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A Direct Comparison of Enclosed Track Plates and Remote Cameras in Detecting Fishers, *Martes pennanti,* in North Dakota

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Fishers (*Martes pennanti*) historically were reported to occupy forested areas of northeastern North Dakota, but the population was presumed extirpated during the 1900s as a result of overtrapping. Recently (≤15 years), Fishers have been recolonizing the state, and there is increasing interest in developing approaches for monitoring the population. During the period June–August 2008, we compared the efficacy of remote cameras and enclosed track plates in detecting Fishers in riparian forest along portions of the drainage basin of the Red River of the North in eastern North Dakota. We monitored 122 scent stations, each composed of both detection devices, with the remote camera positioned to monitor the entrance of the enclosed track plate. Fishers were detected at 40 of the 122 scent stations (32.8%) distributed along approximately 790 km of riparian forest. Among those 40 stations, Fishers were detected by both camera and track plate at 28 stations (70.0%), by camera only at 9 stations (22.5%), and on track plates only at 3 stations (7.5%). Overall, Fishers were detected 37 times by camera (92.5%) and 31 times on a track plate (77.5%). From photographic evidence at the 37 stations where Fishers were detected by camera, we determined that the average latency to initial detection was 4.8 days (SE 0.3, range 1–8). Among the 37 stations where Fishers were detected by camera, detections most frequently occurred on one (27 sites) (73.0%) or two days (7 sites) (19.0%) of a detection period.

Key Words: Fisher, *Martes pennanti*, enclosed track plate, remote camera, Red River of the North, North Dakota.

Fishers (*Martes pennanti*) were historically reported to occupy forested portions of northeastern North Dakota, but overtrapping apparently caused the population to become extirpated during the 1900s (Bailey 1926; Adams 1961). Road kills and accidental captures of Fishers by trappers pursuing legal furbearers demonstrate that Fishers have been recolonizing portions of the Red River of the North and its tributaries in North Dakota since at least 1999 (Triska et al. 2011), presumably from expansion of a well-established population in Minnesota (Berg and Kuehn 1994; Erb 2010*, Seabloom 2011).

In 2008, we initiated a project using remote cameras and enclosed track plates to document the distribution of the newly recolonizing Fisher population in North Dakota (Loughry 2010; Triska 2010; Triska et al. 2011). These devices are known to be generally useful for presence/absence sampling of Fishers (Zielinski and Kucera 1995; Foresman and Pearson 1998; Gompper et al. 2006), and they remain popular methods for determining the presence of Fishers and other mesocarnivores (Long et al. 2008).

Foresman and Pearson (1998) and Gompper et al. (2006) conducted projects that compared the efficacy of remote cameras and track plates in detecting various mesocarnivores, including Fishers. These works provide a comprehensive review of the advantages and disadvantages of the respective devices relative to cost, efficiency, and the questions being addressed. Foresman and Pearson (1998) and Gompper et al. (2006) concluded that both methods have general utility for presence/absence sampling of Fishers. However, differences in habitat, distribution and placement of sampling devices, season, and sample sizes (Foresman and Pearson (1998) detected few Fishers) limit meaningful comparisons between the studies.

Neither Foresman and Pearson (1998) nor Gompper et al. (2006) placed cameras and track plates at the same station. Gompper et al. (2006) detected Fishers at a higher percentage of sites with remote cameras than with enclosed track plates when both devices were simultaneously distributed at different locations along the same 5-km transects. In contrast, Foresman and Pearson (1998) compared the data gathered by cameras and track plates placed at the same general locations during different seasons—winter and spring, respectively. Consequently, spatial and temporal differences in the respective studies in the placement of cameras and track plates do not allow the two to be compared directly.

The objective of our project was to compare detection rates for Fishers for remote cameras and track plates placed simultaneously at the same scent station, with the respective sampling devices thus serving to cross-validate the efficacy of the other at each sampling station. This approach provided certainty that a Fisher attracted to a station encountered and had an opportunity to be detected by both devices. We were particularly interested in determining whether Fishers attracted to a station were generally willing to enter the enclosed track plate.

Study Area

The study was conducted in riparian forests in portions of the Red River of the North and five of its tributaries (the Pembina River, the Tongue River, the Park River, the Forest River, and the Turtle River) in northeastern North Dakota. The Red River of the North (which forms the boundary between North Dakota and Minnesota) originates at the confluence of the Bois de Sioux River and the Otter Tail River at Wahpeton, North Dakota, and Breckenridge, Minnesota, from there flowing northward into Manitoba, Canada (Renard et al. 1986; Koel and Peterka 1998; Hagen et al. 2005*). Sampling locations for our study encompassed river reaches (maximum river distance, i.e., the actual length of the river, including meanders, from the upstream and downstream sampling locations) for a total of approximately 790 km (550 km of the Red River of the North, 60 km of the Pembina River, 50 km of the Tongue River, 15 km of the Park River, 20 km of the Forest River, and 95 km of the Turtle River) (Figure 1).

Previous to European settlement, portions of North Dakota drained by the Red River of the North consisted mainly of tallgrass prairie, much of which now has been replaced by agricultural fields and other development (Renard et al. 1986; Hagen et al. 2005*). The forested portions of the drainage basin were primarily limited to riparian areas, a condition that persists today (Renard et al. 1986; Hagen et al. 2005*; Triska 2010; Triska et al. 2011). Details of forest conditions in eastern North Dakota immediately prior to agricultural development (ca. 1860) are relatively scant. Pre-agricultural forests along tributaries of the Red River of the North generally were described as patches interrupted by extensive segments of prairie, with forests becoming more continuous as tributaries neared the Red River of the North (Severson and Sieg 2006). In contrast, the forest along the Red River of the North was described as relatively continuous, a condition that would differ substantially from the present riparian forest, which is highly fragmented by agricultural and other development (see Triska (2010) for a review of the size and distribution of forest patches in the study area).

Forested patches in the study area during the study were composed almost entirely of deciduous trees, with dominant species consisting of American Elm (*Ulmus americana*), Quaking Aspen (*Populus tremuloides*), Balsam Poplar (*Populus basamifera*), Manitoba Maple (*Acer negundo*), Burr Oak (*Quercus macrocarpa*), Eastern Cottonwood (*Populus deltoides*), Green Ash (*Fraxinus pennsylvanica*), Paper Birch (*Betula papyrifera*), and members of the willow family (Salicaceae). The structure and composition of the understory vegetation varied among sampling locations, but common species included hawthorns (*Crataegus* spp.), Grey Dogwood (*Cornus racemosa*), Chokecherry (*Prunus virginiana*), Missouri Gooseberry (*Ribes missouriense*), raspberries (*Rubus* spp.), and Downy Serviceberry (*Amelanchier arborea*).

Methods

Sampling was conducted during June, July, and August 2008. Sampling involved placing scent stations in forested riparian areas distributed throughout the study area (Figure 1). Each station consisted of an enclosed track plate and a motion-sensitive infrared-triggered remote camera. Our intent was to systematically place stations at intervals of approximately 3000 m along riparian corridors. However, the uneven distribution and size of forested patches contributed to substantial variation in the spacing of stations, with an average distance between adjacent stations of 3015 m (SD 2615, range 213–15,742). We limited sampling to forest patches >2 ha, with the average size of patches sampled being 60.5 ha (SE 11.0).

Five sampling sessions were completed during the study. Each session consisted of the placement and removal of a suite of detection devices (typically, 25 stations were monitored during a session); 127 stations were established. Our goal was to have each station operational for a period of 8 days. However, logistics (e.g., travel distance and differences in time required to access various stations) contributed to variation in the number of days a site was monitored. Our primary interest was the comparison of detection devices, and we therefore omitted stations from the study if cameras or track plates were not functional for a period of ≥4 consecutive days.

We used three models of Cuddeback cameras with motion and heat sensors (Non Typical Inc., Green Bay, Wisconsin): the Excite, Expert, and infrared Noflash. The cameras were positioned to monitor the entrance to and the area surrounding the track plate. Each camera was mounted on a tree at a height of 0.5–1.5 m, 2–2.5 m from the track plate facing the opening. The

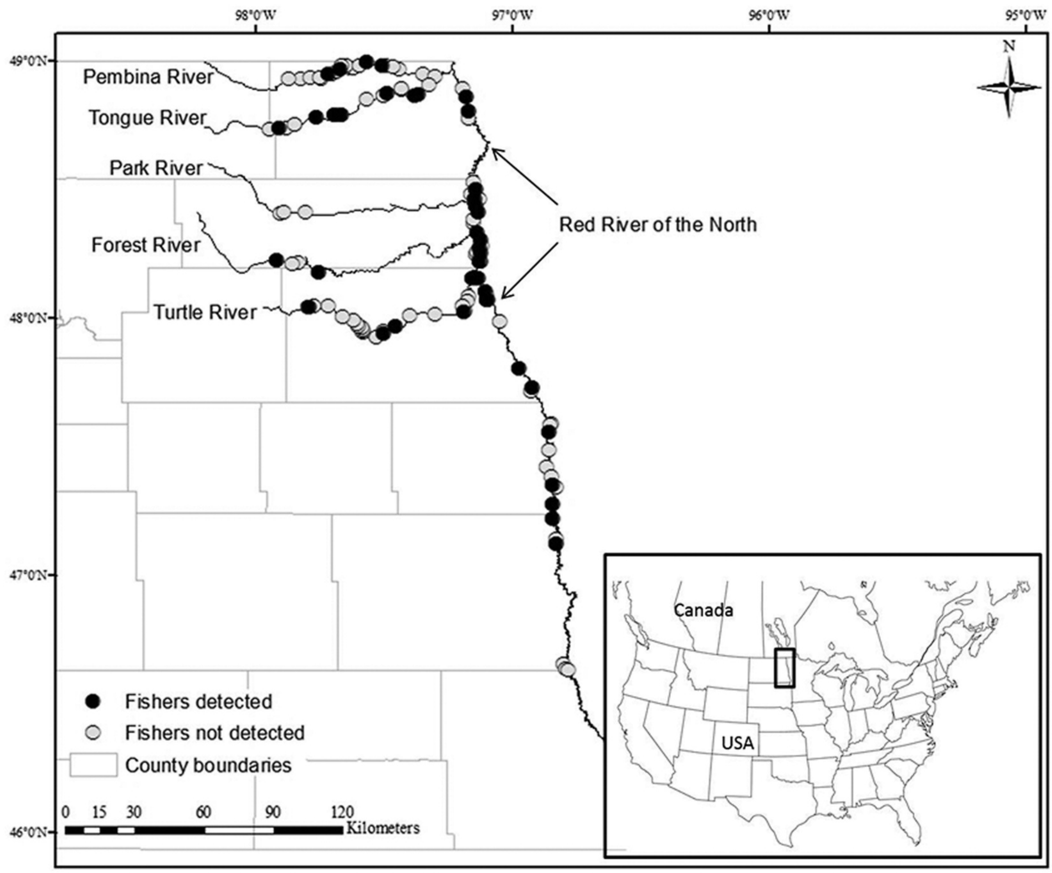

FIGURE 1. Location of the 122 scent stations (dots) along portions of the Red River of the North and five of its tributaries (the Pembina River, the Tongue River, the Park River, the Forest River, and the Turtle River) in eastern North Dakota used to compare Fisher detection rates of enclosed track plates and remote cameras during the period June–August 2008.

camera delay (minimum time between pictures) was set at 1 minute.

Track plates consisted of an aluminum plate 0.1 × 20.3 × 76.2 cm. The front 40 cm of the track plate was blackened with a portable welding torch (only acetylene gas is burnt while blackening the plate [i.e., the oxygen supply required for welding is turned off], which maximizes soot production; see Zielinski and Kucera 1995) and the other 25 cm was covered with contact paper (adhesive side up) to record tracks. Each track plate was mounted on a plywood base 1.9 × 30.4 × 76.2 cm and enclosed by a roof constructed of two pieces of flexible black PVC stock 0.32 × 40.6 × 71.1 cm inserted in grooves 0.9 cm deep cut lengthwise about 1.5 cm from both edges of the plywood base (Figure 2). See Zielinski and Kucera (1995), Foresman and Pearson (1998), Gompper et al. (2006), and Long et al. (2008) for details of configuring various versions of enclosed track plates. A single entrance was established by placing the back of the enclosed track plate against a tree and filling gaps between the tree and the plastic sheeting with branches gathered at the site. Fisher tracks were identified from illustrations, photos, and descriptions provided in Zielinski and Kucera (1995).

For bait, we placed about 85 g of American Beaver (*Castor canadensis*) meat and about 2 g of beaver castor mixed with glycerol at the rear of each track plate (the end against the tree). To serve as a general attractant, we hung a perforated camera film canister containing a cotton swab soaked in Striped Skunk (*Mephitis mephitis*) essence from monofilament fishing line attached to a branch ≤3 m from the entrance of the track plate (usually between the camera and the track plate) at a height of about 2 m. Beaver castor and Striped Skunk essence were purchased from Murray's Lures and Trapping Supplies, Walker, West Virginia, USA.

We typically checked stations midway (Day 4) through a detection period (i.e., the number of days a station was maintained) to perform any needed maintenance (e.g., replenish bait, replace track plates if tracks were present, download pictures from cameras,

FIGURE 2. Fisher (*Martes pennanti*) photographed by a remote camera while leaving an enclosed track plate at a scent station in the Red River of the North drainage basin in eastern North Dakota on 27 June 2008.

and remedy any equipment malfunctions or other problems at the station). The actual number of the day varied, and at some stations there was no midway evaluation because of logistical constraints (e.g., cases where establishing all stations for a session took too much time to facilitate opportunities for a midway evaluation of each station). Consequently, a station had either one or two monitoring periods.

Detection of Fishers

We calculated the percentage of scent stations at which Fishers were detected (i.e., positive stations) and the percentage of monitoring periods during which Fishers were detected. For stations at which Fishers were detected, we compared the percentage of occasions on which Fishers were detected that were common to both the cameras and the track plates with the percentage of occasions on which Fishers were detected only by the camera or on the track plate.

Cameras

Uniquely for cameras, we assessed 1) the number of camera-days per detection, 2) the average number of days on which Fishers were detected at the scent stations where Fishers were detected, 3) the latency to initial detection, and 4) the average number of unique occasions on which a Fisher was detected on each day that a Fisher was detected. We defined camera-days as the sum of 24-hour periods monitored by all cameras functioning for an entire detection cycle, and we defined latency to initial detection as the number of days between when a camera was operational at a positive site and when the first detection was made (Foresman and Pearson 1998). To calculate the number of visits by a Fisher to a station during a monitoring period, we assumed photographs occurring >30 minutes apart represented unique events, from criteria established by Stevens and Serfass (2008).

We could not determine the number of times a Fisher entered an enclosed track plate during a monitoring period—only that a detection had occurred. Even in cases where cameras indicated multiple visits to a scent station, photographs typically showed a Fisher in the vicinity of an enclosed track plate rather than inside it. We used photographic evidence, however, to determine whether Fishers that visited on more than one day during a monitoring period were more likely to be detected at track plates than those that visited on a single day only. To determine whether visits to a station increased the likelihood of a detection by track plates, we compared stations where Fishers were detected by a camera on only one day with stations where Fishers were detected by a camera on more than one day. We used χ^2 analyses to test for independence between stations visited on one day and stations visited on more than one day to compare stations where bait was replenished and stations where the bait was not replenished (i.e., one versus two monitoring periods, respectively). For track plates checked twice, we calculated the percentage of occasions when a Fisher was detected during only the first or second monitoring period with the percentage of occasions when a Fisher was detected during both check periods.

Results

Station monitoring

Of the 127 scent stations we established, 5 were not included in the analysis because either the track plate or the camera was not operational during ≥4 consecutive days of the monitoring period. Of the 122 stations 19 were checked once and 103 were checked twice, resulting in a total of 225 monitoring periods. The average number of days that a station was deployed was 7.8 (SE 0.3, range 4–9), and average deployment days were similar between stations monitored once (7.5 days, SE 0.2) and twice (7.8 days, SE 0.1).

Detection of Fishers

Fishers were detected at 40 of the 122 scent stations (32.8%) (Figure 1). Among those 40 stations, Fishers were detected by both cameras and track plates at 28 stations (70.0%) (Figure 2), by camera only at 9 stations (22.5%), and on track plates only at 3 stations (7.5%) (i.e., overall, a Fisher was detected 37 times by camera (92.5%) and 31 times on a track plate (77.5%)). Fishers were detected during 47 of 225 monitoring periods (20.9%): a Fisher was detected 32 times by camera and on track plates (68.1%), 11 times by camera only (23.4%), and 4 times on track plates (8.5%) only.

Cameras

Fishers were recorded by camera during 48 of 954 camera-days (5.0%) (1 detection: 19.9 camera-days). The average latency to initial detection for the 37 scent stations where Fishers were recorded by camera was 4.8 days (SE 0.3, range 1–8), and the average number of days a camera was deployed at these stations was 7.7 (SE 0.2, range 6–9). Among the 37 stations where Fishers were detected, Fishers most frequently were detected on one (27 sites) (73.0%) or two days (7 sites) (19.0%) (maximum 4 days) of a detection period. Fishers typically did not make multiple visits to a station during a day on which a detection occurred, with the average number of unique occasions when a Fisher was detected on days on which Fishers were detected being 1.2 (SE 0.1, range 1–7).

Track plates

The number of times a Fisher was detected at track plates appeared to be influenced by the number of days a Fisher visited a scent station (as determined by cameras). Among the 37 stations where Fishers were detected by camera, those with detections on 1 day had detections at 19 of 27 (70.4%) of corresponding track plates, whereas those with detections on >1 day had detections at 9 of 10 (90%) of corresponding track plates ($\chi^2_1 = 4.05$, $P = 0.04$). The number of times a Fisher was detected did not differ between stations that were checked once (a Fisher was detected 6 times at 19 sites (31.6%)) or twice (a Fisher was detected 25 times at 103 sites (24.3%)) ($\chi^2_1 = 0.27$, $P = 0.61$). Among the 25 stations at which Fishers were detected that were checked twice, Fishers were detected at 8 stations (32.0%) during the first monitoring period only, at 12 stations (48.0%) during the second monitoring period only, and at 5 stations (20.0%) during both periods. For these 25 sites, the average time of the mid-period check was after 4.2 days (SE 0.1, range 6–9).

Discussion

Both cameras and track plates have been proven to be relatively effective at verifying the presence of Fishers and a variety of other mesocarnivores (Zielinski and Kucera 1995; Foresman and Pearson 1998; Gompper et al. 2006; Long et al. 2008). In this study, cameras were considerably more effective in detecting Fishers, contributing 92.5% of the occasions when Fishers were detected at the 40 stations where the presence of Fishers was recorded, in comparison to 77.5% recorded on track plates.

We encountered relatively few failures with either cameras or track plates during this study. Among the 127 scent stations, only 5 were not operational during a full monitoring period (the batteries failed in cameras at 3 stations and the track plates were trampled by cattle at 2 stations). Other studies also have reported battery failure in remote cameras (e.g., Foresman and Pearson 1998—using film cameras). In our case, this problem was encountered during the first monitoring cycle and was remedied by more diligently monitoring the charge of batteries (i.e., replacing them before charges dropped to <50%). There were 4 occasions when Fishers were detected by track plates but were not recorded by the corresponding camera, all apparently caused by improper mounting of the camera (in each case, the camera had been mounted so that the detection zone (field of view) was above the preferred detection area).

The 11 occasions when Fishers were detected by camera but were not recorded by the corresponding track plates could plausibly be attributed to a variety of factors, including avoidance of the enclosed track plates by some Fishers, dissipation of the scent of lures and bait over time, and the frequency with which Fishers visited a scent station. Fishers are active foragers and will readily explore earthen dens, crevices, and cavities in search of food, as well as for refuge (Powell 1993). Consequently, we generally would not expect

Fishers to be hesitant about entering an enclosed track plate, but such avoidance could be attributed to a disturbance during a visit to a station or negative experiences associated with similar devices (e.g., an Fisher that had previously been trapped in a cage trap and released might avoid entering an enclosed track plate). The number of days a Fisher visited a scent station appeared to influence the likelihood of tracks being left on track plates, with visits on more than one day being more likely to result in tracks than visits during only a single day. Therefore, the likelihood of detecting Fishers using track plates could be enhanced by maintaining stations for longer periods, thereby increasing opportunities for Fishers to make visits to a station on multiple days.

Removal of bait by Raccoons (*Procyon lotor*), feral cats (*Felis catus*), or other wildlife before Fishers visited a scent station is another factor that may have contributed to Fishers not being detected, but, in such instances, lingering scent from the bait presumably served as an adequate olfactory stimulus to entice a Fisher into an enclosed track plate. Our results provide support for this presumption, since there was no substantial difference between the number of times a Fisher was detected by track plates in those stations that were checked once and those that were checked twice (i.e., baits not replenished or replenished, respectively). However, our project was not designed specifically to determine whether persisting smell of bait has the same value as the presence of bait itself in attracting a Fisher into an enclosed track plate, and our results could have been confounded by various factors (e.g., bait plausibly could have been equally present when Fishers arrived at a station, something that would need to be controlled to address the issue beyond inference).

As with most carnivores, monitoring Fishers is particularly challenging because they are elusive, maintain low population densities, and occupy relatively large home ranges (Powell 1993). Consequently, assessing the influence of different factors on the efficacy of detection devices, including regions, seasons, and habitat conditions, is fundamental to enhancing monitoring protocols (Zielinski and Kucera 1995; Long et al. 2008). Various studies have evaluated the relative merit of remote cameras and track plates in monitoring carnivores (Bull et al. 1992; Zielinski and Kucera 1995; Foresman and Pearson 1998; Mowat et al. 2000). Advantages of using cameras instead of track plates include less frequent baiting and monitoring, generally smaller and lighter equipment and materials required for deployment, ease of species identification, and ability to determine the number of individuals visiting a site and visitation patterns (e.g., latency to initial detection and the time, duration, and frequency of visits) (Foresman and Pearson 1998; Hilty and Merenlender 2000; Gompper et al. 2006). These advantages were evident during our project, as cameras allowed us to acquire detailed information on latency to initial detection and diurnal activity patterns, and we were able to identify the general period when cubs began actively moving about the study area (Loughry 2010)—information that could not have been effectively obtained with track plates. Ongoing advances in remote camera technology have made them particularly appropriate for wildlife studies (Long et al. 2008). The cameras used in our study were reliable, easy to use, and outperformed track plates in detecting Fishers.

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