Effects of Camera and Bait Type on a Carnivore Survey

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Introduction

Pierce Cedar Creek Institute (PCCI) has species inventories for vascular plants, herpetofauna, birds, Lepidopteran moths, and macroinvertebrates, but there is currently no assessment of mammalian carnivore species richness at the institute. PCCI manages 661 acres of land composed of forest, wetland (mostly fen), upland field, sand prairie, constructed prairie, and open water systems including lakes and streams. Each of the possible 12 species of carnivores in southwestern Michigan are known to inhabit at least one of these habitat types within the Great Lakes region (Feldhammer et al. 2003, Kurta 1995).

Some of the species likely found at PCCI include Virginia opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), long-tailed weasel (*Mustela frenata*), and striped skunk (*Mephitis mephitis*). Additionally, some rare carnivores may be found at PCCI, including coyote (*Canis latrans*), gray fox (*Urocyon cinereoargentus*), ermine (*Mustela erminea*), least weasel (*Mustela nivalis*), mink (*Mustela vison*), badger (*Taxidea taxus*), and northern river otter (*Lutra canadensis*). Lastly, black bears (*Ursus americanus*) were observed on the property last year. Most of these predators prefer forested habitats (Kurta 1995), so it is likely that the highest carnivore richness will be found within the forested portion of the reserve. An assessment of which carnivores are present will facilitate management decisions, while determining distribution within PCCI will reduce the likelihood of confrontation between researchers and the public while at PCCI.

Carnivores are difficult to survey using observation techniques due to their rare and elusive nature (Gompper et al. 2006, Thompson 2004). An effective way to survey small to medium sized mammals is by using scent baited trackplate stations with remote cameras (Manley and Van Horne 2004). While trackplate stations have been used since the 1950s, the

addition of remote cameras is a recent advancement which has significantly improved detection (Thompson 2004). Remote cameras, triggered by motion or infrared heat provide non-invasive permanent documentation of animals, and are a safe and cost effective method for species richness surveys (Manley and Van Horne 2004; Larrucea et al. 2007). Using remote cameras significantly decrease the time necessary for a inventory analysis (Kelly 2008), removes the danger to animal and researcher associated with live trapping (Kauffman et al. 2007), and can be used to estimate population density (Kelly et al. 2008). Even in cases where individual identification is not feasible, remote cameras can be used to approximate occupancy and provide a count statistic (ratio of number of areas sampled to the proportion occupied) related to population size (Thompson 2004). The success of remote cameras as a survey tool increases with the number used and the length of the sampling period (Kelly 2008).

Problems have been found when remote cameras are used in that they may not provide an unbiased sample of populations (Larrucea et al. 2007). However, this problem is associated with single species studies and does not impact studies involving multiple species. Other problems with remote cameras include the possibility that human activity or the presence of equipment may affect the behavior of the animals. Lastly, due to the difficulty in surveying carnivores, it is important to employ more than one method (Bonaker 2000) to further refine estimates (Barea-Azcon et al. 2007, Janecka et al. 2008).

The first goal for this project was to determine whether 35 mm film or digital cameras are more effective at capturing carnivores. Film cameras require the use of a flash and the shutter produces a sound. In contrast digital cameras are silent and, using infrared techniques, do not require the use of a flash. The null hypothesis for this experiment was that there is no difference in capture rate between the 35 mm film and the digital cameras.

The second goal of this experiment was to determine whether fatty acid scent tablets or trapping lures are more successful at attracting carnivores to remote camera stations and trackplates. The null hypothesis for this experiment was that there will be no difference in carnivore attraction between the two treatments.

A third goal of our study was to determine carnivore richness at Pierce Cedar Creek Institute and how they are distributed across the landscape. We used the data from remote cameras, tracks, and scat to determine what carnivore species are present as well as the relative abundance of carnivore species in each habitat. Since eight of the twelve possible carnivores prefer forested or forest-field edge habitat it is expected that a majority of the species richness will be in the forest (Kurta 1995). The null hypothesis for this experiment was that there will be no difference in carnivore species diversity among the varying habitats.

Methods

For this carnivore study 18 remote cameras (3 prairie, 11 forest, 4 wetland) were evenly distributed across PCCI (Figure 1). Each camera was separated by approximately 500 m in 4 parallel transects separated by about 350 m, using GIS to map locations for cameras. GPS coordinates were obtained for each camera and a remote camera placed at the best available habitat near the specific GPS coordinate. Cameras were placed roughly 0.5 m above ground level in order to maximize the opportunity to capture images of small carnivores. Each transect was checked once a week in order to minimize disturbance with no more than one transect being checked in a day.

Fatty acid scent (USDA Pocatello Supply Depot. 238 E Dillon St, Pocatello, ID 83201) tablets and trapping lures (Blackie's Blend Lures & Baits**.** 5523 SR 514 Glenmont, Ohio 44628. Blackie's Blend TKO Lure) were used to attract carnivores to the remote camera sites. Fatty acid

tablets were placed 5-10 feet in front of the cameras at ground level. Trapping lures were poured on branches or logs 5-10 feet in front of the camera and 0-4 feet above ground level. Track and scat analysis were also taken along each transect to minimize additional disturbance that would result from surveying additional areas around the camera sites. Fatty acid scent tablets and trapping lures were alternated so that no two consecutive cameras used the same bait.

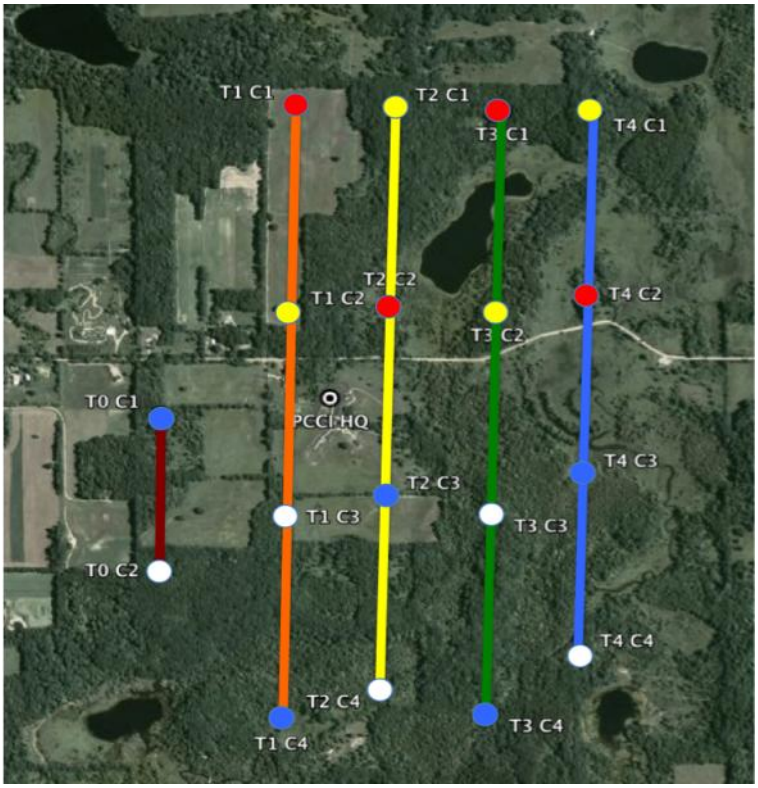

Figure 1. The layout of camera/bait combinations on the PCCI property.

Film/FAS Tablet (252 Trap-nights) Film/Lure (308 Trap-nights)
Digital/FAS Tablet (315 Trap-nights) Digital/Lure (238 Trap-nights)

Each camera was visited once per week when the bait was refreshed; the film and memory cards were replaced as needed. Additionally, we photographed any tracks or scat found along each transect and cleared them to prevent identifying the same sign more than once. Scat and tracks were analyzed based on morphology using *Mammal Tracks and Sign: A Guide to North American Species.*

Carnivore counts were analyzed by attractant type and camera type with which they were photographed. We used a Kolmogorov-Smirnov test to determine if one attractant was more effective, and if there was a preference towards one attractant for certain species. Lastly, we used a Kolmogorov-Smirnov test to determine if some species were more likely to be captured with the digital cameras than the film cameras. Due to technical problems with cameras there were uneven numbers of trap-nights among the different camera and attractant types. To adjust for this we normalized the data by dividing the number of pictures by the number of trap-nights.

Results

We found no significant difference in the number of pictures of target species ($D=0.4$, $P=0.3$) or non-target species ($D=0.4$, $P=0.3$) taken by film and digital cameras (Table 1). Similarly, we failed to find a significant difference in number of target species captured ($D = 0.3$, $P = 0.7$) based on bait type (Table 2). However, we did capture significantly more ($D = 0.6$, $P = 0.03$) non-target species using fatty acid tablets than long distance trapping lure (Table 2).

Table 1. The median number of target and non-target captures per trap-night by film and digital cameras.

	Median Number of Target Species Captures Per Trap-Night	Median Number of Non-Target Species Captures Per Trap-Night
Digital	0.070	0.029
Film	0.042	0.010

Table 2. The median number of target and non-target captures per trap-night by fatty acid tablets and trapping lures.

	Median Number of Target Species Captures Per Trap-Night	Median Number of Non-Target Species Captures Per Trap-Night
Fatty Acid Tablet	0.070	0.051
Trapping Lure	0.042	0.016

The third goal of this study was to determine carnivore diversity within Pierce Cedar Creek Institute. Photographic evidence was found for Raccoon (*Procyon lotor*), Virginia Opossum (*Didelphis virginiana*), Coyote (*Canis latrans*), Grey Fox (*Urocyon cinereoargenteus*) and Mink (*Neovison vison*). There were also coyote and raccoon tracks along with coyote and fox scat. The number of captures was not randomly distributed amongst the forest, wetland, and prairie cameras ($X^2 = 27.54$; $P < 0.0001$). Relative to the number of cameras in each habitat type, we found 19.5% more captures in the forest than expected, 34% fewer capture in the wetland than expected, and 26.5% fewer captures than expected in the prairie.

Discussion

We found no difference in the number of carnivores or non-carnivores captured between digital and film cameras. This shows that comparisons can be made between past studies involving film cameras and more recent studies using digital cameras without concern for possible bias introduced by camera type. The lack of a difference in capture rates was surprising because the white light flash and louder shutter sound of film cameras may be expected to be a greater deterrent to animals than the infrared flash and absence of a shutter sound in the digital cameras. This ability to compare results using the different types of cameras will allow

researchers to examine trends occurring over time, despite the improving technology, a major concern of conservation biology.

The fact that there was no difference in attraction rates between fatty acid tablets and trapping lures for carnivores means that either bait type would lead to an equally successful study. In contrast, the fatty acid tablets were significantly more likely to bring in non-carnivore species. This result probably stems from the ingredients used in the two attractants. Trapping lures are usually made from anal secretions of carnivores, which would not be attractive to a non-carnivore but may in fact be repulsive. Fatty acid scent tablets, though, may provide a more generally attractive scent that may attract non-carnivores.

Lastly, we did find more carnivores in the forest than the other habitat types we surveyed at PCCI. Since carnivores were most prevalent in forests, a management plan that promotes reforestation or increased connectivity between habitat fragments at PCCI may increase carnivore species richness within the reserve.

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