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Tracking vertebrates for conservation: Introduction

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The overarching mission of *Endangered Species Research* (ESR), when founded, was to support the protection of nature (Kinne 2004). Management and conservation efforts for many vertebrate species need explicit data on animal spatial ecology, and acquisition of these are often problematic because many species prefer not to be seen and may travel large distances in habitats that prove difficult for researchers to operate in. It is thus, with pleasure, that we introduce 2008 with a significant body of research that helps rise to these challenges.

The difficulties in tracking vertebrates have resulted in great ingenuity in the development of methodologies, devices and data analysis techniques, and this essence has been captured by this Theme Section (TS) of ESR, spanning 2 issues (Vol 4, Nos. 1 and 2).

Satellite tracking of marine turtles. The TS has grown from the 1st Inter-Research Symposium held within the context of the International Sea Turtle Symposium, and one of the major foci of the TS is this animal group. We begin with a review of how, despite a number of biases, satellite tracking has allowed significant conservation-relevant insights into the movements of sea turtles (Godley et al. 2008). This is followed by papers detailing original studies on 4 sea turtle species. Adult female Kemp's ridley turtles are tracked from nesting sites in the USA (Seney & Landry 2008) and Mexico (Shaver & Rubio 2008), the latter study illustrating how artificially reared individuals fared in comparison to wild individuals. With the largest published sample size yet for the species, Van Dam et al. (2008) elaborate the differences in the post-reproductive migratory patterns of male and female hawksbill turtles. Seminoff et al. (2008) track adult female green turtles, following nesting in the Galápagos, and highlight a behavioural polymorphism in migratory behaviour, with some individuals remaining resident in the archipelago, others moving to coastal waters of South America and, perhaps most surprising of all, some moving to oceanic waters. Finally, 3 papers explore movements of leatherback turtles using novel tagging methodologies (Doyle et al. 2008, Fossette et al. 2008) and consider possible tagging effects (Fossette et al. 2008, Sherrill-Mix & James 2008).

Satellite tracking of other marine vertebrates. Satellite tagging is used to offer conservation-relevant insights into other marine vertebrate taxa. Space use of the endemic Galápagos penguin is described, highlighting that depth and foraging range were much less than would have been predicted by allometric scaling and that animals are very coastal, a worrying finding given the intensity of coastal fishing in the Galápagos despite the relatively low human population (Steinfurth et al. 2008). In contrast, little penguins are tracked in a highly developed habitat, demonstrating the potential threats that might result from anthropogenic activities such as dredging (Preston et al. 2008). In an attempt to maximize any data collected using devices on animals, Tougaard et al. (2008) suggest how to use low precision satellite tracking fixes from harbour seals to model space utilisation, while Thomton et al. (2008) use satellite transmitters to assess the behaviour of juvenile Steller's sea lions following release from captivity.

Other methods of tracking marine vertebrates. There is a growing battery of techniques available for tracking marine vertebrates with developments that are particularly exciting for conservation issues. Where animals can be recaptured, data logging using new and carefully combined sensors offers great potential. While geolocation using light sensors has been employed extensively on birds and fish, Fuller et al. (2008) demonstrate the potential of this approach for sea turtles. Novel techniques are also presented for the measurement of speed, something that has been particularly problematic in the marine environment (Shepard et al. 2008), and flipper stroke rate in pinnipeds (Insley et al. 2008), considered a good measure of how hard animals are working. Wilson et al. (2008) present the first formal articulation of the 'Daily Diary', a generic tag using up to 13 different sensors that also enables workers to approximate the (activity-specific) energy expenditure of free-living animals as well as providing information which allows area use and ani-

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mal route to be determined, along with the environmental conditions experienced by the animal.

More traditional methods. We must not forget that much is to be gained using time-served methodologies applied to modern concerns; especially in the terrestrial environment. From its simplest inception, tracking using spoor left by wild animals can be used in their management and Alibhai et al. (2008) demonstrate this admirably in exploring how specific and individual identification may be possible from footprints of the white rhino. Koprowski et al. (2008) and Lim & Ng (2008) show how useful straightforward radio-tracking can be in Mt. Graham red squirrels and Sunda pangolins, respectively. Finally, Koehn et al. (2008) show that, although radiotelemetry is generally considered poor for tracking aquatic vertebrates, it can lead to useful insights in more geographically constrained systems.

Ethics in tracking studies. It is clear that tracking studies have much to offer conservation and this is overviewed by Cooke (2008); however, he also cautions that much should be done to ensure that such studies do not worsen the situation they seek to inform. As previously mentioned, Sherrill-Mix & James (2008) and Fossette et al. (2008) both critically appraise tagging technologies used in leatherback turtles. As Editors, we would encourage the submission of further such studies.

Additional Theme Sections. The success of this first ESR TS is very apparent and we look forward to building others. It is clear that that there is additional demand for a further tracking TS in the near future. We therefore, encourage further tracking submissions or discussions as to the possible suitability of manuscripts.

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