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Passive Tracking Stations as a Method for Providing Rabies Reservoir Population Information for Oral Rabies Vaccination

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ABSTRACT: Knowledge of wildlife population abundance and activity patterns is integral to sound management decisions. Traditional methods of determining population abundance include mark-recapture, catch/unit effort, aerial and ground counts, and harvest-based or removal efforts. Capture methods are labor intensive and expensive. Census methods are potentially expensive and are often impractical for many wildlife species. Harvest-derived population estimates are not useful where harvest is limited. Tracking or scent stations have been used to index wildlife activity and abundance, but the use of traditional scented-tracking stations may lead to biased population activity or abundance estimates. We built on previous evaluations of passive and scented tracking stations to determine their potential utility for providing raccoon and other carnivore population information to support decisions for wildlife rabies control in coastal pine-oak communities. Methods were evaluated through several small-scale studies conducted in southeastern Massachusetts. Passive tracking stations appear more sensitive to raccoon activity than scented tracking stations (1.38% of scented stations visited vs. 3.38% of passive stations) under apparently low raccoon population densities. Despite concerns over the utility of track-based indices, we recommend the use of passive tracking stations to index raccoon activity over scented tracking stations.

KEY WORDS: activity index, carnivore population estimation, oral rabies vaccination, *Procyon lotor*, raccoon, tracking stations

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INTRODUCTION

USDA APHIS Wildlife Services (WS) and state, federal, and university cooperators are collaborating on a large-scale nationwide effort to reduce the threat of terrestrial rabies to humans and domestic animals, and to reduce costs associated with rabies control and treatment at the local level. The raccoon variant of the rabies virus was first confirmed in Massachusetts in 1992 and rapidly spread to all mainland counties. The first cases of raccoon rabies were detected on Cape Cod during March 2004. Dukes (Martha's Vineyard and associated islands) and Nantucket Counties remain free of raccoon rabies. An oral rabies vaccination (ORV) program targeting raccoons was initiated by Tufts University, the Massachusetts Department of Public Health, and the Centers for Disease Control and Prevention in 1994 to prevent the spread of raccoon rabies to peninsular Cape Cod. WS became involved with federal funding and full-time cooperation with the Massachusetts program in 2001.

Oral Rabies Vaccination

The first-phase goal of the national ORV program is the development and maintenance of vaccination barriers against the movement of specific terrestrial variants of the rabies virus. The ultimate goal is to eliminate terrestrial rabies from areas where it is currently enzootic. Ideally, ORV campaigns incorporate geographic features such as mountain ranges, rivers, and areas of poor-quality target species habitat to increase success (Slate and Bruleigh 1997). Previous southeastern Massachusetts raccoon density estimates suggest that pitch pine (*Pinus rigida*) /scrub oak (*Quercus ilicifolia*) (PP/SO)-dominated forests represent poor quality habitat that may not support robust raccoon populations and could thereby represent a natural barrier to the spread of rabies (D. Slate and T. P. Algeo, WS, unpubl. data).

Knowledge of rabies reservoir and vector population abundance and activity patterns, especially as it relates to habitat quality, is integral to sound ORV decision-making. However, cost-effective methods for population assessments are needed.

Population Indices

Track-based indices have had wide use for monitoring carnivore population fluctuations, relative abundance, activity patterns, and management program effectiveness (Linhart and Knowlton 1975, Roughton and Sweeny 1982, Allen et al. 1996, Slate and Bruleigh 1997, Engeman and Allen 2000). These indices appear to be cost-effectiveness and useful when there is no need to know actual abundance for management decisions. However, while some managers and researchers consider them potentially useful (Linhart and Knowlton 1975, Roughton and Sweeny 1982, Conner et al. 1983, Allen et al. 1996, Engeman and Allen 2000, Engeman and Witmer

2000), others question the relationship between actual abundance and index values (Smith et al. 1994, Nottingham et al. 1989, Anderson 2003). Management and research priorities and perspectives are critical to the formulation of both sets of arguments.

Track Station Research in Southeastern Massachusetts

We conducted this study to 1) compare the utility of passive and scented tracking stations for indexing raccoon and skunk abundance, and 2) learn more about the use of certain habitat types by raccoons, especially PP/SO communities (and their ecologically functional equivalents) for ORV planning.

STUDY AREA AND METHODS

Study Area

This study was conducted in southeastern Massachusetts (mainland Cape Cod) where PP/SO is an important forest cover type. We selected the 57-km^2 Myles Standish State Forest (MSSF) as our primary study area, along with the much smaller (2-km^2) Scusset Beach State Reservation (SBSR), as these were representative of the PP/SO forest type and featured lightly-used roads. MSSF is dominated by PP/SO and also features small areas of wetland/kettle ponds, stands of white pine (*P. strobus*), scrub oak frost pockets, less common miscellaneous forest types, and agriculture– primarily commercial cranberry (*Vaccinium macrocarpon*) production (MA Department of Environmental Management 2001). Human activities include hiking, cycling, hunting, fishing, camping, and horseback riding. SBSR features camping, hiking, swimming, fishing, hunting, and occasional events that attract large crowds. Both areas are bisected by recreational and fire control paths and roadways, but vehicle access is generally prohibited in the areas we selected for study (R. MacKenzie and M. Heath, MA Dept. of Conservation and Recreation, pers. commun.).

Methods

Tracking Station Comparisons

We established 3 study plots (Pockanoket Road = 1.5 km^2, Southwest Line Road = 1.27 km^2, and East Line Road = 1.8 km^2) along blocks of fire control and recreation road (16.6 km) on MSSF, and 1 study plot (2 km^2) on 3.7 km of recreational road and beach frontage at SBSR. Blocks of road were selected on MSSF instead of transects to reduce the potential for a single animal engaged in linear movement to be sampled multiple times (Sargeant et al. 2003). The SBSR road scheme is less systematic, and track stations were located more randomly on roadways throughout the entire reservation. All tracking stations (or pairs of tracking stations) within each study plot were located approximately 0.3 km apart.

Tracking stations were constructed of areas of substrate that were raked free of rocks and debris, and smoothed. Scented tracking stations were circular with a mean diameter of 1.1 m (95% CI = 0.06, n = 14). These were located on alternating sides of and adjacent to roads to reduce the chance of detection bias due to wind direction. Each was equipped with a single fatty acid scent (FAS)-impregnated plaster of paris disk (USDA APHIS WS Pocatello Supply Depot) at its center. Passive tracking stations were placed across roads similar to Engeman et al. (2002) and averaged 1.3 × 2.7 m (95% CI = 0.07 and 0.35, n = 14). Use of the SBSR study plot was discontinued after the March 2003 sampling period due to logistical constraints and study design concerns related to human traffic and irregular distances between track stations.

From their nearest points, the Pockanoket Road study plot was 3.5 km from the Southwest Line Road and 3.0 km from the East Line Road study plots. The Southwest Line Road and East Line Road study plots were 1.4 km apart. The SBSR study plot was more than 12 km from its nearest neighbor, the Southwest Study Plot on MSSF. All tracking station locations were recorded by Global Positioning System (GPS).

We conducted tracking station comparison activities over 1,219 nights (4 study plots on 2 study areas– 4 consecutive nights/sampling session) during June and October 2002, and January, April, and June 2003. However, rain, snow, freezing temperatures, and other factors occasionally resulted in the need to clear tracking stations without data collection.

Tracking stations were visited daily during each sampling period and smoothed after data collection. Track intrusion events from raccoons, skunks, foxes (red and gray), and coyotes were counted and recorded as the apparent number of intrusion events/species/station for passive tracking stations (Engeman et al. 2000), and as presence/absence at scented tracking stations. FAS disks were replaced only as necessary, and were removed from study plots at the end of each sampling period. For consistency of data collection, the number of observers was kept to a minimum.

Because direct comparison of enumerated passive tracking station data with scented tracking station binary data is not possible, we converted passive tracking station results to binary (presence/absence) data.

Tracking Station Bias

Passive and scented tracking stations were co-located (n = 17) at the Pockanoket Study Plot. In addition to comparing animal detection by scented and passive tracking stations, we examined the potential effect of co-locating these types in the Pockanoket study plot, to assess possible bias associated with FAS-impregnated disks being located in close proximity to passive tracking stations. Tracking station results were compared between the Pockanoket Study plot (mixed tracking station types), and the East Line Road (passive tracking stations) (Figure 1), and Southwest Line Road (scented tracking stations) study plots.

The Southwest Line Road and East Line Road study plots received single treatments only (n = 11 each) to facilitate their use in comparisons with the paired tracking stations at the Pockanoket study plot to evaluate potential bias.

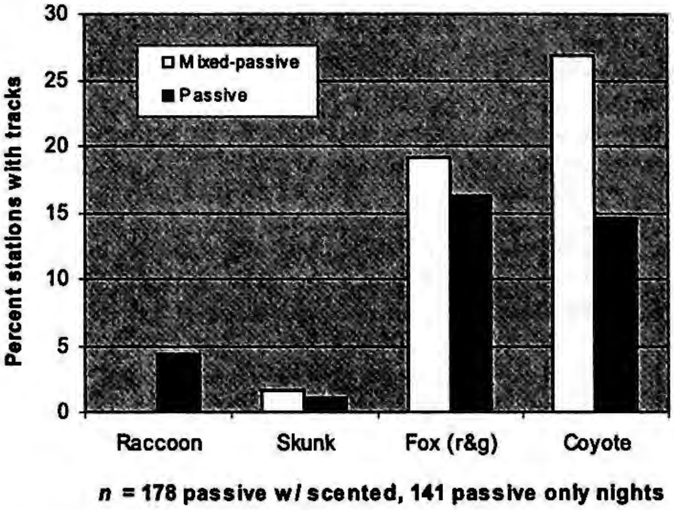

Figure 1. Effect of co-location of tracking station types on wild carnivore behavior in southeastern Massachusetts (June 2002 - June 2003).

Passive Tracking Stations versus Live-Trapping

We conducted a pilot study to compare passive tracking stations and live-trapping for indexing the abundance of raccoons and skunks in PP/SO habitat over 8 track station/trapping nights (11/11/03 to 11/20/03). The purpose of this effort was to 1) compare trap and passive tracking station catch/unit effort in PP/SO, and 2) assess the potential for autocorrelation of passive tracking station results based on linear animal movement (Sargeant et al. 2003). Further studies to assess errors related to animal behavior or observer training and the effect of substrate are planned.

Passive tracking stations (n = 45 to 50) and live-capture cage traps (n = 45 to 50) were located randomly in 5 trap/track station clusters within 3 distinct areas of MSSF selected for uniformity of habitat and human traffic volume. Each area contained 3 to 4 clusters of both treatment types. Passive tracking station (n = 41) substrate types were categorized in the field as sand (21.9%), sand/loam (31.7%), sand/stone (9.7%), sand/loam/stone (19.5%), and sand/loam/vegetation (17.0%), based on appearance. All trap and passive tracking station locations were recorded by GPS.

RESULTS AND DISCUSSION

Tracking Station Comparisons

Raccoon and skunk tracks were detected in low frequency in both types of tracking stations; however, passive tracking stations had more than twice the raccoon track intrusion events (1:2.4) as scented tracking stations over the same time period (Table 1) (n = 31 events, combined scented and passive). Less disparity in activity between tracking station types was noted for skunks (1 scented:1.6 passive) (n = 9). Fox tracks were detected in both types of tracking stations but were observed more frequently in passive tracking stations (1:1.2) (n = 243). Coyotes were detected much less frequently in scented (1:5) (n = 187), than in passive tracking stations.

Passive tracking stations appear to have utility in providing non-intrusive relative abundance indices that can help assess activity and distribution patterns of some species at relatively low cost under some circumstances. However, questions about methodology and ability to accurately detect changes in animal abundance with tracking stations persist (Smith et al. 1994, Nottingham et al. 1989, Anderson 2003, Sargeant et al. 2003). Managers intending to use scented tracking stations for monitoring coyote population trends should consider a similar comparative study under local conditions with the possibility of switching to passive tracking stations if they prove more reliable. Obvious seasonal variations in animal activity as detected by track stations in this study (Table 1) lead to the conclusion that future use of the track stations must be adapted to seasonal effects. Also, given that raccoon activity was low in this study, and that low raccoon densities are reported in southeastern Massachusetts (D. Slate and T. P. Algeo, WS, unpubl. data), we conclude that further evaluations of track stations as a raccoon abundance indexing method must be conducted in areas featuring higher raccoon densities and should be designed to increase sampling effort (Sargeant et al. 2003).

Table 1. Percent of available tracking stations with intrusions by wild carnivores in southeastern Massachusetts, June 2002 - June 2003.

	Raccoon	Skunk	Fox (r&g)	Coyote	*n* nights
June scented	1.3	0	12.5	1.3	72
June passive	2.7	0	9.4	5.4	74
October scented	0	0.5	30.4	6.3	174
October passive	5.6	1.5	31.7	16.4	195
January scented	0	0	9.0	5.7	122
January passive	0.8	0	8.0	31.4	124
March scented	4.6	0	21.7	8.5	129
March passive	6.2	2.6	29.4	36.6	112
June scented	1.0	2.0	7.1	1.0	98
June passive	1.6	0	19.3	33.6	119

Tracking Station Bias

Comparison of passive tracking station results between the Pockanoket Road study plot (co-located with scented tracking stations) ($n = 178$ tracking station nights) and the Southwest Line study plot (passive only) ($n = 141$ nights) demonstrated an apparent effect from co-location, especially for raccoons for which the ratio of mixed: passive only tracking stations with tracks was 0:4.4. A less apparent effect was observed for coyotes (1:1.8), skunks (1:1.4), and foxes (1:1.1). Therefore, we recommend that future efforts to compare tracking station types be designed to keep the types separate.

Passive Tracking Stations versus Live-Trapping

Passive tracking station results from this pilot project included 15 raccoon and 2 skunk intrusion events (Figure 2), and 77 fox and 184 coyote intrusion events. In addition, deer, domestic dog and cat, rabbit, bird, and human (foot, horseback, vehicle) track station intrusion events were noted. Track station intrusions where species was in doubt were not included in the above totals. Only 2 unique raccoons were captured, along with a single recapture (Figure 2).

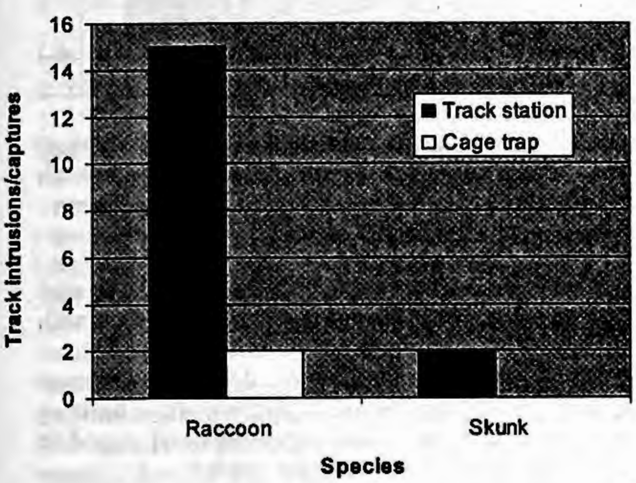

Figure 2. Passive tracking stations versus cage trapping for raccoon population assessment in southeastern Massachusetts.

CONCLUSION

Passive tracking stations appear more sensitive to raccoon activity than do scented tracking stations. However, further evaluations of track stations as a raccoon abundance indexing tool must be conducted in areas featuring higher raccoon densities to increase sampling effort (Sargeant et al. 2003) for confirmation. Due to an apparent effect from co-location of track station types, we recommend that future efforts to compare tracking station types be designed to keep the types separate.

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