use is poor. I tested betalights used in conjunction with radio telemetry to aid in observations of foraging Boreal Owls (*Aegolius funereus*). Two betalight attachment positions were tested. Betalights attached atop backpack-mounted radio transmitters facilitated observation of owls only slightly compared to radio-marked owls without betalights observed with night vision goggles. By attaching the betalight to the radio antenna, however, it was held free of the owl's plumage and was more visible. This attachment method was not adequately tested but has potential to aid considerably in future nocturnal studies of owls.

To date the study of owl ecology has relied heavily on prey lists derived from pellet analysis and prey found at nests. Interpretation of feeding ecology, population stability, and food niche overlap data suffer because of difficulties associated with observing free-ranging nocturnal owls. Data are needed on owl foraging behavior, the structure of foraging habitats chosen by owls, and how that structure influences hunting success.

In my efforts to study habitat use by Boreal Owls (*Aegolius funereus*), I was frustrated by difficulties encountered observing nocturnally foraging owls. Thus, I sought to develop a method to aid in observing the small owls during nocturnal forays.

Betalights are pyrex capsules filled with tritium and coated internally with phosphore. Beta particles emitted by the tritium excite the phosphore, producing light. Betalights are manufactured by Saunders-Roe Developments Inc. (P.O. Box 5536, Winston-Salem, NC 27301) and have been used successfully in studies of various nocturnal mammals (Thompson 1982; Crabtree and Broome 1985). I am unaware, however, of betalights previously being used in owl studies. Herein I describe a method for using betalights in conjunction with radio-marking in owl studies and describe results of preliminary tests of the method.

METHODS

I designed a betalight system for attachment to backpack-mounted radio transmitters. My objectives in the design were to provide a secure attachment between betalight and transmitter, to reinforce the betalight to prevent breakage, and to attach the light in a visible position without hampering the owl's flight or the owl's ability to enter and leave a cavity.

Cylindrical betalights (type MH 35/g/75) measuring 11.5 mm × 1.4 mm dia were purchased from Saunders-Roe Developments, Inc. Each betalight was placed in a clear acrylic rod 15 mm × 10 mm dia, with a 13 mm × 1.5 mm dia bore centered along the long axis of the rod. The betalight was glued in place using Super Glue (Coctite Corp., Cleveland, OH 44128). Each betalight-acrylic rod package (hereafter betalight package) weighed 1 g. Two methods for attaching the betalight package to a radio transmitter were tested using a 6 g backpack style transmitter with 22 cm antenna (type MPB 1220 LD, Wildlife Materials Inc., RR 1, Giant City Road, Carbondale, Illinois 62901). Boreal Owls ranging in weight from 111–130 g carried the betalight packages.

Initially, I attached the betalight to the acrylic transmitter body with dental acrylic just above the antenna (Fig. 1). With the transmitter mounted on the bird's back, the long axis of the betalight was nearly perpendicular to the plane of the owl's back. Hereafter this method is referred to as Method I.

A second attachment method placed the betalight on the antenna about 3 cm from the transmitter body (Fig. 2). I reinforced the lower 2.5 cm of antenna base with heat shrink tubing and attached the betalight package just out from the reinforcement. The antenna was placed in a 1 mm groove cut into the acrylic rod housing the betalight (along the long axis of the rod). Epoxy glue bonded the betalight package to the antenna wire. With the transmitter mounted as a backpack on an owl, the long axis of the light was held at about 30° to the plane of the owl's back. Hereafter, this method is referred to as Method II.

Night vision goggles in conjunction with standard hand-held radio-telemetry equipment were used to monitor owls after dark. All owls marked with betalights were radio-tagged during a study of habitat use in the Frank Church-River of No Return Wilderness of central Idaho (45°23′N., 115°15′W.) in the mountains of Chamberlain Basin in seral and mature forest types of subalpine fir (*Abies lasiocarpa*) zone. All travel was restricted to foot. Three of 16 adult owls radio-tagged during the first three yrs of study carried betalight packages.

RESULTS

Three male Boreal Owls outfitted with betalights carried the betalight package a total of 11 mo. Two carried betalight packages mounted by Method I and the third by Method II. I removed the light when changing the transmitter package on the first owl

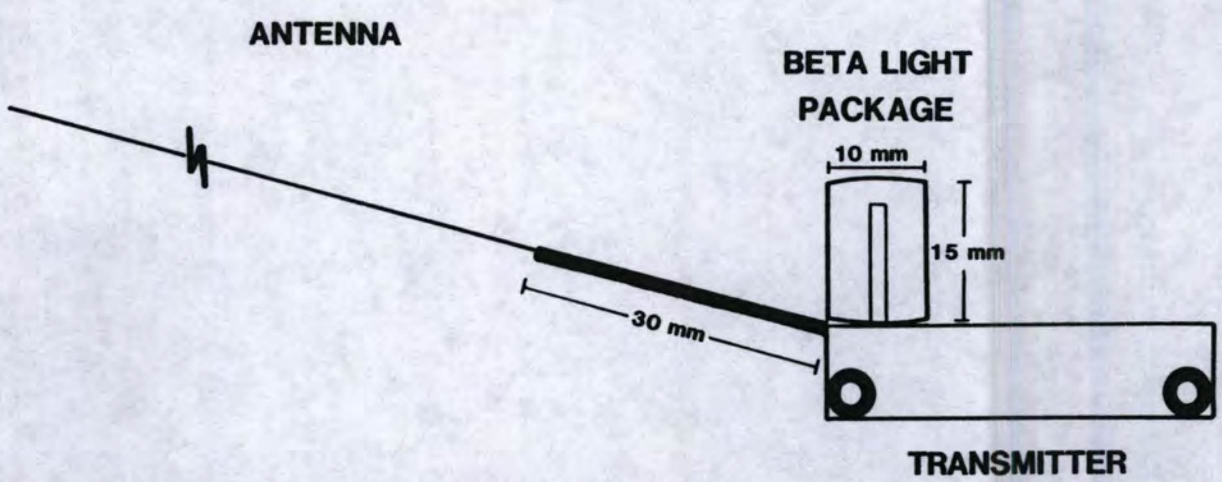

Figure 1. Betalight Attachment Method I. Betalight mounted in clear acrylic rod is bonded to radio transmitter with dental acrylic.

four mo after attachment. The owl gained 13 g (12% of its body weight) during this period from mid-March through mid-July. A second male carried a betalight five mo (September–January), and like two other owls recaptured in January 1986 had lost weight (16 g or 13% of its body weight). The third owl dispersed from the study area two mo after the betalight was attached in May. Two of 13 Boreal Owls radio-marked without betalights died whereas none of the three marked with betalights died. Mortality of radio-marked owls with betalights, then, was not increased compared to radio-marked owls without lights, although our sample size is quite small.

I followed owls during evening and night-time hunting forays a total of 23.3 hr on 10 nights. Observation sessions began when the owl left its daytime roost and ended when the owl became inactive 2–3 hr later or when contact was lost. During the first 0.5–1.0 hr of observation, night vision aids were not required; 4.6 hr of observation were made at dusk. During 16.3 hr I observed radio-marked owls not wearing lights. The remaining 7 hr of observation I followed owls wearing betalight packages. Frequent head turning and active posturing indicated the owls were foraging during my observations which contrasts sharply with normal roosting and preening behavior (G. Hayward, pers. obs.).

On three nights I followed one owl wearing a betalight attached using Method I for a total of 5.5 hr. Night-vision goggles facilitated observation of one prey capture, three feeding sessions and numerous perch locations. The betalight, however, was rarely visible. During a night involving three hr of observation I saw the betalight only twice. Plumage at the base of the head and along the owl's back concealed much of the betalight permitting a clear view only from directly behind the bird.

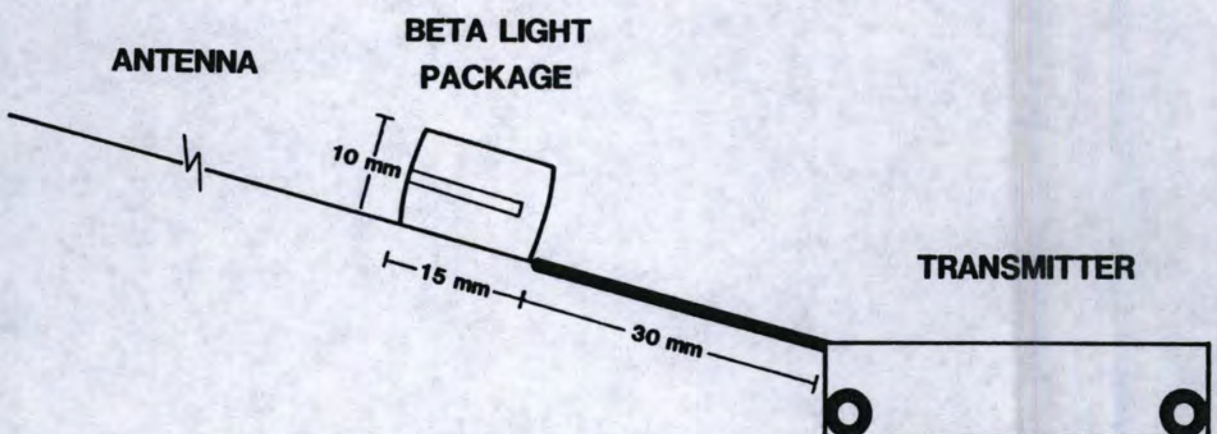

Figure 2. Betalight Attachment Method II. Betalight is glued to transmitter antenna with epoxy.

The betalight mounted by Method II remained clear of the owl's plumage. The light was visible from each side and behind the owl. I followed this owl for 1.6 hr over two nights. The light was visible from about 10 m without aid of night vision goggles. Unfortunately, the owl dispersed from the study area. The short observation period and the rapid rate at which this owl moved while foraging prevented a thorough assessment of attachment Method II.

Because I was unable to adequately evaluate attachment Method II (the more visible light position) in the field, I measured the distance over which the betalights were visible in a controlled situation. Simply holding the light against a dark background, I viewed the light at night with unaided vision and with night vision goggles (Model AN/PVS-5A; ITT, Electo-Optical Prod. Div.). Under a starlit sky with no moon and two km from city lights, the betalight was visible to the unaided eye for eight m and for 31 m with the aid of night vision goggles. A larger betalight would increase detection distances considerably.

Using radio-telemetry and night vision goggles, I also observed foraging owls not wearing betalight packages. In this way I gathered information on foraging behavior and foraging microhabitat unobtainable using triangulation or simple pellet collection. In situations where an owl's foraging strategy involved flights <75 m and searches of three min or more at each perch, I could follow the owl reasonably well as it foraged. These results are comparable to the observations obtained with betalights mounted as in Method I.

Discussion

Understanding the ecology of nocturnal owl species has been hampered by a paucity of information on foraging behavior and habitat. Published analyses of niche overlap among sympatric species strongly emphasize prey species and size class with little consideration for where each owl species obtains food. Authors frequently speculate on mechanisms "that would allow two owl species to forage in sympatry" (Marks and Marks 1981:82) without information on where foraging occurs. Marti (1974), Herrara and Hiraldo (1976), Marks and Marks (1981), and Marks and Marti (1984) studied food niche overlap through quantitative analysis of size class and species overlap in prey but only alluded to the necessity of obtaining foraging habitat information. Holmes and Recher (1986) showed that habitat structure influenced foraging strategy and success in other avian predators. Lundberg (1980) emphasized the role of habitat differences in his discussion of interactions between Ural Owls (*Strix uralensis*) and Tawny Owls (*S. aluco*), and Southern and Lowe (1968) and Hirons (1985) demonstrated the importance of vegetation structure in determining prey availability and habitat use. Nesting success, territory size and productivity have been linked to habitat characteristics influencing prey availability (Hirons 1985).

Direct observation of foraging owls has been more successful in open habitats (examples: Clark 1975; Chamberlain 1980; Kertell 1986) than forested habitats. In Sweden Norberg (1970) studied the foraging behavior of the forest-dwelling Boreal Owl during twilight nights of summer in the far north. Foraging habitat of Boreal Owls was further studied by Sonerud et al. (1986) by following radio-marked owls during twilight, combining direct observations and triangulation to discern habitat use.

Further study of foraging behavior and habitat use by nocturnal owls, especially forest owls, will require a combination of radio-telemetry and a light source attached to the owl. In open habitats radio telemetry may not be necessary and owls marked simply with a light source may be observed with the aid of a light intensifying instrument (Braun Hill and Clayton 1985). Wolcott (1977) described a battery powered LED light source (weighing five g) visible from 300 m when viewed using a night scope which he used on Ghost Crabs (*Ocypode quadrata*). DeLong and Murphy (1982) used a similar package to study behavior of Long-eared Owls (*Asio otus*) at their nest sites. The LED light, however, has a limited effective life (one mo) and is heavy due to the size of the battery.

Betalights provide an effective alternative light-emitting marker with characteristics which make them preferable for marking owls. Powered by radioactive gas, betalights are lightweight (ours one g) and have extremely long effective lives (12 yrs). Betalights are inexpensive (<$10 U.S.) and are available in several colors to facilitate tracking individuals. The most significant drawback in using betalights as markers involves restrictions on transportation and handling of radioactive substances. Betalights are designed to be safe light sources, but the user must meet certain licensing requirements. The radiation control officer or other officials at the user's institution should be consulted concerning restrictions applying to local areas.

During my trials, several factors hampered observation of Boreal Owls during nocturnal forays, whether or not owls carried a betalight. Extremely dense forest vegetation restricted visibility, resulting in a bias against recording use of denser forest habitats. Dense forest vegetation and tree fall also restricted observer mobility. Apparently, the noise made while approaching Boreal Owls did not disturb the hunting owls who continued to hunt and obtain prey. Sonerud et al. (1986) were also able to follow foraging Boreal Owls on foot without disturbing the owls' hunting.

Betalight packages mounted by Method I enhanced observation of owls only slightly compared to radio-marked owls without betalights observed with night vision goggles. Mounting a betalight on the radio antenna rather than the transmitter rendered the betalight much more visible. Method II of attaching a betalight was not adequately field tested but has potential to aid considerably in future nocturnal studies of owl behavior and habitat use.

Limitations on size and placement of betalights on Boreal Owls contributed to the difficulties experienced with following owls after dark. The Boreal Owl is a cavity nesting bird which may use holes only slightly larger than its head. Therefore, the size of our betalight package was limited to the smallest light source manufactured by Saunders-Roe which produces only 75 microlamberts of light.

In more accessible areas betalight markers used in conjunction with night viewing aids would facilitate studies of owl movements. In particular studies of the large, platform nesting owls could be undertaken. On large *Strix, Bubo, Asio,* and *Tyto,* as well as others, larger betalights (e.g., Type "Q," a hemisphere, Saunders-Roe) mounted on a short pedestal (two cm) atop a radio transmitter or on the antenna would provide a visible light for night tracking. In studies of larger species the danger of predation by other owls as a result of the marker would be reduced, and concerns associated with weight and package size would be less critical. Betalights might be better suited for species inhabiting open habitats where vegetation places fewer restrictions on viewing distances and viewer mobility.

This preliminary work suggests that betalights are useful for studying foraging and other behavior and habitat use by owls. Although past studies of food habits, limited to pellet analysis, were important first steps in understanding owl ecology, future studies should emphasize where owls obtain prey. The interrelationship between an owl species, its prey and other owl species can only be defined with knowledge of where interactions are taking place. To avoid considering foraging habitat in future discussions of niche overlap among owls may significantly distort our perception of the indirect interactions between species! Betalights offer an effective method to aid in studies of owl foraging and habitat use, as well as other behavior, ultimately increasing our understanding of the ecology of these nocturnal predators.

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