

GPS Tracking, Are We Still Lost?

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Advances in science are often underpinned by the development of new tools to measure and quantify processes and interactions. Calibration and validation of novel data collection tools provides the basis for interpretation. Since the early 1990's satellite based global position systems (GPS) have provided unique and novel data that has been used to track animal movement (Hulbert and French 2001). Tracking animals with GPS provides new and interesting data, but the cost of devices often limits the number used in experiments. The reduced numbers of devices in combination with technical constraints can potentially weaken the statistical power of experiments and create significant experimental design challenges.

Scientists working in extensive landscapes have driven the use of GPS based devices for tracking animals and they have mostly considered the location and movement of semi-domesticated herbivores (Ungar *et al.* 2005). A small number of commercial companies provide off-the-shelf GPS units for animal experimentation. However, these commercial devices can be expensive and do not always have the functionality required by researchers; as a result animal scientists often develop and build in-house devices to meet their specific research needs. Technology limitations including spatial accuracy, rate of data collection, battery life and environmental factors causing loss of data have preoccupied animal science researchers (Hulbert and French 2001; D'Eon 2003; Frair *et al.* 2004). It is therefore not surprising that there have been a significant number of methodological papers published in the literature that have considered novel GPS based techniques to track animal movement.

Livestock scientists have used GPS data to inform them about behavioural differences between treatment groups in free-grazing experiments (Rutter *et al.* 1997; Ungar *et al.* 2005). A shift in focus from the environment to the animal brings the challenge of ensuring independence of the experimental unit; is it the individual animal or the herd? Social facilitation challenges independence of the individual in a group.

This paper explores some of the assumptions and considerations that livestock scientists might wish to consider when deciding whether to use GPS to track animal movement. We consider how GPS data can be used as an explanatory variable within studies that are observing the impact of grazing animals in the environment. The opportunity to use GPS data for behavioural studies is explored and in particular we consider what is an appropriate experimental unit. We explore how GPS data might be used to determine whether there is independence between individuals within free grazing livestock experiments (i.e. where the interaction within the group no longer influences the individual animal).

There has been a disproportionately large amount of effort put into research to establish and validate GPS technology for animal monitoring. As spatial livestock monitoring tools become more widely used, there will be a greater need to ensure the data and associated processing methods are able to answer a broader range of questions. Experimental design and analytical techniques need to be given more attention if GPS technology is to provide answers to questions associated with free-grazing animals.

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