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Classifying and inferring behaviors using real-time acceleration biotelemetry in reproductive steelhead trout (*Oncorhynchus mykiss*)

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Abstract

Movement behaviors are central to ecology and conservation. Movement sensing technologies can monitor behaviors that are otherwise difficult to observe under field conditions and may enhance the ability to quantify behaviors at the population scale. We monitored steelhead trout (*Oncorhynchus mykiss*) spawning behaviors in a seminatural enclosure using accelerometer telemetry tags while simultaneously observing behaviors with underwater cameras. Behavioral assignments from visual observations were compared to acceleration histories to develop assignment criteria for acceleration data, including for a key behavior (oviposition). Behavioral events independently classified using acceleration data prior to reviewing video were compared to video scoring and 97% of holding behaviors, 93% of digging behaviors, and 86% of oviposition/covering behaviors were correctly assigned using acceleration data alone. We applied the method to *at-liberty* steelhead in spawning tributaries. Acceleration records revealed putative spawning and oviposition in *at-liberty* female steelhead, and time budgets for *at-liberty* steelhead were similar to those monitored within enclosures. The use of similar movement sensing tags and classification approaches offers a method for monitoring movement behavior, activity budgets, and habitat use in a broad array of aquatic and terrestrial taxa, and may be especially useful when behaviors are cryptic.

KEYWORDS

accelerometer, biotelemetry, intragastric, radio telemetry, steelhead spawning

1 | INTRODUCTION

Movement behaviors of animals are linked to individual fitness at multiple scales. Therefore, understanding movement behavior is critical to understanding factors affecting species of ecological and management interest. Collecting movement data on species in visually limited environments has been particularly challenging. Improvements in optics (Graham, Jones, & Reid, 2004), acoustic cameras (Martignac, Daroux, Bagliniere, Ombredane, & Guillard, 2015; Mueller, Brown, Hop, & Moulton, 2006), and the use of passive integrated transponder (PIT) tag (Roussel, Haro, & Cunjak, 2000) and accelerometer tag technology have enhanced the capacity for tracking movements and behaviors (Broell, Taylor, Litvak, Bezanson, & Taggart, 2016; Moser, Corbett, Burke, & Langness, 2018; Thiem et al., 2015; Watanabe, Wei, Du, Li, & Miyazaki, 2013). The development of commercial accelerometer telemetry tags will provide