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The ecological role of the New England cottontail (*Sylvilagus transitionalis*) and the impacts of environmental and human influences on wild rabbit abundance

Wild rabbits are historically a widespread species, famous for their breeding ability. In recent decades however, the species has suffered a dramatic decline. Rabbits have been widely studied as habitat indicator species in Mediterranean food webs but little research has been done regarding their presence in the United States. Of the wild species in the US, there are 14 species of rabbits; New England cottontails (*Sylvilagus transitionalis*) are the only rabbits indigenous to the extreme northeast portion of the United States. As early as 1960, this small rabbit with gray-brown fur and a small, white tail was found in New York, New Jersey and throughout southern New England, generally along the edges of wooded areas with dense cover. Today, this rabbit's range has shrunk by more than 75 percent. Its numbers are so greatly diminished that it has been recognized by the U.S. Fish and Wildlife Service (USFWS) as an endangered species¹. This paper will hypothesize effects on current New England cottontail rabbit abundance, taking into account environmental factors and man-made influences known to affect wild rabbit abundance. Additionally, this paper highlights habitat management strategies to encourage awareness of the effects of natural and human influence on rabbit abundance, which may be used in consideration of conservation measures for the preservation of species biodiversity.

Rabbits play a major role in ecosystems. They impact significantly upon both predators and primary producers, as well as conservation of biological diversity. Excluding rabbit grazing from a plant community produces marked top-down effects on community composition. Rabbits promote plant diversity through cycling of nutrients and their contribution to soil fertility². High plant diversity provides insurance against environmental change, as a taxonomically and functionally more diverse plant community is likely to have constituents which can thrive in altered circumstances. Diversity in plant communities may be maintained by a variety of mechanisms. These include herbivory, interspecific differences in seed dispersal and the differential responses of plants to heterogeneity of resources (including water, nutrients, and light)³. Rabbits scatter fecal pellets throughout their habitat range, and deposit large numbers of pellets at latrines. Rabbits contribute to biosystem diversity by a plant-animal mutualistic interaction of seed dispersal; seeds from a wide variety of plants can be excreted in widespread areas. Enrichment by rabbit latrines has a demonstrable increase in plant nutrient concentration and organic matter, soil chemistry and plant growth, potentially creating fertile islands of luxuriant growth between shrubs.

Prior to European settlement, the New England cottontail was probably found along river valleys where floods and beavers created the disturbances needed to generate its preferred habitat. During colonial times, much of the New England forest was cleared for agriculture and then subsequently abandoned. This abandonment of farmland, relatively flat topography, high quality vegetation, and areas with dense refugia such as shrublands, early-successional forests, or other disturbance-generated thickets⁴ allowed for a great

deal of early habitats to develop and the New England cottontail to thrive. Today, the native New England cottontail's range has shrunk by 75 percent in only the last 40 years⁵. One factor commonly known to affect wild rabbit population and habitat loss is viral epizootic diseases, particularly RHD. Increased predation and species competition have also been suggested as factors causing the decline of rabbit diversity in many human-altered landscapes. Ever-increasing climate and land use changes, and increasing urbanization hinder the recovery of New England cottontail populations, leading to habitat fragmentation, local extinctions, and larger ecological consequences.

The reduction in distribution and abundance of New England cottontail rabbits is influenced by climatological variables. Seasonal availability of resources affects the fecundity and health of wild rabbits. Most of New Jersey has a humid subtropical climate, characterized by hot, humid summers and chilly to mild winters. Northwestern regions of the state have a humid continental climate, similarly marked by variable weather patterns and a large seasonal temperature variance, but with slightly cooler temperatures. Autumn rainfall influences the germination and growth of the annual plants, which, in turn, influences the onset of the rabbit breeding season (January to April). High rainfall can cause a shortening of the breeding season; this makes thermoregulation difficult, thereby increasing mortality rates in early winter. In addition, excessive soil moisture limits plant growth, leading to food shortages and delaying the onset of the breeding period. Conversely, in February and May, when rainfall is usually low, increased rainfall may be associated with an increase in quality food for New England cottontails⁶.

A proliferation of exotic plant species has also contributed to the New England cottontail's decline. Rabbit abundance depends largely on the availability of high quality food, and many plants that form the habitat where the New England cottontail can be found are dominated by non-native species that do not provide rabbits with the food resources that native plant species do. The introduction of invasive exotic species, such as multiflora rose, honeysuckle bush and autumn olive, has changed the type of habitat available to the New England cottontail.

Biologists believe competition between high densities of other species has also contributed to the New England cottontail's decline. New England cottontails are the only rabbits indigenous to the extreme northeast portion of the United States. Since their introduction in the early 1900s, Eastern cottontails (*S. floridanus*) have become better suited to the increasing urban environment prevalent in the region. Both species of cottontails utilize similar habitats, so competition for food has been suggested as an explanation for the decline and threat of extinction to New England cottontail populations. Additionally, extremely high densities of white-tailed deer could also limit rabbit populations due to competition for available food⁷. Deer eat many of the same grasses, plants, barks and twigs as the New England cottontail and affect the structure and density of many understory plants that provide thicket habitat.

Habitat quality in human-dominated landscapes is a major factor limiting the distribution and abundance of New England cottontail populations. Habitats are aging or have been developed and are no longer suitable for the cottontail⁸; this habitat loss is due to human

land uses such as suburban and rural housing, commercial development, and road and highway development, which has resulted in habitat fragmentation. Habitat fragmentation can threaten a species' survival and is the primary cause of the loss of biodiversity in many scenarios; it affects both plants and animal populations at several scales. As an area is cut into smaller pieces, there is less habitat available, and a species will support a correspondingly smaller population. Habitat patch quality (such as abundance of food and risk of predation) can affect the survival of animals that are sequestered to such remnant areas. New England cottontails living on small, resource poor patches are typically in poor physical condition and fed at sites farther from refugia, resulting in a higher mortality rate than among rabbits occupying large habitats with abundant resources⁹. Rabbits on smaller patches tend to deplete their food supply early in the winter, so obtaining food, no matter how low quality, incurs additional predation costs. Even moderate levels of habitat fragmentation can elevate predation rates and subsequently alter the composition of prey communities. Movement in between patches only occurs occasionally as it is hazardous and difficult, and edge effects cause habitats to be adjacent to land occupied by predators or harsh environmental conditions. Habitat patches are particularly detrimental, as this affects connectivity between subpopulations, leading to isolation of neighboring populations, loss of genetic diversity, and local extinctions. As a result, local populations of New England cottontails may become vulnerable to extinction if large patches of habitat are not maintained¹⁰.

Warrens could be the answer to many of the problems caused by habitat fragmentation. Open burrow systems have been recognized as an important source of heterogeneity in

many ecosystems, enhancing density and biodiversity¹¹. They are long-lived, influencing geomorphology, aerating soils, increasing nutrient inputs and fertility¹² for plant communities and faunal diversity. Warrens offer retreat sites for refuge and serve as shelter from threatening weather and extreme temperatures. They may affect the spatial distribution of invertebrates¹³ improving resource availability for many taxa, (including small mammals, reptiles, and amphibians) which can dramatically alter food web dynamics. Rabbit warrens may have further implications within the ecosystem, potentially mitigating the effects of habitat fragmentation by acting as a bridge, linking patches of favorable habitat for food and shelter, and promoting species dispersal by offering more choices for mates. New England cottontails have the potential to modulate the availability of resources through warrens, with important implications for community ecology and the maintenance of biodiversity.

This paper was motivated by my interest in wildlife conservation and the ecological role of the rabbit. Monitoring abundance trends of wildlife populations is an essential component of any management program and should be used to evaluate the current status of a species for its inclusion on national/international lists of endangered species. The lack of nation-wide survey schemes for common species is a problem in many wildlife monitoring programs¹⁴. My perception is that New Jersey wild rabbit abundance is poorly understood. Given the current status of the New England cottontail as a candidate for the national list of endangered species, determining relationships between environmental and specific habitat factors could help guide specific habitat management strategies, aimed to enhance rabbit recovery populations in Northeastern United States ecosystems.

Low density New England cottontail populations in marginal habitats could continue to have an increased risk of extinction unless effective habitat management measures are established. New England cottontail abundance is positively affected by the presence of good scrub cover in natural vegetation thickets such as shrublands and early-successional forests.¹⁵ Unfortunately, thickets are declining in the Northeastern U.S. They tend to grow back to forests in just a few decades; the shrub layer thins, and this creates a situation that the New England cottontail no longer finds suitable¹⁶. To assure that species dependent on thicket habitats persist,¹⁷ halting the decline of scrub and brushland habitat is imperative. To increase habitat suitability and connect isolated patches which could be hindering the repopulation of some suitable habitats,¹⁸ large patches of habitat should be maintained in a landscape network. Efforts to enhance long-term viability of New England cottontails should also include identifying potential habitat, free of the competing Eastern cottontail, to which New England cottontails could be restored.

A decline in the New England cottontail rabbit population can leave a region vulnerable to ecological consequences. Excluding rabbit grazing from a plant community produces marked changes in community composition. Rabbits impact significantly on both primary production and the conservation and promotion of biological diversity through cycling of nutrients and contribution to soil fertility. Structural heterogeneity within a habitat may be crucial in order to cope with environmental variables such as topography, soil composition, and global climate change. Further intensification by impacts from disease, species competition, incorrect land use management and urban development can lead to patch isolation, disappearance of warrens, loss of habitat or local extinctions of New

England cottontails. Working together, states and federal agencies may help ensure the future survival of the New England cottontail.

The New England cottontail serves as an excellent habitat indicator in New Jersey where habitat fragmentation and environmental stress so strongly impact the distribution of the species. As the State of New Jersey has momentum in management of its hills and highlands, preserves its farmlands and watersheds, conserves pinelands and wetlands, the loss of the checkerboard fields, meadows, pastures and wooded edges that are the habitats of the cottontail may diminish. Environmental managers will find it a prudent measure for their environmental assessments to include a stronger emphasis on the habitat of New England cottontail to determine the impact and affects of a proposed project. This rabbit is an important common denominator in the determination of the environmental health, vitality and sustainability of a habitat.

Fortunately, the cottontail has been able to survive and proliferate even as encroachment and fragmentation has forced them into inhospitable and often harsh landscape settings. Resiliently, the rabbits who historically travelled in open conditions have been forced to resort to moving underground and through a maze of warrens. What will be critical going forward in the management of the environment will be better understanding the effect and impact of projects on this *new* habitat in the already developed areas of the State. Should we force the cottontail further from the fractured open spaces and out of their warrens, the effect could devastate population and species distribution and have a negative effect on the local and regional food webs within the State and at regional levels.

References

- ¹ United States Fish and Wildlife Service. Mammals of New Jersey
<http://www.state.nj.us/dep/fgw/chkmamls.htm>
- ² Willott SJ., Miller AJ., Incoll LD., and Compton SG. 2000. The contribution of rabbits (*Oryctolagus cuniculus* L.) to soil fertility in semi-arid Spain. *Biol Fertil Soils* **31**:379-384.
- ³ Willott SJ., Miller AJ., Incoll LD., and Compton SG. 2000. The contribution of rabbits (*Oryctolagus cuniculus* L.) to soil fertility in semi-arid Spain. *Biol Fertil Soils* **31**:379-384.
- ⁴ Litvaitis, JA. 2003. Are pre-Columbian conditions relevant baselines in managed forests of the northeastern United States? *Forest Ecology and Management* **185**:113-126.
- ⁵ Litvaitis, JA., MS. Barbour, AL. Brown, AI. Kovach, JD. Oehler, BL. Probert, DF. Smith, JP. Tash, R. Villafuerte, and MK. Litvaitis. 2006. Testing multiple hypotheses to identify the causes of the decline of a lagomorph species: the New England cottontail as a case study. *Biology of lagomorphs - evolution, ecology and conservation*. Springer-Verlag, Berlin.
- ⁶ Calvete C., Estrada R., Angulo E., and Cabezas-Ruiz S. 2004. Habitat factors related to wild rabbit conservation in an agricultural landscape. *Landscape Ecology* **19**:531-542.
- ⁷ Delibes-Mateos M., Ferreras P., and Villafuerte R. 2008. Rabbit (*Oryctolagus cuniculus*) abundance and protected areas in central-southern Spar: why they do not match? *Eur J Wildl Res* doi: 10.1007/s10344-008-0216-5.
- ⁸ Villafuerte R., JA. Litvaitis, and DF. Smith. 1997. Physiological responses by lagomorphs to resource limitations imposed by habitat fragmentation: implications to condition-sensitive predation. *Canadian Journal of Zoology* **75**:148-151.
- ⁹ Villafuerte R., JA. Litvaitis, and DF. Smith. 1997. Physiological responses by lagomorphs to resource limitations imposed by habitat fragmentation: implications to condition-sensitive predation. *Canadian Journal of Zoology* **75**:148-151.
- ¹⁰ Barbour, MS., and JA. Litvaitis. 1993. Niche dimensions of New England cottontails in relation to habitat patch size. *Oecologia* **95**:321-327.
- ¹¹ Bravo LG., Belliure J., and Rebollo S. 2008. European rabbits as ecosystem engineers: warrens increase lizard density and diversity. *Biodivers Conserv* doi:10.1007/s10531-008-9438-9.
- ¹² Markwell TJ. and Daugherty CH. 2002. Invertebrate and lizard abundance is greater on seabird-inhabited islands than on seabird-free islands in the Marlborough Sounds, New Zealand. *Ecoscience* **9**:293-299.
- ¹³ Hawkins LK. and Nicoletto PF. 1992. Kangaroo rat burrows structure the spatial organization of ground-dwelling animals in a semiarid grassland. *J Arid Environ* **23**:199-208.

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- ¹⁴ Virgos E., Cabezas-Diaz S., and Lozano J. 2007. Is the wild rabbit (*Oryctolagus cuniculus*) a threatened species in Spain? Sociological constraints in the conservation of species. *Biodivers Conserv* **16**:3489-3504. doi: 10.1007/s10531-006-9054-5
- ¹⁵ Calvete C., Estrada R., Angulo E., and Cabezas-Ruiz S. 2004. Habitat factors related to wild rabbit conservation in an agricultural landscape. *Landscape Ecology* **19**:531-542.
- ¹⁶ Calvete C., Estrada R., Angulo E., and Cabezas-Ruiz S. 2004. Habitat factors related to wild rabbit conservation in an agricultural landscape. *Landscape Ecology* **19**:531-542.
- ¹⁷ Litvaitis, J.A. 2003. Are pre-Columbian conditions relevant baselines in managed forests of the northeastern United States? *Forest Ecology and Management* **185**:113-126.
- ¹⁸ Calvete C., Estrada R., Angulo E., and Cabezas-Ruiz S. 2004. Habitat factors related to wild rabbit conservation in an agricultural landscape. *Landscape Ecology* **19**:531-542.

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