Sampling interval in telemetry studies on animal home ranges

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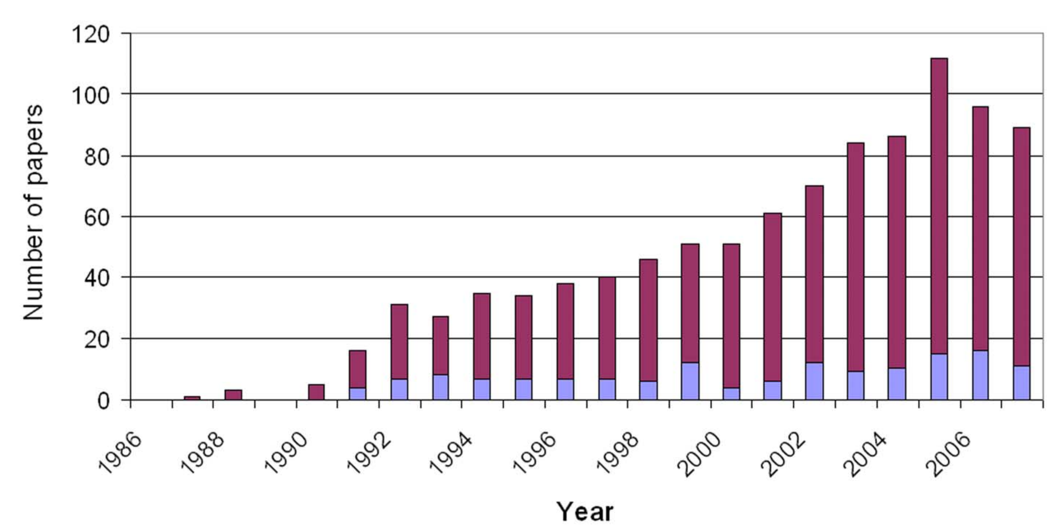
1. Introduction

The home range of an animal has been defined as "that area traversed by the individual in its normal activities of food gathering, mating, and caring for young" [1]. The size and shape of animal home ranges provide important biological information on the species in question and home range analysis has received growing attention in biology (*Fig. 1*). Home ranges are usually modelled from discrete observations obtained by tagging individuals with various types of VHF or GPS transmitters.

Modern methods to calculate home ranges can be highly sensitive to sampling regime [2, 3, 4, 5, 6, 7]. Therefore, it is important to decide on a proper sampling interval. This issue has received much attention in the literature for decades, with contradictory views on the relevance of autocorrelation (whether the location of an animal at time t+1 is dependent on the location of the animal at time t). Swihart and Slade [8] have provided the only statistical method for calculating autocorrelation and the time to independence (TTI) between locations. The underlying assumptions for their calculations however only apply to a very few real cases and recent studies have shown that relevant biological information may be lost with the elimination of autocorrelation [9, 10, 11]. Still, a standardized sampling method for calculating home ranges is crucial for comparison and statistical tests [6, 12]. An even (continuous) sample interval is probably the best method to obtain unbiased locations, regardless of autocorrelation of locations as long as the duration of the study is sufficient [6, 12, 13].

Fig. 1 . Number of papers on home ranges in scientific journals from 1986 - 2007 and the number of them that quote Swihart and Slade (1985) (in blue)



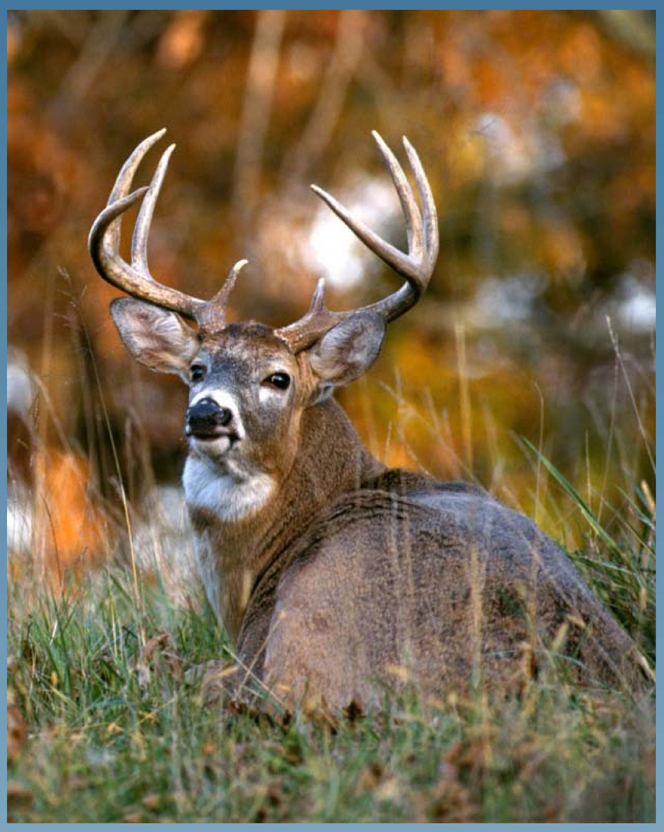
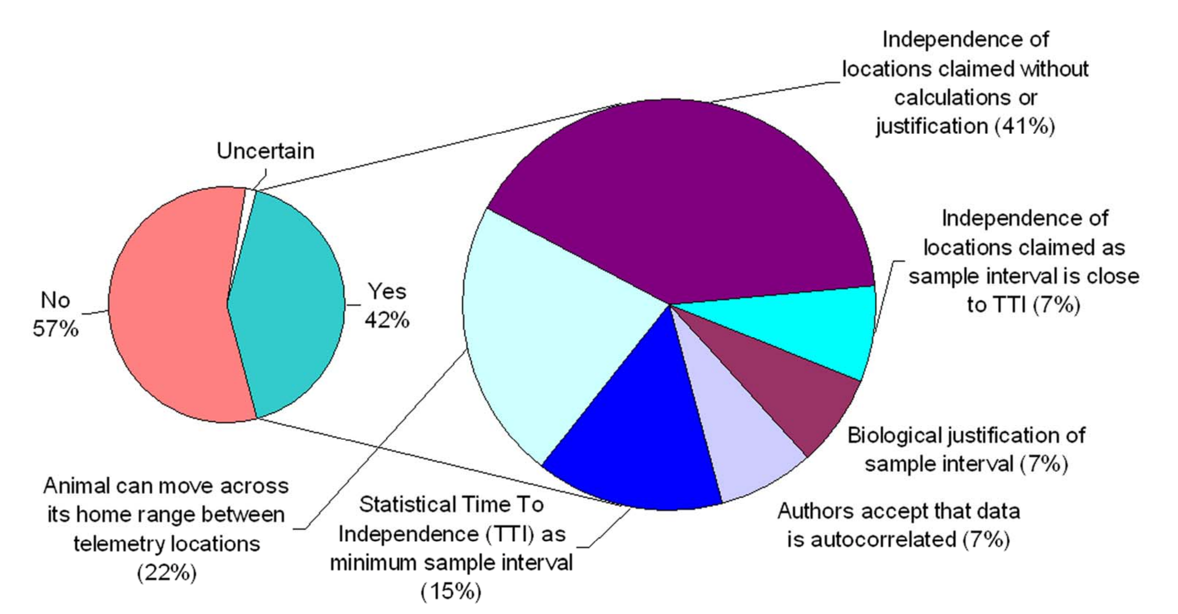


Fig. 2. Is sample interval justified in recent literature?



2. How are things done today?

A literature review of 75 home range articles published in 2006-2007 indicates that many authors pay little attention to the relevance of an appropriate sample interval (*Fig. 2*) and the majority of home range studies collect data in a discontinuous manner (*Fig. 3*).

The use of kernel methods [14] to calculate home ranges and utility distributions has grown considerably in the last years (*Fig. 4*). This is not surprising as kernel methods have been reported to be superior to other methods available today [2, 15, 6].

Fig. 3 . Method of radio tracking in recent literature

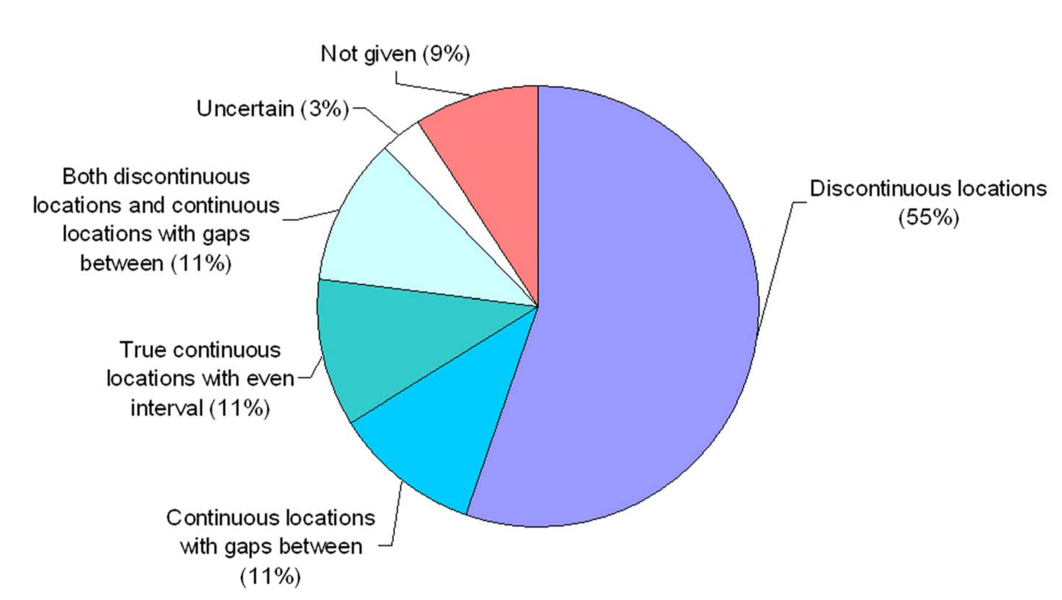
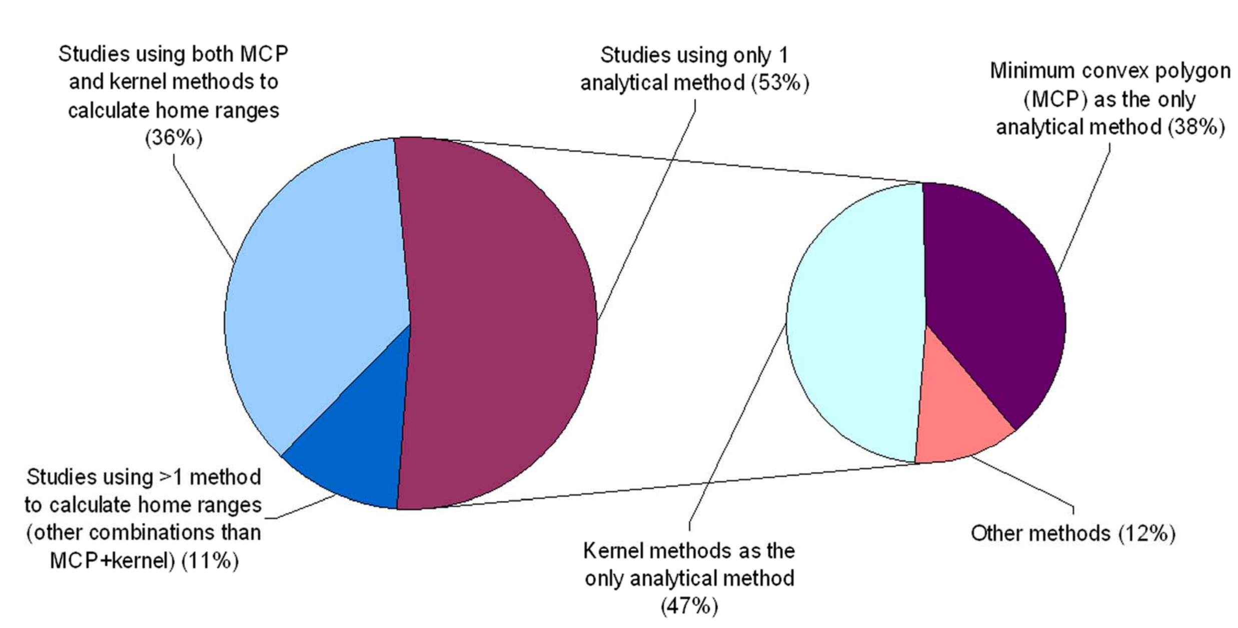


Fig. 4 . Analytical methods used to calculate home ranges in recent literature



3. What can be done in the future?

There is a need to find a practical solution to calculate the appropriate time interval between consecutive locations in animal home range studies. We propose 3 new methods:

A) Biological time to independence

In cases where continuous location sampling may be difficult or impossible, we propose that a biological time to independence should be calculated and used as the minimum time interval between locations. In this case, it is necessary to take account of several factors in the biology of the animal in question: 1) the average travelling speed when active, $\bar{r}$, 2) the average proportion of activity over each 24 hour cycle, $\bar{a}$, and 3) an approximate home range length, ι.

BioTTI = $(\iota / \bar{r}) / \bar{a}$

B) Incremental analysis on the effect of a growing sampling interval

In cases where an even sample interval is possible, we propose using an incremental analysis on the effect of a growing sampling interval on the home range size, with a fixed total sample of 50 locations. We choose 50 locations as it is the recommended number of locations needed for the kernel methods to accurately describe an underlying utility distribution [7] and a sample size of ≥ 50 should overcome the possible effect of telemetry error on kernel home range estimates [16].

C) Minimizing the number of locations with identical coordinates

When datasets are very large (such as those obtained with GPS tagging), researchers can experience difficulties in their data analysis due to a large number of identical locations, as animals repeatedly use the same spots within their home ranges [3].

In these cases we suggest minimizing the number of identical locations by using the average maximum duration of inactivity per 24 hour of the animal in question as the sample interval, as long as the interval will provide locations dispersed over the 24 hour solar day.

4. Summary

The lack of standardization of sample regime and analytical methods in studies of animal home ranges can make comparison across studies difficult and lead scientists to wrong biological conclusions. We hope that our suggestions will help researchers finding an appropriate sample interval to overcome a part of this problem.

5. References

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