Patterns of Native and Domesticated Predator Distribution in an Urban Nature Preserve

Susan Reigler, Omar Attum, and Christian Cutshall
Department of Biology, Indiana University Southeast, New Albany, Indiana 47150
Contact: sreigler@ius.edu
812-941-2016

Introduction

Urban nature preserves face many challenges to their ecological integrity, including pollution of their watersheds, replacement of native by invasive species, and the reduction of native bird and small mammal populations by non-native domesticated predators such as cats and dogs (Pickett, *et al.* 2001). Several studies have shown that the relationship between the presence of domesticated predators and the potential for increased predation on native bird and small mammal populations (May and Norton 1996, Keyser, *et al.* 1998, Crooks and Soule 1999, Lacerda, *et al.* 2009). In Australia, domestic cats have even been credited with causing the extinction of several species of small, native mammals (Johnson *et al.* 1989). Such predation by domesticated species also creates competition with native predators for prey (Marks and Duncan 2009).

Several factors contribute to the negative impact that non-native predators have on native wildlife in urban forests; the amount of fragmentation within a preserve (Zipkin, *et al.* 2009), the size of habitat fragments within urban forests (Crooks 2002, Ewers and Didham 2007), and edge effects (Murcia, 1995 and Lacerda, *et al.* 2009) Most urban preserves are small and surrounded by urban and suburban matrices. This has the effect of reducing the forest interior, making these preserves more vulnerable to edge effects (Harper, et al. 2005). Consequences of the increased edge effects resulting from fragmentation include damage to vegetation and soil, greater dispersal of pollen and seeds of invasive plants, and changes in humidity and nutrient cycling (Harper, *et al.* 2005).

The purpose of this study was to examine if hiking trails in an urban preserve have created an edge effect by effectively fragmenting the forest into smaller patches. We also examined if trails provided predators increased access to forest interior by examining the relationship between distance to these trail edges and the presence/absence of native and non-native mammal predators in an urban nature preserve.
.

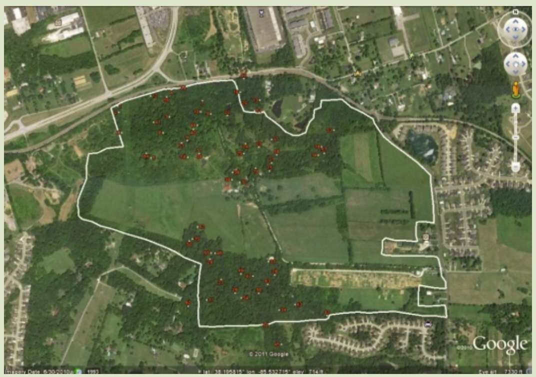

Figure 1. Randomly-generated points for camera trap placement.

Methods

This study occurred at Blackacre State Nature Preserve, located approximately eighteen miles east of Louisville, Kentucky (38.195 N, 85.533W). Blackacre SNP is an urban nature preserve, containing 113 hectares of mixed habitat, including two tracts of secondary growth forest, restored tall grass prairies, meadows, and wetlands. A network of hiking trails allows visitor access. State law prohibits bringing pets onto the preserve, but the forest tracts are bordered by suburban subdivisions with resident cats and dogs and neighbors do not always confine their pets.

Forest patches were mapped and quantified using Google Earth We then selected 52 random locations inside forest patches and measured the shortest straight-line distance of each point from a forest edge twice, once for patches defined by forest edge and a second time for patches defined by both forest and hiking trail edges.

Thirteen Scout Guard camera traps (Model SG550) were placed at each of the random points on a rotating schedule between 9 March and 11 April, 2010. Each camera deployment lasted 72 hours, with our cameras programmed to record 30 second videos for each event. A locking cable secured each camera trap to a tree at one and one half meters from the ground, with the camera facing the direction of the nearest edge.

We used an ANOVA to compare the size of forest patches defined only by forest edges versus forest patches defined by both forest and trail edges. We compared the distance to forest and trail edge for locations in which each species was observed and not observed through the use of independent t-tests in which unequal variances were assumed. We accounted for multiple tests for each species by adjusting the p-values using Bonferroni corrections (significance = $\alpha_{adj,} P < 0.025$).

Figure 2. Raccoons not on a trail.

Figure 3. Cat on woodland hiking trail.

Results

There was no relationship between raccoon presence and distance to hiking trails. (Table 1.) Our results suggest that hiking trails allowed access to forest interior as cats and opossums were found at significantly shorter distances from hiking trails in comparison to locations in which the species were not recorded.

Discussion

Our study suggests that hiking trails do increase fragmentation of forest patches and this fragmentation has an effect on the distribution of both cats and opossums within the preserve. Hiking trails create breaks in the forest canopy and new boundaries within the forest. These new boundaries can be considered soft edges allowing native and non-native predators increased access to the forest interior (Collinge, 2009).

Cats and opossums were found most frequently within the vicinity of a trail suggesting that the trails are allowing these species to penetrate the interior of forest patches. Domesticated cats often hunt within the vicinity of forest edge habitat and rarely venture more than 10 m into the forest (Kays and DeWan 2004). Opossums are edge-utilizing predators and this utilization of edges has helped opossums adapt to human-altered landscapes (Zegers, *et al.* 2000; Prange and Gehrt 2004). The distribution of raccoons, on the other hand, was not related to distance to forest edges or to hiking trails. The ubiquitous raccoon distribution suggests that raccoons are able to use forest and edge habitat.

Hiking trail systems that fragment the forest of urban nature preserves and potentially allow increased access to domesticated predators creates a management and conservation concern. We believe that the potential of hiking trails to fragment forests and allow predator access is dependent upon reserve size. Hiking trails in larger nature preserves probably have minimal impact because trail density in relation to reserve area is lower than in smaller reserves, which therefore preserves more forest interior habitat (McKinney 2005).

TABLE 1. The Mean ± SE distance (m) for Each Species from Forest Edge Without and When Accounting for the Presence of Hiking Trails. Sample size in parenthesis.

	Present	Absent
Cats		
Distance to edge (No Trails)	42 m ± SE 21 (n = 7)	40 m ± SE 5 (n = 57)
Distance to edge (Trails)	6 m ± SE 2 (n = 7)	27 m ± SE 4 (n = 57)
Opossums		
Distance to edge (No Trails)	38 m ± SE 10 (n = 12)	41 m ± SE 6 (n = 52)
Distance to edge (Trails)	14 m ± SE 4 (n = 12)	27 m ± SE 4 (n = 52)
Raccoons		
Distance to edge (No Trails)	42 m ± SE 6 (n = 48)	34 m ± SE 8 (n = 16)
Distance to edge (Trails)	24 m ± SE 4 (n = 48)	27 m ± SE 6 (n = 16)

Management Recommendations

In small urban nature preserves, trails that bisect the interior may allow access by cats and native edge predators. We suggest that hiking trail development in urban or small forest nature reserves should occur on the periphery of the forest and not bisect the forest interior. This will help minimize the penetration of domesticated predators, such as cats, into the core of the forest fragments, thus helping to preserve the biodiversity of potential prey species and minimize competition between native and domesticated predators for those prey species. A trail system along the perimeter of small preserves would allow the conservation of the core zone and the protection of native bird and small mammal populations while still allowing passive human recreation (Alexander 2008).

References

ALEXANDER, M. 2008. Management Planning for Nature Conservation: A Theoretical Basis & Practical Guide. Springer, New York.
COLLINGE, S.K. 2009. Ecology of Fragmented Landscapes. Johns Hopkins University Press, Baltimore.
CROOKS, K.R. 2002. Relative sensitivities of mammalian carnivores to habitat fragmentation. Conservation Biology 2: 488-502.
CROOKS, K.R.AND M.E. SOULE 1999. Mesopredator release and avifaunal extinctions in a fragmented system. Nature 400:563-566.
EWERS, R. M. AND R. K. DIDHAM 2007. The effect of fragment shape and species' sensitivity to habitat edges on animal population size. Conservation Biology 21(4):926-936.
HARPER, K. A., S.E. MACDONALD, P.J. BURTON, J. CHEN, K.D. BROSOFSKE, S.C. SAUNDERS, E.S EUSKIRCHEN, D. ROBERTS, M.S. JAITEH AND P. ESSEEN 2005. Edge effects on forest structure and composition in fragmented landscapes. Conservation Biology 19 (3): 768-782.
KAYS, R.W. AND A.A. DEWAN 2004. Ecological impact of inside/outside house cats around a suburban nature preserve. Animal Conservation 7:1-11.
LACERDA, A.C.R., W.M. TOMAS & J. MARINHO-FILHO 2009. Domestic dogs as an edge effect in the Brasília National Park, Brazil: interactions with native mammals. Animal Conservation 12:477-487.
MARKS, B.K. AND R.S. DUNCAN 2009. Use of forest edges by free-ranging cats and dogs in an urban forest fragment. Southeastern Naturalist 8(3): 427-436.
MCKINNEY, M.L. 2005. Scaling of park trail length and visitation with park area: conservation implications. Animal Conservation 8: 135-141.
MELBOURNE, B.A., K.F. DAVIES, C.R. MARGULES, D.B. LINDENMAYER, D. A. SAUNDERS, C. WISSEL and K. HENLE 2004. Species survival in fragmented landscapes: where to from here? Biodiversity and Conservation 13: 275-284.
MURCIA, C. 1995. Edge effects in fragmented forests: implications for conservation. TREE 10(2): 58-62.
PICKETT, S.T.A., M.L. CADENASSO, J.M. GROVE, C.H. NILON, R.V. POUYAT, W.C. ZIPPERER, AND R. COSTANZA 2001. Urban ecological systems: linking terrestrial, physical, and socioeconomic components of metropolitan areas. Annual Review of Ecology and Systematics 32:127-57.
PRANGE, S. AND S.D. GEHRT 2004. Changes in Mesopredator-community structure in response to urbanization. Canadian Journal of Zoology 82:1804-1817.
ZEGARS, D.A., S. MAY AND L.J. GOODRICH 2000. Identification of nest predators at farm/forest edge and forest interior sites. Journal of Field Ornithology 71(2):207-216.
ZIPKIN, E.F., A. DEWAN AND J.A. ROYLE 2009. Impacts of forest fragmentation on species richness: a hierarchical approach to community modelling. Journal of Applied Ecology 46:815-822.

Acknowledgements

We are grateful to the Kentucky State Nature Preserves Commission, Frankfort, KY for providing permission to carry out this research and to the students in the Applied Conservation Biology class at Indiana University Southeast for their assistance in the field. This project was funded by Indiana University Southeast.