Behavioural states as a proxy for habitat hotspots by mountain goats (*Oreamnos americanus)* using hidden Markov models

LAURA KROESEN, Biological Sciences, Simon Fraser University, Vancouver British Columbia, Canada

DAVID HIK, Biological Sciences, Simon Fraser University, Vancouver British Columbia, Canada

SETH CHERRY, Lake Louise, Yoho and Kootenay National Parks, Parks Canada, Radium Hot Springs, British Columbia, Canada

ABSTRACT: Understanding where, why, and how individual animals move is a fundamental biological question, but, directly observing animal behaviour and the habitat they utilize is logistically challenging. Mountain goats (*Oreamnos americanus*) are elusive high alpine ungulates that live in steep and mountainous environments where it is difficult to directly observe and record behaviour. Hidden Markov models (HMM) are emerging as a useful method for predicting the behaviour of animals over space and time. We used HMM to identify hidden behavioural states and predict habitat hotspots of mountain goats. We evaluated how these inferred states can serve as a proxy for identifying habitat hotspots. We explored associated environmental covariates, time of day, and distance from escape terrain, to explain these behaviours, and visited field sites selected by mapping fast and slow movements of mountain goats to look for physical evidence of several behaviours, including foraging, travelling and bedding. We found mountain goats are most likely to forage during daylight hours away from escape terrain, travel within and away from escape terrain during the crepuscular periods and bed nearest to escape terrain in the night-time and afternoon. The inferred behavioural states were validated against the field observations. Our results illustrate that HMMs have the power to predict habitat hotspots of mountain goat and this approach may assist wildlife managers in assessing locations where mountain goats spend most of their time and the movement corridors that connect them.

KEY WORDS: Mountain goat (*Oreamnos americanus*), Hidden Markov Models (HMM), movement ecology, animal behavior, Rocky Mountains