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Short communication

Camera traps at northern river otter latrines enhance carnivore detectability along riparian areas in eastern North America

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ABSTRACT

We evaluated the efficacy of placing camera traps at river otter (*Lontra canadensis*) latrines (discrete sites in riparian areas where otters regularly deposit scats, urine, and anal secretions) to detect other carnivores occupying Great Swamp National Wildlife Refuge, New Jersey, USA. We postulated that scents at latrines may serve as an attractant to other carnivores and evaluated this premise by using camera traps to compare carnivore detection rates (overall and by species) and richness (overall and for each survey month) between latrine ($n = 5$) and non-latrine riparian areas ($n = 5$). On average carnivore richness was about 1.7 times higher than that of a non-latrine, and mean richness was higher at latrines for all survey months. Likewise, the overall carnivore detection frequency was 3.5 times greater at latrines, and the detection frequencies for red foxes (*Vulpes vulpes*), northern raccoons (*Procyon lotor*), river otters, mink (*Neovison vison*), long-tailed weasels (*Mustela frenata*), and Virginia opossums (*Didelphis virginiana*) were greater at latrines. American black bears (*Ursus americanus*) and eastern coyotes (*Canis latrans*) where detected more frequently at non-latrines. Our study provides evidence that placement of camera traps at otter latrines may serve as a new and novel approach for monitoring carnivore populations in riparian areas.

1. Introduction

Use of camera-trap surveys is particularly effective when collecting information on rare and elusive mammals, such as many species in the Order Carnivora (Kays and Slauson, 2008). For instance, based on a review of 266 camera-trap studies conducted from 2008–2013, Burton et al. (2015) point out that carnivores were the focus of 64.7% of those studies. Although camera trapping continues to expand in carnivore investigations, applications for use of camera-trap surveys to detect carnivores are still developing and can benefit from further refinement and innovation (Harmsen et al., 2010; Meek and Pittet, 2012). In North America, northern river otter (*Lontra canadensis*; hereafter otter[s]) latrines may serve as an attractant for sympatric carnivores and be ideal locations to place camera traps to detect carnivores.

Otters establish latrines by consistently depositing scat, urine, and anal secretions (hereafter collectively referred to as excrement) at discrete sites along riparian areas and other aquatic environments (Ben-David et al., 1998; Swimley et al., 1998). The accumulation of excrement at latrines causes them to have a distinct strong and persistent odor. Latrines often exhibit prominent visual characteristics caused by otters scraping vegetation and soil litter into piles (Stevens and Serfass,

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2005). Camera traps positioned at latrines have been used to study otter visitation patterns, group composition, seasonality in marking, and detectability (Olson et al., 2005, 2008; Stevens and Serfass, 2008; Green et al., 2015; Day et al., 2016). Interestingly, camera traps at latrines in Pennsylvania and Maryland, USA, documented several carnivore species (S. Stevens, pers. comm.) at rates speculated to be higher than at non-latrine riparian areas (hereafter non-latrines).

Olfactory and visual cues (i.e., excrement and scrapings) contributed by otters at latrines may serve as attractants for other carnivores, accounting for frequent detections. For example, the excrement deposited by otters at latrines may function in the same capacity as a lure (e.g., skunk tincture or catnip; Long et al., 2008). Further, in many carnivore species a behavior known as overmarking is common, in which an animal deposits its own scent atop scent marks of conspecifics (Brown and MacDonald, 1985; Rodgers et al., 2015). This overmarking behavior may likewise apply to heterospecifics. However, carnivores have been suggested to frequent riparian areas as travel corridors and for foraging (Serfass and Brooks, 1998; Hilty and Merenlender, 2004). Hence, frequent detections of carnivores at latrines may be primarily attributable to frequent use of riparian areas. If so, camera traps positioned at non-latrines may be equally or more effective in detecting carnivores than those at latrines.

As part of a larger project that used camera-trap surveys to monitor carnivores (Wagnon, 2015), we evaluated and compared carnivore detections between latrines and non-latrines. Our specific objectives were to use camera traps to: (1) evaluate if carnivores are regularly detected at otter latrines; and (2) determine if detections and richness are similar or vary between latrines and non-latrines. To the best of our understanding, this study represents the first of its kind evaluating latrines as potential sites to detect carnivores with camera traps.

2. Materials and methods

2.1. Study area

Our study was conducted in the 3144 ha wildlife preserve of Great Swamp National Wildlife Refuge (hereafter referred to as Refuge), New Jersey, USA (Fig. 1). The Refuge is located about 50 km west of downtown New York City, New York, USA, and is located entirely within the Piedmont physiographic province (US Fish and Wildlife Service, 2014). Five streams flow through the Refuge, all comprising part of the headwater system within the Passaic River drainage. Our study was focused on the western portion of the Refuge, which also contains 5 wetland impoundments (Fig. 1). Nine carnivores were known to occur at our study site: red fox (*Vulpes vulpes*), coyote (*Canis latrans*), northern raccoon (*Procyon lotor*), American mink (*Neovison vison*), otter, gray fox (*Urocyon cinereoargentueus*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), and American black bear (*Ursus americanus*) (US Fish and Wildlife Service, 2014). The Virginia opossum (*Didelphis virginiana*) was also known to occur at the Refuge, and was included as a target species because this predator may fill a similar ecological role as other mid-sized carnivores (Gompper et al., 2006; for convenience we hereafter include the Virginia opossum in collective references to carnivore detections).

2.2. Data collection

From May to August in 2013 and 2014, we conducted otter latrine searches along all streams and wetland impoundments. For a latrine to be selected for a camera-trap site we established two criteria: (1) latrines were separated by a straight-line distance >1 km; and (2) the riparian areas associated with latrines did not impede access to other carnivores (e.g., areas with dense vegetation patterns were excluded). Five latrines met these conditions and were included in the analysis.

For our comparison camera traps were placed at the 5 latrines, each paired with a corresponding non-latrine camera trap. Each latrine and non-latrine was considered a sampling pair, and pairs were labeled 1–5 (Fig. 1). The intended distance between camera traps comprising a sampling pair was to be 100 m, but actual distances between paired camera traps ranged from 70 to 127 m ($\bar{x} = 102.8$ m). This variation in distance was attributable to our second criterion used for our latrine selection, which required that conditions at a site would not impede target species from moving through the detection zone of the camera trap (e.g., areas with dense vegetation or other characteristics interpreted as likely to impede animal's movements along the riparian area were excluded). Otters typically mark 1–2 m from the water's edge (Swimley et al., 1998), which was the case in our study. Hence, camera traps at both latrines and non-latrines were installed about 3–4 m from the water's periphery. All camera traps were attached to a tree using a mounting strap, and positioned to face perpendicular to the shoreline about 0.5–1 m off the ground.

Camera-trap surveys were conducted from 1 August 2014–27 February 2015. Camera traps were checked at the beginning of each survey month to replace SD cards and batteries if necessary. Additionally, we recorded the presence/absence of otter excrement during each camera check by noting if excrement was deposited at a latrine since the last check. Two Reconyx® digital cameras (Reconyx Inc., Holmen, Wisconsin, USA) and 8 Cuddeback® digital cameras (Nontypical Inc., Green Bay, Wisconsin, USA) were used in the study. The same make of camera traps were used at each sampling pair. Camera traps were programmed to take 1 image with a 15-s delay between images.

2.3. Data analysis

We summarized all images from camera traps by species and location. Images of the same species at a site were identified as temporally independent if separated by >60 min (i.e., a detection). Also, we used the maximum number of individuals