The Science Behind Algonquin's Animals

New Technologies

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GPS Collars

In 1994 the first animal-based GPS (Global Positioning System) location system was introduced to the world of wildlife research. GPS technology automatically records an animal's location through a receiver in a standard telemetry collar which simultaneously receives signals from four satellites. Movement information is stored in a computer chip inside the collar, along with times and dates of the locations, and the estimated accuracy of the locations. Specified in advance by the researcher, data collection can be set at regular intervals of 15 minutes or as long as desired.

Because each GPS reading draws battery power, collar life varies with interval length. The current generation of collars can record between 2000 and 90 000 locations, making the life expectancy 20 days with 15 minute intervals and up to a year if the interval is 2 hours.

There are four main methods of data storage and retrieval that researchers can use in GPS telemetry; on-board storage for later collar retrieval and subsequent downloading, remote downloading to a portable receiver, remote relaying through a satellite system and remote relaying through a mobile radio network or GSM (Global System for Mobile Communication). Each one of these methods of data storage and retrieval has its advantages and disadvantages.

Collars with only on-board storage capabilities minimize efforts of researchers and invasiveness to the animal since only one handling is required. Once attached, the collar with stay with the animal until an automatic or remotely triggered drop-off mechanism releases the collar which can then be retrieved. The data then can be downloaded all at once from the collar. Another advantage is the relatively small size of the on-board storage collars as they contain relatively smaller circuitry and are less complex than other types of GPS collars and thus can carry heavier, longer lasting batteries for the same overall collar weight.

The on-board storage collars are less expensive since they are less complex and require less hardware such as special field receivers. As well, with remote or automatic release or drop-off mechanisms are advantageous because after retrieval they can be refurbished and reused.

The main disadvantage when using an on-board only GPS unit is data loss. If a collar fails to release, all the data is lost unless the animal can be recaptured. As well, since there are no intermediate data reports, the collar could malfunction and not collect data or may collect data at the wrong intervals. Some collars contain VHF beacons that alert researchers to the status of the last location attempt. However, the beacon only indicates that the unit appears to be functioning properly and does not transmit any data. Consequently, if the collar is not retrieved then all data is lost.

The second method of data retrieval is remote downloading to a portable receiver. This method ensures that at least partial data recovery will occur even is the collar malfunctions and fails to release from the animal. Data is remotely downloaded directly to the researcher throughout the study period. The collar is programmed to transmit data through a VHF signal to the researcher's receiver.

Researchers can receive reports as little as once per week or up to five times per day. This timely retrieval of data allows researchers to supplement the location information with field data. For example, if location data from a wolf indicated that the animal spent a large amount of time in a concentrated area then that may indicate the location of a kill. The researcher can then try to find the kill using a hand held GPS unit.

A very important feature with this type of GPS unit is long-term data retention following remote data transmission. While intermittent reports are valuable to researchers in allowing data analysis throughout the study, long term, on-board storage allows researchers to fill in any blanks when the collar is retrieved.

Some disadvantages to this method include the relative increase in complexity of the collar which contributes to the weight and cost of the telemetry unit and receiving equipment. Besides the cost, it takes additional labour to retrieve the intermediate data reports.

The third main method of data retrieval and storage for GPS telemetry uses a satellite system to relay the intermittent data reports. The researcher does not need to be in the field to collect the data reports or has to maintain special receivers and additional equipment.

A main disadvantage of this method includes the added bulk and weight of the telemetry unit since transmitting to satellites takes more power. The added weight limits the size of animal that can tolerate this type of GPS unit.

The fourth method of data retrieval which was introduced in March 2002 is through a mobile radio network known as the Global System for Mobile Communications or GSM. This method is similar to mobile phone service as the data is sent as an SMS (Short Message Service). The location coordinates of an animal are sent by a GSM modem that is integrated into the GPS collar directly to a researcher's office where they can be transferred by computer to a digital map.

The are several advantages of having a GPS-GMS collar is that the researcher does not have to be in the field to collect the data as it is sent directly to their office through a SMS. The researcher also has the option of receiving the data in real time by choosing to receive data after each GPS fix. This allows researchers to track an animal from the office in a time saving, environmentally sound, and inexpensive manner.

A main disadvantage of a GMS system is that the animal has to be in an area where GMS coverage is available in order for the data to be transmitted. Data will continued to be stored while the animal is out of the coverage area but not transmitted until the animal is back in the coverage area. Thus if a researcher has chosen to receive data after each GPS fix they may experience large gaps in there data sets.

Compared to conventional radio telemetry collars there are several advantages and disadvantages that GPS units possess. The most apparent advantage of the GPS collar is the large amount of data that can be collected. A good data set for traditional radio telemetry is around 200-300 locations. GPS collars can provide10 to 300 times that amount.

GPS collars cost more than a conventional collar, $3000 compared to $250, but overall research costs are considerably lower. The most expensive part of radio telemetry studies involves collecting the data, which includes personnel time, flight time and vehicle expenses. With GPS collars the data is collected automatically so other expenses are largely avoided. GPS collar expense can be further reduces by replacing batteries and reusing the collars.

GPS tracking also allows researchers to obtain data on an animal's location in all weather as frequently as every minute or as infrequently as once per week. They also provide greater accuracy than conventional collars, at least when conventional collars are tracked from the ground rather from an aircraft. Location errors with conventional telemetry can be half a kilometre or more. GPS locations are accurate to within 100 metres 95 percent of the time and can be made accurate to within 5 metres.

Another advantage is the data obtained from GPS collars which provides good approximations of routes traveled by animals and information about the animals' activity patterns. With GPS data and a GIS (Geographic Information System) program, it is possible to 'connect the dots' with lines, add the lengths of these lines and total the distances traveled at different times of day. This is possible with conventional radio telemetry but requires extensive around the clock field time and associated location errors would make comparisons less meaningful.

One apparent disadvantage of GPS collars is, while they provide increased accuracy, the longevity is much less than that of conventional radio telemetry collars. Depending on the frequency of the intervals for data collection a GPS collar will only last between 20 days and a year whereas conventional telemetry collars can last up to four years. Batteries can be replaced on GPS collars given them longer field life but this involves locating and recapturing the animal.

The cost of the collars is another factor. Costing nearly ten times as conventional telemetry collars this can limit the number of individual animals being tracked. If the animals are the study unit this reduced sample size can cause data-analysis problems when generalizing about a population.

The quantity of data that can be acquired with GPS collars will make some questions easier to address than in the past. For example, GPS and GIS data can show how dispersing wolves use the landscape. How often and when do dispersing wolves cross Highway 60 in Algonquin Park? How closely do they approach human-made structures and campgrounds? How often do they travel on logging roads and for how long?
The challenge in GPS telemetry may prove to be in the analysis of so much data. But for many researchers who are studying elusive animals such as the wolf, which are often studied with relatively small telemetry data sets, this will be a very welcome challenge.

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G.I.S.

Maps have always contributed invaluable information to wildlife research projects, lending graphic support to research proposals, queries and conclusions. Clear cartographic images are excellent communicators and research tools, yet traditional maps have always been limited in data representation. Paper maps are limited to flat, static images, representing a particular moment in time. The evolution of the digital map and Geographic Information Systems (GIS) dramatically changed the nature of spatial data representation.

A GIS is composed of a detailed digital map image that consists of a virtually unlimited number of data layers, each of which may represent various groups of features (e.g. soil type layer, vegetation layer, political boundary layer). Each feature of a digital map has the potential to be linked to characteristic data that relates to that feature. (e.g.

There are several advantages to using GIS in wildlife research. It allows for a smooth integration of field research data from a wide variety of sources and media. Location data from a GPS-GMS collar can be downloaded in a researcher's office daily where they can be transferred by computer to a digital map.

Related data linked to mapped features allow researchers access to an unlimited wealth of information. It also allows for the production of cost-effective maps, charts, tables and reports to support research objectives.