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Why publish *Animal Biotelemetry?*

A Peter Klimley

"Biotelemetry" refers to the sending of biological measurements from a transmitter on an animal to a receiver. The information is transmitted either with an ultrasonic (kHz) or radio signal (MHz). The ultrasonic signal is propagated by a ceramic ring, or piezo-electric transducer (PZT), whereas the radio signal is propagated by a conductive wire, or antenna. Which mode of telemetry is chosen to remotely monitor the behavior and movements of animals depends on the transmission properties of the medium. Marine scientists have utilized ultrasonic telemetry because a signal composed of those frequencies propagates quickly with little attenuation in salt water, whereas radio signals are absorbed quickly in this medium. Scientists working in the freshwater and terrestrial environments have mainly utilized radio telemetry because the signals of those frequencies propagate far in freshwater and air.

Telemetry has often been used to study large marine vertebrates because poor visibility has limited direct observation. Tagged marine fish were first followed by boat, while determining the direction of the subject with a directional hydrophone and estimating its position by situating the boat above it and recording a position. The first transmitters were beacons that enabled researchers to describe the daily offshore migrations of tunas off Hawaii [1]. Later tags were equipped with multiple sensors such as those used to record the depths and headings of scalloped hammerhead sharks, and the water temperatures and underwater illumination to understand their navigational abilities [2]. Additional sensors continue to be developed such as an accelerometer used to identify behaviors from records of an individual's movement along three axes [3] and pH sensors to detect feeding by a change in pH in the stomach associated with digestion [4].

Shipboard tracking of animals is an arduous activity. The recent development of coded beacons and small automated receivers have made it possible to describe simultaneously the "homing" behavior of multiple individuals to "hot spots" such as reefs and seamounts in the ocean and their seasonal residence at these spots [5]. Arrays of closely spaced receivers can record the paths of multiple individuals in confined areas such as white sharks feeding on seals near an insular colony [6]. Another landmark in animal tracking was the development of microprocessor based data-storage, or archival tag. The first such tags had to be retrieved to download the stored data, so they were first placed on seals that return annually to a rookery [7] and next on bluefin tuna that have high recapture rates [8]. The utility of data storage tags was increased with a corrosive link added to the tag so that it would float to the surface at a preset interval and transmit its information to the ARGOS satellite. These pop-up archival tags (PATs) were first used to delineate long-distance migrations of white sharks from the coast near seal colonies into the North Pacific Ocean [9].

The migrations of fresh water fish and home ranges of terrestrial species were first delineated using very high frequency (VHF) transmitters attached to animals and tracking them using a directional antenna. A radio transmitter was developed [10] and used to track fish in fresh water [11] at roughly the same time they were being placed on mobile terrestrial animals such as mountain lions [12] and later tigers [13] to describe their home ranges. Satellite transmitters were first placed only on the larger terrestrial vertebrates, due mainly to the large size of the transmitter and battery pack, such as black bears [14] and elk [15]. They were positioned using the Doppler principle with the polar orbiting ARGOS satellites. The size of these satellite transmitters has decreased steadily with the switch from the use of discrete electronic components to very large scale integrated circuits. Of recent significance to terrestrial animal tracking was the launching of the Global Positioning System, an array of geostationary satellites that permit the tags to determine their position by the difference in the time arrival of a signal from a satellite [16]. The GPS transmitter could be smaller because it did not need a large power supply to transmit a signal. However, the some GPS tags now have a VHF stage, which downloads the data in the satellite to a stationary receiver. These tags are so miniaturized now that

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they can be attached to small birds, and contain electrodes to monitor the neural activity of birds when orienting to visual landmarks [17].

I have given a brief personal view of the history of biotelemetry. However, there is planned to be three thorough reviews published in the first year of the journal on the history of telemetry in the marine, freshwater, and terrestrial ecosystems. In the beginning, only a few investigators tracked animals with devices built in their own laboratory. Now there are numerous companies that build electronic tags ranging from passive devices that store information such as archival and GPS data loggers, to active devices that transmit their information to underwater recorders or satellites such as coded ultrasonic beacons and pop-up archival tags respectively. These transmitters are providing important insights into the physiology and behavior of a plethora of species ranging from the small salmon smolt to large white shark during many important life events such as their long distance migrations. *Animal Biotelemetry* will serve as an outlet for publishing the results of studies utilizing telemetric techniques to understand physiological, behavioral, and ecological mechanisms in both terrestrial and aquatic species. Furthermore, the journal will provide a venue for descriptions of newly developed tracking technologies, and importantly new methods for analyzing telemetric data.

Specifically, the journal will serve as a venue for the following types of information:

1) Descriptions of the movements, behaviour, physiology and ecology of aquatic and terrestrial animals determined using electronic tags.
2) Applications of telemetric data to address applied conservation and wildlife management problems.
3) Innovation in the design of tracking systems, electronic tags, sensor design, and power sources.
4) Development and application of analytical methods, geographic information systems and software for processing telemetric data, including circular and home range statistics, vector analyses, and simulations using diffusion and random walk models.
5) Establishment of the range of radio and acoustic transmitters with varying power levels.
6) Evaluation of the effects of existing and novel tag attachment techniques on the physiology of species to ensure that animal behaviour and survival is unimpaired by diverse tagging techniques.

The journal is to provide a detailed, constructive and informative peer review that will help the editors make a decision on publication and the author(s) improve the manuscript. In a general sense, reviewers will be asked to identify the overall strengths and weaknesses of the manuscript and asked to provide guidance on how the manuscript could be improved to make it acceptable for publication in *Animal Biotelemetry*. There are several points to keep in mind when presenting the results of a telemetric study. Description of the methods and results of the study should be clear, and placed in the context of the existing scientific literature. Sufficient detail must be provided to allow readers to evaluate your work. The number of subjects tracked should be adequate to support the conclusions of the study. If not justified using a power analysis, a pilot study may be necessary to determine the proper samples size. A modest number of individuals may be tracked in the absence of information on the behaviour and movements of a particular species. One should ask whether something new has been learned and if there is a clear conclusion from the study. Associate Editors, each chosen for his or her taxonomic and technological expertise, will guide authors through the review process and help to produce a first class publication.

There are some unique aspects to open access publishing, which will benefit both authors in and readers of *Animal Biotelemetry*. All articles are freely and universally accessible online, so an author's research is available to readers at no cost and not limited by their library's budget. This ensures that research published in the journal is disseminated to the widest possible audience. Open access journals have the potential to reach a much larger set of readers than any subscription-based journal, in print and online. Some studies have suggested a correlation between open access, higher downloads and higher citations, leading to a higher impact journal- as measured by, for example, Impact Factor. Authors retain copyright for their work and grant anyone the right to reproduce and disseminate the article, provided that it is correctly cited, and without the introduction of errors. The journal will be included in a number of freely accessible full-text indexing services and articles will be archived soon after publication in these repositories. This means that the information will be available not only to academics but also to policy makers, sharing important, conservation-based information about some of the world's most charismatic animals such as white sharks and black bears.

There will be a diversity of articles published at the launch of *Animal Biotelemetry*. One article will present evidence on the efficacy of using ultraviolet radiation to disinfect the tools used in surgically implanting transmitters in fish. Another article will reveal the best method of fitting tags into the peritoneum of long and slender European eels. In the third article, the widely separated migratory paths of white sharks will be shown for successive years based on the positioning of a tag fitted on the dorsal fin that transmits when the shark rises to the sea surface and the ARGOS satellite is overhead.

A challenge that confronts all of us, who collect vast quantities of data, be they behavioral measurements such as an animal's height or depth, flying or swimming speeds, movement along three axes, or environmental measurements of temperature and irradiance levels, is how to best to distil them to answer important scientific questions. It is the aim of this journal to provide to provide a forum for the biotelemetry community to present their work in an understandable and convincing fashion at one site where the results of the studies will be easily accessible by a diverse audience of academics, agency scientists, consultants, and those interested in the general public.

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