THE USE OF BIO-TELEMETRY FOR STUDYING SQUIRREL POPULATION DYNAMICS AND BEHAVIOR

INTRODUCTION

A full understanding of the ecology and behavior of any animal requires a knowledge of the animal's movements. Historically, data from natural events involving any animal under natural conditions have been obtained from such methods as trapping, marking, recapture and visual observations.

In the 1950's and early 1960's however, major breakthroughs in data gathering techniques were made when biologists began developing telemetering devices with which to monitor animal movement and to a limited degree, physiological parameters. Wild animals were being tracked for days, weeks and even months, continuously telemetering such events as temperature, daily and seasonal movement patterns, dispersal and behavior.

Radio-telemetry, may be defined as the use of a miniature radio transmitter attached to a free roaming, wild animal, without use of restraining harnesses or wires, and capable of emitting a signal at a given frequency, which when received by a remote receiving station provides continuous data of a specific nature.

PROJECT DESCRIPTION

The UWM Field Station was established as a center for research and advanced study in the fields of botany, zoology and environmental measurement and in keeping with this theme of investigation, Dr. C. M. Weise, in the Dept. of Zoology, and I have developed a radio-telemetric tracking station at the Field Station's Cedar-Sauk area.

We have elected to work with three species of squirrels that occur at the field station. They are: the Gray Squirrel, (*Sciurus carolinensis*), the Fox Squirrel (*Sciurus niger*), and the Red Squirrel (*Tamiasciurus hudsonicus*).

In general, we are studying the interspecific and intraspecific relationships between the three squirrel populations. Specifically, we intend to live trap, mark, release and observe squirrels of each species to determine the populations and distribution of each. Using radio-telemetry we are attempting to find out whether squirrels of the three species divide up the forest in a mutually exclusive way on a day-to-day or possibly even an hour-to-hour basis. It is known that the squirrels do not hold or defend permanent territories, but it is also generally agreed that the three species are antagonistic toward one another. Some observers have claimed Red Squirrels to be dominant over Gray; others have claimed Gray squirrels to be dominant over Red, and the status of the Fox Squirrel seems to be completely unknown.

We are also seeking to determine the location, composition and micro-environmental conditions in squirrel nests; these may be critical factors in the local distribution of squirrels, especially in winter and the breeding period.

METHODS

The basic components of a telemetry station are the radio transmitter, the directionally sensitive receiving antenna and the tunable or crystal controlled radio receiver.

The Field Station utilizes two custom built, portable, 12 channel, crystal controlled receivers of the type manufactured by S.L. Markuson, Esko, Minnesota. The receivers may be used either with a hand held, highly portable directional antenna for tracking in the field or they may be plugged directly into a yagi temporary directional antenna (TDA), system.

Four TDA units have been set up in a maple-beech climax upland woods area at the Field Station for the purpose of tracking squirrels. The TDA system is tied in directly with a two and one-half acre grid system which permits pin point location of the receiving antennae. The towers are twenty feet high, support an 11 element boom some 12 feet long, have a direction indicating compass rosette at the base and are supported by a sliding sleeve guy-wire system. The units are positioned in two parallel though staggered, rows of two units each, with 660 feet between rows and 990 feet between units in each row. Units 2 and 3 are 660 feet apart and directly opposite one another, while units 1 and 4 are on the distant ends of their respective rows. This permits us to accurately cover 120 acres of Red, Fox and Gray Squirrel habitat. Either units 1 or 4 may be rapidly disassembled and mounted on the back of a four wheel drive pick-up truck which can be driven to other grid points giving added flexibility to the receiving system.

The effective range of the transmitters has been closely controlled by tuning the transmitter circuit to produce the greatest possible longevity and maintain a maximum effective range of about one half mile. The life of the transmitter is directly dependent on the size of the battery and the range desired. By reducing the transmitter's range and hence its power demand and by using the largest battery possible, with respect to the animal's size, we have succeeded in obtaining 100 days of transmitter life for Fox and Gray Squirrels and 50-60 days for Red Squirrels. The transmitters are attached to the animal with a copper collar which also serves as the transmitting antenna. The weight of a completed Red Squirrel transmitter-collar unit is approximately 15 grams, including its dental acrylic encapsulant. Fox and Gray Squirrel transmitters weigh about 12 grams more due to a larger battery and transmitter.

The method of operation can be described quite simply as follows: the transmitter emits a given signal which two receivers, working simultaneously at two seperate TDA stations, tune in. Once tuned in, the operators of the two TDA units turn their antennae until the strongest signal is located. An azimuth or compass direction is then taken. The point at which these two azimuths cross is the location of the animal.

DISCUSSION

No data are available for presentation at this time as the actual field work has only recently begun. Therefore, I will describe some of the ways in which the potential data will be processed and presented.

The data that are accumulated by the tracking system will be entered on computer punch cards. The movements of the animals can be plotted by computer with the aid of an x-y plotter on a detailed area map. From this map it is then possible to determine the home range and local movements of an animal over a given period of time. It will show, if superimposed with other animal movements, the amount of overlap of home range and local movement. Also, it may indicate, by reason of time and direction of the azimuths, direct interaction between two or more animals. From the maps we will also be able to determine the centers of activity, those areas in which the squirrel spends the majority of its active time.

Specific actions can often be monitored by the receiver operator because physical activity tends to differentially modulate or vary the tone of the signal for such events as being at rest (normal signal), running and climbing. Thus these events are recorded and the per cent of time involved is calculated relative to the tracking period. Feeding and nesting behavior can be closely followed. The animal's response to weather changes, young-adult relationships, dispersal and behavior and development of young can be monitored, plotted and interpreted.

The duration of the sampling period and the frequency with which azimuths are taken within a sampling period, are very critical to the type of data required. Intervals of two minutes or less, over a period of ten minutes may supply voluminous amounts of data for intensive local movement, behavioral and interspecific-intraspecific contact relationship studies. Intervals of ten minutes over a sample period of one to two hours will provide adequate data, over a period of time, on home range and proportional use of area by the different species. It is also necessary to establish a schedule of times during which sampling periods will occur. In order to eliminate personal convenience as an unfavorable bias, a table of random numbers is used to select sampling periods. It is important therefore, that the researcher clearly define his objectives during any particular tracking period in order to avoid unnecessary work or omission of required data.

Aside from tracking the animals with radio devices it will also be necessary to determine the age, sex and size of the populations. Aging and sexing will permit us to analyze the population structure, whereas marking and recapture and visual observation of marked animals will permit us to determine population size and distribution.

In conclusion, it should be pointed out that while radio telemetry is being used as a tool in the ecological and behavioral research of squirrels it is our desire to expand this program to include other animals as well as other fields, such as physiology. Often bio-telemetry can, if properly applied, provide an important supplement to the traditional methods of data collection, gathering a much more complete record of the events being analyzed.

Paul E. Matthiae
Resident Manager
UWM Field Station