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Finding our way: On the sharing and reuse of animal telemetry data in Australasia

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HIGHLIGHTS

- Details the breadth and depth of animal telemetry research in Australasia
- Less than half of all telemetry research has been published
- Less then 8 % of telemetry data is discoverable
- Provides direction to enhance data sharing across the discipline

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ABSTRACT

The presence and movements of organisms both reflect and influence the distribution of ecological resources in space and time. The monitoring of animal movement by telemetry devices is being increasingly used to inform management of marine, freshwater and terrestrial ecosystems. Here, we brought together academics, and environmental managers to determine the extent of animal movement research in the Australasian region, and assess the opportunities and challenges in the sharing and reuse of these data. This working group was formed under the Australian Centre for Ecological Analysis and Synthesis (ACEAS), whose overall aim was to facilitate trans-organisational and transdisciplinary synthesis. We discovered that between 2000 and 2012 at least 501 peer-reviewed scientific papers were published that report animal location data collected by telemetry devices from within the Australasian region. Collectively, this involved the capture and electronic tagging of 12 656 animals. The majority of studies were undertaken to address specific management questions; rarely were these data used beyond their original intent. We estimate that approximately half (~500) of all animal telemetry projects undertaken remained unpublished, a similar proportion were not discoverable via online resources, and less than 8.8% of all animals tagged and tracked had their data stored in a discoverable and accessible manner. Animal telemetry data contain a wealth of information about how animals and species interact with each other and the landscapes they inhabit. These data are expensive and difficult to collect and can reduce survivorship of the tagged individuals, which implies an ethical obligation to make the data available to the scientific community. This is the first study to quantify the gap between telemetry devices placed on animals and findings/data published,

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and presents methods for improvement. Instigation of these strategies will enhance the cost-effectiveness of the research and maximise its impact on the management of natural resources.

1. Introduction

Animal movement reflects and influences the distribution of ecological resources in space and time (Brown et al., 2013). Understanding movement assists in assessing how animal populations and ecosystems may respond to natural (e.g. climatological, geomorphological) and anthropogenic (e.g. habitat loss and disturbance) changes, and as a consequence, there is a growing body of research investigating the causes, mechanisms, patterns and impacts of animal movement (Nathan et al., 2008). The advent of satellite-based animal telemetry, combined with advances in receiver technology, battery-life, and miniaturisation, has dramatically increased the duration, frequency, and accuracy by which researchers and resource managers can record observations from free-ranging animals (Tomkiewicz et al., 2010). This has resulted in a proliferation of studies utilising animal-borne devices, and throughout Australasia many species have had their movements recorded.

National collaborative cyber-research infrastructures (e.g. DataONE (USA), Dryad (UK), Terrestrial Ecosystem Resource Network (Australia)) are enhancing scientific innovation in the environmental and ecological sciences through the discovery, sharing and reuse of environmental data (Hampton et al., 2012, 2013). A search of these national data repositories however, reveals that collections of animal telemetry data are poorly represented, and the current number of projects using collaborative infrastructure framework does not reflect the high usage of animal-borne devices by the ecological community. A working group, sponsored by the Australian Centre for Ecological Analysis and Synthesis (ACEAS), was convened in 2012 to bring together field biologists, resource managers, statisticians, modellers and policy makers to discuss this issue and assess the opportunities and challenges for the sharing and reuse of animal telemetry data via national collaborative cyber-infrastructures.

Our first objective was to characterise the variety and frequency of animal telemetry research throughout Australasia and quantify research output. Although we were primarily interested in ecosystem science and management in Australia, we included the wider Australasian region because many marine and avian species move throughout this region. Our study was limited to research projects that began after 1999 because after this period was really when animal telemetry research exploded onto the animal ecology scene. This was due to technological development, miniaturisation, improvements in power consumption and reduction in costs, and because of the removal of 'selective availability' from GPS satellites (i.e., the accuracy of the satellites was no longer intentionally degraded; Tomkiewicz et al., 2010). Our second objective was to determine the number of animal telemetry research projects that were discoverable via online ecological data-repositories for the same temporal and spatial extent, thereby allowing us to determine the proportion of telemetry datasets that are shared with the wider ecological community. Finally, we assessed the opportunities and challenges associated with sharing and reusing animal telemetry data, for purposes for which they were not originally collected. Based on the findings from these studies, we discuss the current state of collaborative use of animal telemetry data across Australasia and suggest how trans-disciplinary collaboration may assist us to enhance the emerging discipline of movement ecology into the future.

2. Methods

The ISI Web of Science (WoS) online was used to search for peer-reviewed publications containing one of 30 different keywords commonly used to describe animal telemetry studies (Supplementary data). These publications were further refined within the WoS to include only papers published between and including 2000 to 2012, and undertaken in the Australasian region (Australia, New Zealand, Papua New Guinea, Solomon Islands and New Caledonia). The following information was extracted for each publication where possible, publication year, scientific journal, study time frame, corresponding author contact details, primary institute responsible for the study, funding agency, study purpose, number of citations, longitude and latitude of study site, study species, telemetry technology employed, total number of tagged individuals and total tracking days. Only one publication was counted for each research project.

To estimate the proportion of publications that are missed by the WoS search we communicated directly with 10 of the authors in the database to obtain comprehensive lists of relevant publications. The difference between the number of papers in the WoS database and the actual number of papers provided by the authors is a measure of the proportion of missed publications.

We hypothesised that approved permit applications could be used as a proxy for the total number of animal telemetry projects (both published and unpublished) undertaken in the region. Local authorities in Australia and New Zealand were approached and requested to provide details on approved ethics applications. Unfortunately, permit applications could not be acquired for all areas in the Australasian region because different countries and states stored this information in different formats, and many were stored in paper format in decentralised archives. Therefore, for efficiency, we focused on only those animal telemetry studies conducted in New Zealand, where all permit applications had been submitted, authorised, and stored electronically through a central authority (i.e. the Department of Conservation). Researchers with approved permits were then asked to provide further details relating to the number of tags actually deployed and what technology was used.

Comparisons were then made between the animal telemetry projects undertaken and those reported in the scientific peer-reviewed publications. The proportion of the total number of research projects that were actually published was extrapolated throughout the Australasian region under the assumption that the proportion of unpublished animal telemetry studies did not vary among countries. We base this on the fact that; 1/ the majority of the research throughout the region is undertaken by researchers based at New Zealand or Australian institutes, 2/ both countries have a similar socio-economic index, 3/ the academic and research outputs of the universities within the two countries are similar, and 4 /both are English speaking.

Finally, a search of on-line facilities that store ecological data within the Australasian region (Movebank.org, OzTrack.org, OBIS-SEAMAP, Seaturtle.org, Terrestrial Ecosystem Resource Network, Australia National Data-service, Integrative Marine Observing System, The Atlas of Living Australia) was undertaken. This was then used to assess the proportion of completed animal-telemetry projects that were discoverable online, as well as collections of animal telemetry data that were open-access and available for download by a third-party.

3. Results

Based on the literature keyword searches, 501 papers that used animal-borne telemetry devices in the Australasian region had been published in 116 different journals between 2000 and 2012. These papers had been cited 5593 times (April 2013), and averaged 11.00 ± 0.59 (mean ± S.D.) citations per publication. This body of scientific research involved the capture and tagging of 12,656 animals, and amassed 81,546 tracking days. Comparing our database with a selected subgroup of authors, the database contained 81% of the total number of