BIOTELEMETRY
— a valuable tool in bird study

By THOMAS H. NICHOLLS and DWAIN W. WARNER

Introduction

“Tied a silver thread to the leg of each, loose enough not to hurt the part, but so fastened that no exertions of theirs could remove it.” So wrote J. J. Audubon who was probably the first person in the New World to mark birds in such a way that they could be recognized individually. We have come a long way since Audubon’s day as can be evidenced by the tremendous amount of literature on methods concerned with the study of animal behavior.

Movement studies of birds have been based almost entirely on visual observation, on recapture of previously trapped and marked birds, and on appearance in study areas of species intermittently captured by various sampling methods. Data from these types of studies are the basis for a major part of current interpretations of: response to environmental change, home range, territory, migration, dispersal, and for much interpretation of population structure and even systematics, evolution and biogeography.

Several methods have been used to study bird activities. The aluminum leg band has been in use for years. Banding supplies information on two precise moments in the bird’s life: when it is banded and when it is recaptured or found dead. The activities of a banded bird are virtually unknown from the time of banding until the bird is found again.

In order to acquire more information on the local movements of birds, color bands in different combinations have been used successfully to identify and observe individual birds with the aid of binoculars. Large plastic back tags have been used on such birds as hawks, eagles, and pheasants with some success. The use of dyes and paints have been used extensively in marking birds. Another popular technique has been to insert dyed feathers into the plumage of the bird. Such feathers are attached with household cement and tied with a thread to the shaft of an attached feather on the tail, wing, back, or head. A similar method, called imping, requires that an attached feather be cut off and a dyed feather joined at the cut end by an imping needle. Other methods have been used to mark individual birds, but all these methods have the major limitation of being unable to tell us where and what a bird is doing 24 hours a day. The need to know an animal’s seasonal and annual movements and the physical as well as biological stimuli responsible for these movements has become paramount in many fields of science. A relatively new research tool has been developed which is helping to deter-
mine ecological requirements and physiological responses of wild animals in their natural habitats. This exciting and versatile tool is biotelemetry.

**Uses of Biotelemetry**

Biotelemetry is the instrumental technique for gaining and transmitting information from a living organism and its environment to a remote observer. One of the primary objectives of biotelemetry studies is to obtain information on the natural movements and behavior patterns of individual animals. Specifically, this could include the determination of home range, habitat use, activity periods, effects of weather on activity, daily and seasonal movement patterns, family relationships, and whether the species is territorial.

Radio devices are becoming increasingly useful in measuring such physiological processes as blood pressure, heart beat, respiration, and temperature. These devices are invaluable in medical research.

In this fantastic electronic age we look forward to using television cameras to monitor animals in their environment, for example, an owl nest or a fox den. Listening devices attached to animals or placed at nests or other centers of activity will tell us much about an animal by listening and recording the sounds it makes. Some workers have made use of a radio-controlled anesthetic device, so that an experimental animal could be anesthetized by radio and thus be recaptured at any time. These
devices, and new ones being developed, have tremendous possibilities of gaining continuous data from environments heretofore unavailable to the scientist.

Automatic Radio-Tracking System

A unique automatic radio-tracking system for monitoring animal movements is located on the Cedar Creek Natural History area in Anoka and Isanti counties in Minnesota. It is located about 30 miles north of Minneapolis and about the same distance west of St. Croix Falls, Wisconsin. The area consists of some 4,500 acres which are administered by the University of Minnesota. It has a wide range of habitats which make it ideal for tracking several different species of animals.

Cedar Creek’s automatic radio-tracking system consists of two towers each with a rotating yagi antenna one-half mile apart. The antennas rotate every 45 seconds. Under ideal conditions this system has a potential of obtaining 1,920 locations per animal every 24 hours on up to 52 different animals. Each animal with a miniature radio transmitter is assigned a different radio frequency. Therefore, when the tower antennas point in the direction of an animal with a transmitter, they detect the radio frequency energy emitted from the transmitter. Degree bear-
nings obtained from the two towers permit animals to be located by triangulation. Radio signals received by the antennas are recorded on 16-mm film which moves through a shutterless camera at the rate of 100 feet per 24 hours. After standard photographic development, these data are read from the film using a microfilm reader. The data are transferred to machine punch cards and analyzed by a digital computer which calculates movement and location parameters and draws a map of movements for each individual animal. Animals which go beyond the range of the automatic radio-tracking system are found by mobile or portable receiving units which can be taken into the field.

The following animals have been tracked by use of miniature radio transmitters for varying periods of time: red fox, cottontail rabbit, white-tailed deer, raccoon, badger, Cooper's hawk, broad-winged hawk, great horned owl, barred owl, and saw-whet owl.

Some of the radio-equipped animals, particularly in the case of birds, fox, and deer, could easily find their way into Wisconsin. Readers of the Passenger Pigeon are requested to report any finds of wild animals wearing strange looking collars or harness-type affairs which might bear a transmitter to: University of Minnesota, Museum of Natural History, Minneapolis, Minnesota; or the Illinois Natural History Survey at Urbana, Illinois, which is also doing extensive work with biotelemetry.

**Birds and Biotelemetry**

Biotelemetry is quickly becoming a useful tool in bird study (Bellrose, et al., 1962; Graber, 1965; Marshall, 1963; Southern, 1965). In the spring of 1965 the senior author began a study of the owls of Cedar Creek using the automatic-tracking system. At this writing, radio transmitters have been placed on and carried successfully by the great horned, barred, and saw-whet owl. Over 1,000 days of data have been acquired from 16 individual owls.

The basic design (Cochran, et al., 1963) used successfully on great horned and barred owls consisted of a harness which holds the transmitter under the feathers just above the breast bone. The two loops of the harness served as antennas. The harness with the transmitter weighed 75 grams. The saw-whet owls carried without difficulty a seven gram transmitter on its back with an eight-inch trailing whip antenna.

Monitoring owl movements have provided valuable information on their natural movements and behavior patterns. Determinations have been made of home range, habitat use, activity periods, daily and seasonal movement patterns, feeding habits as well as other factors. The results of the owl study will be published at a later date. In addition to studying owl behavior, one of the objectives of the owl study was to test and refine basic radio-tracking techniques on birds.

Some migratory birds have been implicated as possible important vectors of animal and plant pathogens. For example, a bird bitten by a diseased mosquito in South America may become a flying reservoir for a pathogenic parasite. This same bird could become an important source of the pathogen when it arrives at its North American nesting area a few days or weeks later. Another example might include a flock of birds feeding in a wheat field of Mexico and picking up fungus spores on their feathers as they move about the field. A few days or weeks later some of
the same birds might land in a South Dakota wheat field carrying a new race of the wheat rust fungus to which the plants are not resistant. Under favorable environmental conditions a build up of the wheat rust fungus could lead to an epidemic with a resulting loss to the wheat crop.

There are many pathogens which birds could conceivably carry from one part of the world to another through their migratory journeys. Thus, we need to know more about where birds go, what they do, how they find their way, and what happens to them as they move around. This is especially true if we are to understand their role in the transmission and dissemination of animal and plant pathogens. Biotelemetry will be an essential and useful tool for understanding these problems. In addition, the use of miniature radio transmitters may help solve the great mystery of bird orientation and migration. As the use of telemetry on birds becomes tested and refined to insure its great capabilities without influencing the natural activities of birds, the day will come when a space satellite will monitor the movements of many migratory birds at one time.

Minnesota Museum of Natural History
Minneapolis, Minnesota 55455

Literature Cited


Interesting Experiences with a Tape Recorder

By JOHN SAETVEIT

Binoculars and a field guide are standard equipment to a bird watcher. However, much more of bird watching can be enjoyed if this equipment is supplemented by a portable tape recorder. A tape recorder will attract birds for close observation. With a recorder it is possible to bring some birds close enough to take pictures with just an ordinary camera.

This was the case at the end of May last year when Mr. Ed Prins, Bob Fiehweg, and I, were in north central Michigan searching for the Kirtland's Warbler.