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Using spatially explicit models to determine seasonal differences in space use and behaviour of feral buffalo in the Northern Territory

Kyana N. Pike [a], Maryam Golchin [a,b] Justin Perry [c], Eric Vanderduys [d] and Andrew Hoskins [a,b]

[a] Health & Biosecurity / Environment, CSIRO, Townsville, Australia
[b] College of Public Health Medical and Veterinary Sciences, Australian Institute of Tropical Health and Medicine, James Cook University, Townsville, Australia
[c] Northern Australian Indigenous Land and Sea Management Alliance, Australia
[d] CSIRO Environment, Brisbane, Australia
Email: kyana.pike@csiro.au

Abstract: Managing feral buffalo in northern Australia has become a formidable challenge. In the Northern Territory, there are over 200,000 Asian water buffalo (*Bubalus bubalis*), and their large and dense population causes a multitude of economic, biosecurity, cultural, and environmental problems (Collier et al., 2011; Robinson and Whitehead, 2003). Traditional Owners, environmental managers, and landowners, thus need to know where buffalo are in the landscape and what they are doing to adequately manage and mitigate these issues. However, due to the remoteness of buffalo inhabited areas there is limited infrastructure and access available, and the buffalo's large size and aggressive nature make them very difficult to observe and manage in the wild. Advances in Global Positioning System (GPS) tracking technology allows managers to safely collect high frequency, remotely sensed data on animal locations in space and time that overcome some of the issues of working in logistically challenging locations. The next challenge then becomes extracting ecological metrics from these data with appropriate modelling techniques that accounts for the inherent spatio-temporal autocorrelation and restrictions of high frequency data (Calabrese et al., 2016). Here we present a success story of harnessing spatially explicit movement models to understand buffalo movement and social behaviour to provide data-rich decision support to wildlife managers. We used continuous time movement models to produce autocorrelated kernel density estimates of buffalo home ranges and social encounter area from 126,567 locations from 17 buffalo GPS tracked over a 16-month period. We compared the movement, space use, and social behaviour of buffalo between the wet and dry season of the Djelk area, when resource availability is vastly different in the wetlands of the Northern Territory. We found in the dry season, buffalo space use was restricted, and the size of their home range was significantly smaller than in the wet season. During the wet season, buffalo expanded their home range area as well as their social encounter area with other buffalo. These differences in their space use and social patterns suggest, increased disease surveillance may be needed for the wet season when buffalo were more likely to share space and interact. During the dry season however, buffalo movement was more predictable and restricted, suggesting greater optimization opportunities for the sustainable harvest of buffalo. Results from these models can be used by land holders, Traditional Owners, and wildlife managers to make evidence-based decisions to improve buffalo management in respect to disease risk, sustainable harvest, and damage to environmental and cultural assets.

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