

A Honeycomb Repeater Radiotelemetry System and Migration Dataloggers for Raptor Research

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Radiotelemetric technique in phenology and migration studies gives us a chance to acquire qualitatively new knowledge of the biology of birds of prey. However, the conventional techniques of radio and satellite tracking are not flexible/adaptable enough for such studies. Radiotracking is suitable for studying birds within the limits of restricted research areas but of little use for studying migrations. The drawbacks of satellite tracking, given the global character of migration studies, is the high cost, limitation in size of the birds tracked, etc.

The system here under consideration is composed of simple, autonomous and cheap devices for automatic presence-absence recording of radiotagged birds in the area controlled by such a device. They are, in fact, dataloggers, consisting of telemetry receiver, timer and processor with memory.

The processor switches on when a radio signal from a radio-marked animal is detected in the receiver: the individual code is identified and registered in the memory together with the precise time on the reference clock. To avoid overloading of the memory, only changes in the radio-signal are recorded. Recording may take place at certain time intervals.

The antennas of recorders may be directional or omnidirectional depending on the conditions of the experiment.

A single device may provide virtually complete recording of radio-marked birds at 10 to 50km distance when recorders are properly installed in a narrow or bottleneck place on the migration route, with power outputs comparable to those of conventional tracking transmitters. Operational time of these transmitters (with cell power supply) is considerably longer than that of conventional radiotracking units, as the pulse repetition rate may be one pulse per minute or even lower.

These recorders should be installed on hills, cliffs, tree-tops, skyscrapers, chimneys, etc. The instruments are airtight and many of them are supplied with solar cells.

It is desirable to camouflage the units and antennas. The automatic recorders can be installed for one or several seasons.

Information is read out from all the devices installed in the area after the end of the observation period. This general data bank is then used for drawing maps of the birds' route, indicating areas, time and activity patterns of flight.

The automatic recorders may also be part of a retransmitting system, described below, serving as a signal recording station.

Employment of low-powered retransmitters may considerably increase the efficiency of radiotelemetric survey of birds of prey. Successful radiotracking by means of conventional facilities depends greatly on the relief of the terrain. Blind spots between hills or mountains can be much larger than controlled areas. Besides, the region under study often consists of a few areas dozens of miles apart (sites of roosting, feeding, nesting etc.). In such cases the direct receiving of signals is generally impossible, even with uprated radiomarks.

The retransmitting systems differ from direct position-finding systems (radiotracking and triangulation) in their ability to transmit information from the object regardless of the possibility of direct radio contact between the object and the recording station. This enables us to record even low-powered radio tags from birds in valleys, hollows, mountain gorges etc. dozens of miles away from the signal recording station.

Long range of the system is obtained by a long distance between retransmitter and receiver, with directional transmitting and receiving antennas of great amplification. Retransmitters may differ in the constructions of non-scanning receiving antennas and have a range of 0.5km² (a small gorge) to 1,000km².

The principal type of retransmitter we are developing is a construction without mechanical traversing units, supplied with solar cells and storage batteries. It is made up of compact, airtight units, various in shape and weighing 0.3-2.5kg.

Several small solar panels fixed over the top of a tree are employed if there is not enough light for the continuous work of the instrument on tree-trunks or branches suitable for installing retransmitters. Retransmitters on cliffs and other open places may have a specially designed shape with a surface sufficient for carrying solar cells of the required capacity.

Retransmitting antennas are made of thin, strong and corrosion-proof wire, and connected to the main unit by a thin cable. The antennas may also be fixed directly to the frame of the retransmitter. A properly installed device is hard to spot, but additional camouflage is desirable. In any case, wind loading should be taken into consideration. Retransmitting, non-scanning receiving antennas may be omnidirectional or directional for controlling an elliptic area with the defined direction as the longitudinal axis. An object cannot be located within this circle or ellipse. In any case, the distance between object and retransmitter can be estimated from the strength of the signal. In general, it is more efficient to use several retransmitters than to employ radio triangulation techniques for tracking birds with large home ranges of complex shape or relief and remote feeding, nesting and other areas, even if the accuracy of locating the bird is low with the proposed network of retransmitting units.

Location accuracy of radiotransmitters can be increased if the controlled area is divided by installing a number of retransmitters with adjacent or partially overlapping receiving zones. The transmitting power of such a device (let it be called "microtransmitter") can be 10-100 times lower than the above, and placing in the terrain is not so critical. These tiny and very economical transceivers could be used, not only for radiotracking but also as remote transducers of various ecological parameters.

The system may be used as follows: data from these tiny hydro-meteorological stations improve our understanding of the birds' flight biology if the abiotic parameters are constantly monitored by transducers. This is especially useful for high mountains and other extreme conditions.

Continuous recording of physiological parameters by means of retransmitters requires high power consumption as well as the transmission of acoustic signals, but this is possible for the majority of retransmitter designs.

Transmitting of high quality acoustic signals deserves a separate network of specially designed retransmitters with increased power consumption; they would be highly informative for ethological research.

The importance of ethological and physiological data on the nesting and breeding biology of rare and endangered species for artificial rearing justifies not only the employment of a single transmitter but also a separate retransmitter communication line for each nest separately. Employment of a retransmitter network in reserves may also be important in terms of species conservation projects.

Two-way retransmitting systems enable us to affect and control the behaviour of the birds studied and/or other animals by experimental acoustic signals, etc.

Preliminary testing of experimental models of the above instruments is encouraging and we hope that the spectrum of application and possibilities of existing conventional ground-based methods of biotelemetry can be considerably extended through the wide use of simple cheap instruments similar to those described in this paper. It is evident that combining ground-based retransmitters with satellites for transmitting biological information has great potentialities.

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