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# EFFICACY OF PHOTOGRAPHIC SCENT STATIONS TO DETECT MOUNTAIN LIONS

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Estimating size of animal populations is important for effective management and conservation. Mountain lions (*Puma concolor*) have proven especially difficult to enumerate (Anderson 1983), and the current most reliable method involves capturing a significant portion of the population and monitoring individual animals via radio telemetry (Logan and Sweanor 2001). High costs associated with this approach have motivated researchers to investigate alternative census techniques, such as harvest data (Stiver 1989), track analyses (Van Sickle and Lindzey 1991, Lewison et al. 2001), fecal DNA (Ernest et al. 2000), and scent stations (Muñoz-Pedreros et al. 1995). These techniques vary widely in cost and precision. Because of important limitations of many of these census methods, we were interested in developing a protocol for estimating size of mountain lion populations using a combination of scent lures and automatic camera systems.

Several felids are attracted to scent stations (McDaniel et al. 2000), and mountain lions may also be drawn to some scent lures. Young and Goldman (1946) obtained photographs of 2 mountain lions attracted to a catnip-based lure, whereas Muñoz-Pedreros et al. (1995) lured mountain lions to track stations using plaster disks treated with bobcat (*Lynx rufus*) urine. In addition to Young and Goldman's (1946) early success with cameras, Pierce et al. (1998) obtained multiple photographs of radio-collared mountain lions from automatic cameras placed near cached prey. Analyses of the latter photographs revealed mountain lions often have unique markings that may permit individual identification, important for population size estimation (Karanth and Nichols 1998, Sweitzer et al. 2000). We therefore hypothesized it may be possible to attract mountain lions to scent lures and use photographic identification to estimate population size by sight-resight analysis. To test this we used automatic camera stations baited with scent lures (photographic scent stations) at a study area in the Black Hills, South Dakota, that included multiple mountain lions based on information from a companion study (Fecske and Jenks unpublished data).

We conducted the study May–August 2000 in the central Black Hills of South Dakota, where a study of radio-collared mountain lions has been ongoing since 1999 (Fecske and Jenks unpublished data). The study area is dominated by ponderosa pine (*Pinus ponderosa*) associated with white spruce (*Picea glauca*), quaking aspen (*Populus tremuloides*), and birch (*Betula* spp.). Understory cover ranges from bare and rocky terrain to a thick covering consisting of forbs and willows (*Salix* spp.).

We designed a 3 × 4 grid of photographic scent stations such that the western half intersected portions of known home ranges of 3 radio-collared mountain lions (ML-1, ML-2, and ML-3), while the other half was considered outside the range of radio-collared mountain lions but likely included the ranges of unmarked mountain lions (e.g., UML-1). Camera systems at scent stations were TrailMaster® TM1500 ($n = 12$) or TM 550 ($n = 2$) infrared monitors mounted on trees or wood posts and linked to autofocus 35-mm cameras (Goodson and Associates, Lenexa, KS). Time delay between photographs was set at 2 minutes. To

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expose animals to at least 1 or 2 traps (Otis et al. 1978), we set spacing between stations at 7–9 km, based on mean home range size of male (320 km$^2$) and female (67 km$^2$) mountain lions in similar habitat in north central Wyoming (Logan et al. 1986).

Individual photographic scent stations were positioned within the grid in areas of probable mountain lion use (slopes ≥50%, distance from water ≤500 m; Logan and Irwin 1985), identified from a GIS habitat model for the study area. Exact placement of photographic scent stations was based on topographic features that may concentrate mountain lion travel and therefore increase probability of detection (Anderson 1983). Ten of 12 camera stations in the grid were placed along ridge lines, river bottoms, marked slope transitions, or game trails; 1 was placed near the remains of a presumed mountain lion–killed porcupine (*Erethizon dorsatum*), and 1 was placed in an area where an unmarked mountain lion was observed. After beginning the study, we added 2 camera stations within the 3 × 4 grid in areas where additional sightings of unmarked mountain lions had been noted. Photographic scent station density was approximately 0.04 cameras · km$^{-2}$. Because the goal of the study was to develop a census technique independent of radio telemetry, our camera station placement strategy incorporated only types of information readily available to researchers if there were no ongoing mountain lion studies in the area. Thus, locations of mountain lions prior to the study were used only to identify suitable areas with high probability of occupancy and, via weekly flights during the study, to confirm the presence of mountain lions in the study area.

Scent lures used in the study included skunk oil, Powder River Cat Call™ (PRCC, M&M Fur Company, Bridgewater, SD), and bobcat urine. Skunk oil and PRCC were selected for use based on a pilot study to assess response of captive mountain lions to different types of scent lures; skunk oil and PRCC elicited the highest numbers of approaches and interest (Fecske and Jenks unpublished data). Bobcat urine was used due to success in South America (Muñoz-Pedreros et al. 1995). Skunk oil was mixed with vegetable oil (to slow evaporation), placed in a 250-mL jar with a perforated metal lid, and affixed 1 m above the ground to a small tree within view of the camera. Approximately 5 mL of PRCC was spread on the same tree below the jar of skunk oil. Skunk oil and PRCC were originally the only 2 scents used, but after the first 6 weeks (483 camera-nights) when no photographs of mountain lions were obtained, photographic scent stations were supplemented with 3–5 mL of bobcat urine sprayed around the base of the scent post (638 camera-nights).

Scent stations ($n$ = 14) were monitored for 1121 camera-nights during a 103-day period. Study animals ML-1 and ML-2 were each located in the grid 3 times, and ML-1 and ML-3 were located close to the grid on multiple occasions. Two observations of UML-1 and her kitten were less than 1 km from the grid, and UML-2 was observed within the grid once. Hence, 3 mountain lions were confirmed within the grid, 3 additional mountain lions were confirmed in the area, and additional animals may have been present. Despite the confirmed presence of these individuals, we obtained no photographs of mountain lions.

Lack of photographs of mountain lions was not due to inoperative camera systems, because photographs of many nontarget species (white-tailed deer, *Odocoileus virginianus*; mule deer, *O. hemionus*; raccoon, *Procyon lotor*; red squirrel, *Tamiasciurus hudsonicus*; turkey vulture, *Cathartes aura*; free-ranging cattle, feral dogs, and bobcat) were obtained. Other possibilities for the lack of mountain lion photographs include insufficient effort, inappropriate camera station placement, low camera station density, or poor choice of scent lures.

Photographic scent stations were operative for a combined 1121 camera-nights, which should have been sufficient to detect mountain lions because other studies have detected felids with similar or less effort. Carbone et al. (2001) report photographic detection rates for tigers in 14 unpublished studies conducted throughout Asia; average detection rates were 126.7 camera-days per photograph, and the lowest detection rate was 1 photograph per 329.7 camera days. Karanth (1995) obtained 3 photographs of tigers during 387 camera-nights, and Karanth and Nichols (1998) reported 187 photographs of tigers during 3079 camera-nights. In both studies cameras were placed along known travel paths used by tigers. Although detection rates were not reported, Karanth and Nichols (1998) also reported photographing leopards (*Panthera pardus*).

Placing photographic scent stations along established travel routes could potentially increase success. Studying mountain lions in desert habitats of the San Andres Mountains, Logan and Sweanor (2001) used snares set along travel routes to catch 107 mountain lions a total of 209 times with average success rate of 1 capture per 193 snare-days. However, to our knowledge, regular travel routes have not been determined for mountain lions in northern habitats, and thick vegetative cover hinders detection of tracks and paths. Therefore, aided by GIS, we placed photographic scent stations in areas of suitable habitat and positioned them along ridge lines, river bottoms, slope transitions, or game trails that might have concentrated mountain lion travel (Anderson 1983). We are not aware of any unusual aspects of habitat use by mountain lions in the Black Hills region that would have indicated alternative camera placements. Adult male mountain lions may communicate via scrapes (Seidensticker et al. 1973), and placing camera stations around scrape sites may prove effective.

Camera station density was designed to expose animals to at least 1 or 2 photographic scent stations (Otis et al. 1978). Muñoz-Pedreros et al. (1995) attracted mountain lions to scent stations ($n$ = 10), but the extremely small study area (1 $km^2$) and consistency of track sizes suggests that a single family group may have been detected multiple times. Relatively high densities of camera stations may be required for reliably detecting mountain lions.

The scent lures we used had previously been effective on captive mountain lions (skunk oil, Powder River Cat Call™; Fecske and Jenks unpublished data) and free-ranging mountain lions in South America (bobcat urine; Muñoz-Pedreros et al. 1995). Our use of multiple scent lures concurrently could have negated the effectiveness of a single attractant. However, Harrison (1997), although successful in detecting jaguarundi (*Herpailurus yaguarundi*) and margay (*Leopardus pardalis*) at scent lures of bobcat urine, synthetic fatty acid, catnip oil, or Hawbaker's Wildcat 2 commercial lure, was unable to detect mountain lions when using these lures individually. Further, although skunk oil and Powder River Cat Call™ were attractive to 2 captive mountain lions (Fecske and Jenks unpublished data), these animals were likely sensory-deprived; free-ranging mountain lions may not be similarly interested in these scents.

Although our test of photographic scent stations failed to detect mountain lions, further experimentation with different camera station densities, alternative camera placement strategies, or alternative scents may be worthwhile before the method is deemed ineffective for this species. Specifically, in habitats where mountain lion travel routes can be determined, techniques used by Karanth and Nichols (1998) to photograph tigers could potentially be used to detect mountain lions.

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