TWO OPTICAL TRACKING DEVICES FOR NOCTURNAL FIELD STUDIES OF BIRDS

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Avian behavioral ecologists are painfully aware of the difficulty of collecting field data on the behavior of nocturnal birds. Such data are important in their own right and for comparison with the rapidly accumulating information on diurnal behavior. Various techniques have been recently described for marking animals to aid in nighttime data collection (see for example Buchler 1976). We describe and summarize our experience with two types of optical transmitters used for tracking birds at night. They were used in the senior author's field study on the behavioral ecology of Black Skimmers (Rynchops niger) conducted June through August 1978 on Long Island, New York (see Gochfeld 1976).

Both transmitters are inexpensive and easily made. The first, the flasher, is a battery operated, electronically regulated flashing light. The second, the liquid tag, is an encapsulated chemiluminescent liquid. The requisites of a tracking system (be it optical, infrared, radio, or other) are as follows:

a) the transmitter must emit sufficient radiation to be detected at a useful distance by a suitable receiver;

b) the receiver must be sensitive enough to detect the transmitted radiation above any similar background radiation;

c) the system must have sufficient directional sensitivity to allow accurate location of the individual;

d) the transmitter must be small enough to be borne by the animal;

e) the receiver must be portable enough for convenience in the field;

f) the transmitter and the signal must not interfere with the behavior being studied;

g) the system should allow some individual recognition.

Optical tracking has an advantage over radio tracking. The human eye can determine the optical transmitter-receiver direction to within $\pm 0.01^\circ$. By contrast a radio receiver of the size convenient for field use can determine the direction to only $\pm 10^\circ$.

Active vs. Passive Transmitters: Passive optical transmitters such as reflecting tape or paint, require illumination from a distance by a bright light. Repeated exposure to such a light source could severely alter the animal's behavior. In the present study we chose to avoid passive transmitters. Active optical transmitters, such as battery powered lamps, require an internal energy source. However, because the energy source is limited in size, these have a limited useful life. In some cases it is possible to replenish the energy supply, thereby increasing the useful life (e.g., recharging of batteries by a solar cell). The useful life of an active optical transmitter can be increased by switching it off at times, by increasing the size of the energy source, or by reducing intensity. Reducing intensity limits the detection range, and increasing the size of the source increases its weight. Therefore, a flashing transmitter seemed preferable for this study.

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MATERIALS AND METHODS

Flashing Transmitter:

The flasher we constructed is similar to a device used by Wolcott (1977) in a study of the nocturnal movement of crabs. Wolcott reported that his flasher was visible with the naked eye at distances of up to five meters and with the aid of an image intensifier (starlight scope) at distances of up to 300 meters. The flasher is a light emitting diode (LED) powered by small mercury cells (batteries). The LED flashes on and off to conserve battery life.

Our flashers had flash durations of 1.7 to 2.0 ms and flash periods ranging from 0.6 to 1.0 seconds. Increasing the flash duration increases the visibility of the LED at the cost of proportionately faster battery drainage. Although n-creasing the time between flashes reduces battery drain, if this interval exceeds about two seconds, it is very difficult to locate and follow the flasher by eye.

Wolcott (opcit) used one LED in each flasher and one flasher per crab. He used an image intensifier to locate the flasher. To avoid the need for an image intensifier we modified Wolcott's design by placing three LED's in parallel. The FLV112 LED's we chose are focused light sources. Roughly 90% of the light is emitted within an angle of 30% with respect to the cylindrical axis of the LED. By arranging the LED's as shown in Figure 1, and placing the flasher on the back of the bird as shown in Figure 2, we were able to direct most of the light from the LED's toward the front and sides of the bird. This allows the LED's to be visible at night with the naked eye at distances up to 30 meters from the front and sides of the bird through an angle subtending 220° as shown in Figure 2. Within this horizontal angle the LED's are visible over a verticle angle of ±30°. We chose not to add one or two more LED's to direct light toward the rear of the bird, since this would have increased the mass of the flasher and also further increased the drain on the batteries. With 7x35 binoculars which gather about 25 times more light from a distant point source than the naked eye, the flasher is visible at night at distances upto about 125 meters.
The flasher will operate at temperatures from 0°C to 50°C. The flash period is temperature sensitive; our flashers have a period of 0.6 seconds at 20°C and a period of 0.46 seconds at 40°C.

Our flashers were 9 g in mass. We used two Mallory DURACELL (registered trademark) RM4000R mercury cells having a total mass of 2.2 g. The remaining 6.8 g consisted of LED's (0.6 g total), circuitry and epoxy encapsulating material (3.2 g), a battery holder (3.0 g), and a thin waterproofing coating of paraffin over the entire device. We also wrapped a short strip of strapping tape around the flasher behind the LED's to provide a more uniform surface for attachment to a bird. We attached the flashers to feathers of the spinal tract as described below with about 1 g of quick setting epoxy. The total mass carried by the bird was then 10 g. This is less than 5% of the subject's mass (Black Skimmer males are approximately 350 g; females are approximately 250 g).

The electronic components, including standard size transistors, were purchased at an electronics hobby shop. The mercury cells were purchased at a camera store. The materials for each flasher cost less than $6.00. An individual with some experience equivalent to an undergraduate introductory electronics course and some experience soldering miniature components can construct the flasher in less than three hours.

Liquid Tag:

CYALUME (registered trademark), a chemiluminescent liquid marketed by American Cyanamid Company as an emergency light source, was used as an optical transmitter on bats by Buchler (1976). The chemiluminescence is triggered by the mixing of two liquids, one is mainly dibutyl phthalate the other mainly dimethyl phthalate plus alcohol and hydrogen peroxide. The mixture emits a green-white light which drops in intensity with time as the chemical reaction proceeds to completion. The period of time that the mixture emits detectable li is somewhat inversely proportional to the initial intensity of the light. The initial intensity depends upon the total quantity and proportions of the two liquids (Buchler, opcit).

The liquid tag we tested on birds consisted of 4.2 g of substrate component mixed with .6 g of activator component in a thin walled, transparent, plastic bulb, molded over a Bunsen burner to approximately 2.0 cm in diameter. We used a hypodermic syringe to inject the mixture into the bulb through a small opening previously pierced with a red hot needle; we sealed the opening with quick setting epoxy. The sealed bulbs were attached to the feathers of the spinal tract as described below with about 1 g of quick setting epoxy. The total mass carried by the bird was 9 g.

Four hours after mixing, the liquid tag is visible with the naked eye at 600 meters and with binoculars (7x35) at well over 1.5 km. Twelve hours after mixing it is visible with the naked eye at 80 meters.

We were able to attach a transmitter to a skimmer in less than five minutes. We spread epoxy over the surface of the feathers of the spinal tract and then pressed a transmitter onto the epoxy. Quick setting epoxy sets in about five minutes but remains tacky for almost an hour. Thus it was necessary to dust the epoxied area with talcum or fine soil after transmitter attachment (Buchler, opcit) to prevent unepoxied feathers from sticking.

Trapping:

Black Skimmers were nest-trapped using 2.5 cm mesh chicken wire traps. The traps were approximately 70 x 70 x 25 cm, with a 15 cm wide funnel opening. Birds were readily trapped late in incubation. Early trapping sometimes caused abandonment.

RESULTS

Skimmers restrained less than five minutes during transmitter attachment appeared to resume normal activity within ten minutes of release. We observed one light-tagged skimmer leave the nesting area, return with a fish, and feed young all within 20 minutes of release.

In order to avoid continued disturbance of individual nesting pairs we did not closely observe the same skimmers for more than three days running. However, we did document operating flashers still firmly attached after three days. During an indoor test, we found that transmitters would remain attached to pigeons for at least a week after which the test was terminated.

Usually we placed one transmitter on a given skimmer. We could identify two marked skimmers by using flashers with different periods. Different colored LED's can be employed to differentiate marked individuals. For example Brooks and Dodge (1978) used different colored LED's to differentiate marked beavers. In one case we attached both a flasher and a liquid tag to the same skimmer. We were then able to observe the activity of the skimmer at a distance on the first night via the liquid tag and the activity at close range on subsequent nights via the flasher.

DISCUSSION

The techniques allowed D.C. to monitor the activity of Skimmers in the colony on dark nights. One could determine the constancy of incubation, any change over between sexes, feeding forays, and responses to predators. The feeding behavior or at least movements could also be traced-particularly with the liquid tag.

The possible influence of the light sources on the bird's behavior is still unknown. It is anticipated that the relatively brighter light of the liquid tag would have some effect.

SUMMARY

Two light emitting markers for nocturnal tracking of birds were devised and determined useful in field tests on Black Skimmers. The first, a miniature optical telemetry transmitter, may be viewed with binoculars for over 100 meters and produces accurately timed flashes for up to two weeks. The second, a chemiluminescent tag, may be viewed with the naked eye for over 1.5 km and has a maximum lifespan of 12 hours. Both devices are inexpensive, easily manufactured, lightweight and rugged.

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LITERATURE CITED

Brooks, R. P., and W. E. Dodge. 1978. A night identification collar for beavers. J. Wildl. Manage. 42(2): 448-452.

Buchler, E. R. 1976. A chemiluminescent tag for tracking bats and other small nocturnal animals. J. Mammal. 57(1): 173-176.

Gochfeld, M. 1976. Waterbird colonies of Long Island, New York, 3. The Cedar Beach tenery. Kingbird 26(2): 63-80.

Wolcott, T. G. 1977. Optical tracking and telemetry for nocturnal field studies. J. Wildl. Manage. 41(2): 309-312.

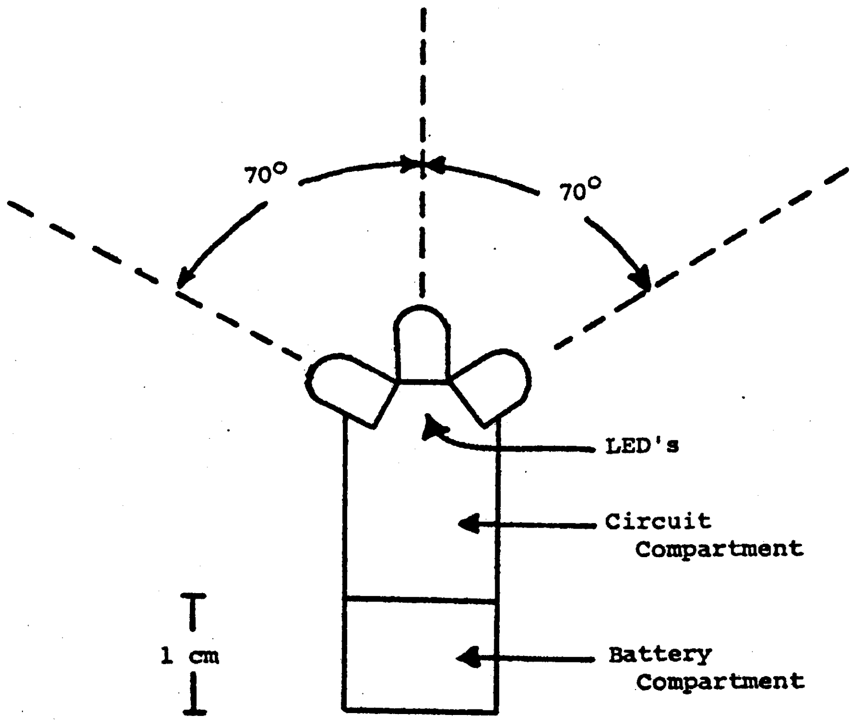

Figure 1. Top view of flasher showing LED alignment.

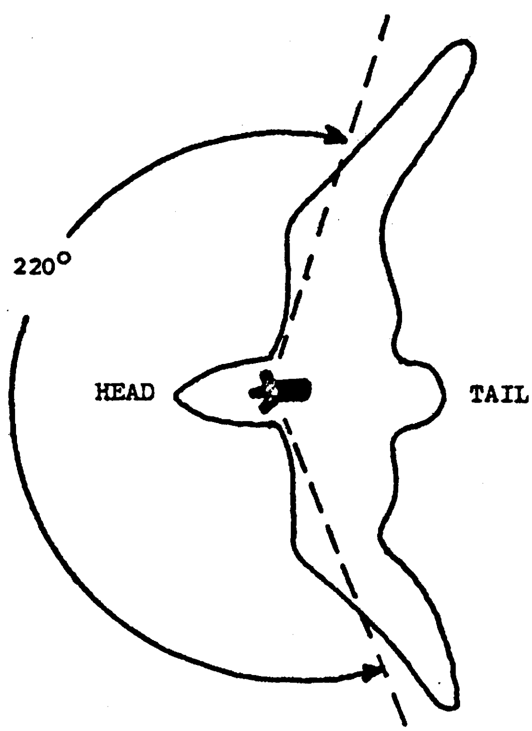

Figure 2. Top view of flasher on bird showing angle of maximum visibility.