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Specialists in Animal Radio Monitoring

MORTALITY SENSING

Radio tags can be used to discover much about what an animal does when it is alive, but equally, a radio tag can help to discover when an animal is dead, and thereby how and why it died. A standard radio tag will permit the death of an animal to be discovered, simply by virtue of the tag having remained in one place for longer than expected, and by the absence of any of the fluctuations in signal strength that occur as an animal moves. However, it may be some days before the death is discovered, and in studies where causes of mortality are the prime research interest, such a delay is not acceptable (because the body may have decomposed or been damaged to the point where it is more difficult to determine the cause of death). In these mortality studies, there are special circuits that can be added to the transmitter to provide specific signal patterns when an animal dies. These circuits are either 'activity-mediated' or 'temperature-mediated'.

Activity-mediated mortality-sensing

This is the 'traditional' circuit used in radio tags to indicate when an animal has died. The tag is fitted with a special timing circuit and a mercury tilt-switch. The timer is reset by the switch whenever it changes state (i.e. on to off, or off to on). If the animal is alive, the switch will change state occasionally as it moves, and the timer will continue to be reset. If the timer is not reset during a predefined period (the 'time-out' period), the circuit will cause the transmitter pulse rate to become very fast, indicating that the animal may have died. The time-out period is typically 2-4 hours, but it can be set to almost any shorter or longer period if required.

If the animal moves after the circuit has switched to the fast 'dead' signal, the timer is reset and the pulse rate return to the 'live' signal. This is useful in preventing false alarms, but can cause a delay in finding bodies which are moved by a predator or scavenger. When it is particularly important to find an animal as soon as possible after its death, a temperature-mediated mortality-sensing circuit may be more appropriate.

Monitoring animal activity using mortality-sensing circuits

The mortality circuit can be adapted for activity-sensing. In this case the time-out is very short (e.g. 2 minutes) and the signal can be sampled to discover almost instantaneously whether or not an animal has moved within the time-out period immediately prior to the sampling time. This adaption is particularly useful when a number of animals are being monitored with a data logger. Rather than having to dwell on each tag frequency for an extended period to detect the occasional changes in pulse rate that indicate an animal is active, the logger can determine within just 2-3 pulse intervals (a few seconds) whether the animal has been active during the past few minutes. Thus the rate at which animals are sampled is greatly increased, potentially allowing more animals to be monitored without reducing the quantity of data collected.

Temperature-mediated mortality-sensing

Temperature-mediated mortality-sensing circuits use body temperature as an indicator of whether an animal is alive or dead. The main circuit component is a thermistor; a semiconductor device, the resistance of which changes with temperature. As the thermistor temperature falls, it increases the pulse rate of the transmitter. The principle of operation, therefore, is to fix the thermistor where it is as close as possible to skin temperature. When the animal dies and its body cools, the thermistor will cool with it, and the pulse rate of the tag will increase.

The thermistor is usually very small, and there are few other additional components in the circuit. Thus the circuit is inherently less costly and adds far less bulk and weight to a tag than does a conventional activity-mediated circuit. A further advantage of the temperature-mediated mortality circuit is that it can not be reset by a predator or scavenger after the animal carrying it is dead. Unfortunately the circuit also has two disadvantages, which can preclude its use on some species and in some climates. The first problem is that the thermistor must be able to monitor skin temperature, and this usually means that it must touch the animal's skin. This is fine with a backpack on a bird, where the thermistor is positioned under the tag where it can touch the bird's back, but it would not be practical to use a thermistor if the bird was tagged with a tail-mount. The position of the thermistor can also be problematic on a mammal collar or bird necklace where the tightness of the collar/necklace and the exact position of the thermistor determines what degree of contact is made between the thermistor and the neck. Unless a very loose collar must be used (e.g. because the animal's neck is expected to grow), it would usually be possible to position the thermistor in a suitable place where it would be at least insulated by the feathers or fur, even if it was not in direct contact with the skin. However, for each new species that is monitored using this circuit, it is often necessary to trial a tag or two before using them on a large scale.

The second, and more important, requirement of temperature-mediated mortality circuits is for sufficient differential between the thermistor temperature on a live animal, and external temperature. The circuit gives ambiguous results in hot climates, where a thermistor on a dead animal in direct sunlight could easily reach a much higher temperature than on a live animal. As a rule of thumb, the thermistor temperature on a live animal should be at least 10 'C above ambient temperature. When the thermistor is in close contact with an animal's skin, its temperature will be only a few degrees lower, and the circuit will then work well in most tempErate climate zones.

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