Habitat preferences of New England cottontail and eastern cottontail in relation to proximity to wetlands and developed areas

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Abstract

The New England cottontail (*Sylvilagus transitionalis*) has been listed as a candidate species under the Endangered Species Act, and is a high conservation priority in the Northeastern United States. Federal and state wildlife agencies actively encourage landowners to create early successional habitat for New England cottontail by clearcutting blocks of forest. In 2012 the University of Rhode Island prepared a GIS model to identify sites for creation of habitat for NEC. However, some aspects of NEC habitat preferences are not well understood. The University of Rhode Island recently completed an analysis of overstory canopy cover in 336 cottontail locations that found that NEC occupied sites with higher overstory tree canopy than EC. The current study used the same 336 cottontail locations to assess NEC and EC habitat preferences in relation to wetlands, open areas, and developed areas. Contrary to our expectations, NEC did not appear to avoid wetlands. There were also no indications that NEC preferred or avoided sites near agriculture, pasture, grassland or developed areas, however, EC were more likely to occupy these sites. Based on these findings, we offer suggestions for fine-tuning the RI GIS model to identify sites for creation of habitat for NEC.

1. Introduction

Conservation of the New England cottontail (NEC, *Sylvilagus transitionalis*) is a high priority in the Northeastern United States. The range of the species decreased by more than 80% during the past fifty years (Litvaitis et al. 2006), prompting its nomination by the US Fish & Wildlife Service (USFWS) as a candidate for threatened or endangered status under the Endangered Species Act (USFWS 2006). The decline of the NEC is attributed to several factors, including competition with the introduced eastern cottontail (EC, *S. floridanus* (Johnston 1972, Litvaitis et al. 2006, Fenderson et al. 2011). The population of EC has continued to expand while NEC has declined, which may be due to EC's adaptability to a variety of habitat types (Fay and Chandler 1955, Johnston 1972, Probert and Litvaitis 1996, Smith and Litvaitis 1999). However, the loss of early successional habitat and habitat fragmentation are generally considered to be the most important factors affecting the decline of NEC (Litvaitis et al. 2008, Fuller and Tur 2012). Early successional habitat was widely available in the region in the early 20th century due to agricultural abandonment, but in recent decades most of this habitat has transitioned to mature forests with less understory cover and become more fragmented by development and infrastructure (Lorimer 2001, Trani et al. 2001, Foster and Aber 2004).

The New England Technical Committee has proposed an ambitious target of restoring 14,500 ha of habitat by 2020, of which almost half is planned to be achieved on private land (Fuller and Tur 2012). The Natural Resources Conservation Service (NRCS) of the US Department of Agriculture encourages private landowners to create habitat for NEC by offering technical and financial assistance (NRCS 2014). The patch size of clearcuts is recommended to be at least 10 ha, because occupancy of small patches is believed to result in lower body weight, increased risky foraging behavior, and increased mortality from depredation (Litvaitis et al. 2008, Fuller and Tur 2012).

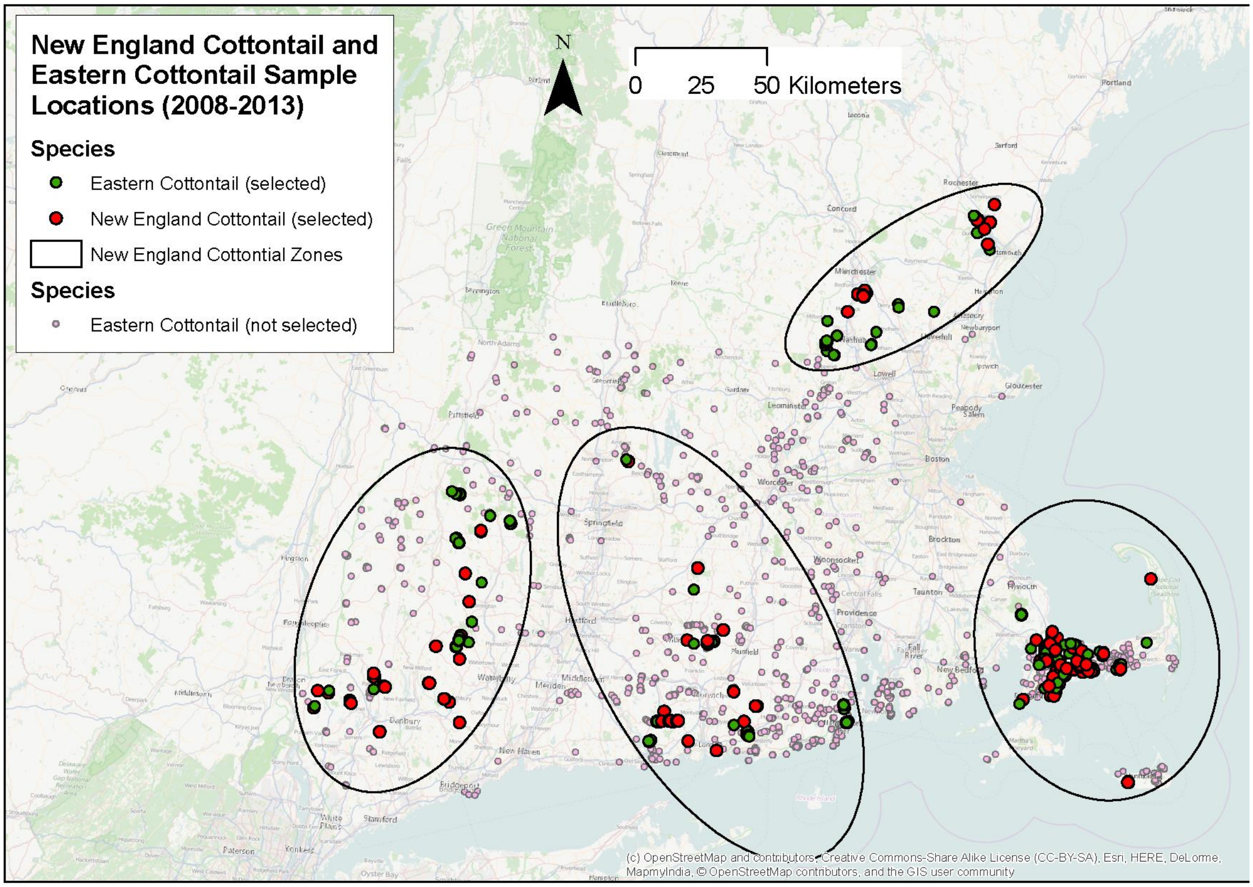
In 2012, a group of federal and state agencies in Rhode Island recommended that site selection for creation of NEC habitat exclude (a) very poorly drained soils (defined by having a drainage classification in the Rhode Island Geographic Information System (GIS) soils layer), (b) open areas such as agriculture and pasture, and (c) developed areas. These criteria were included in a GIS model prepared by the University of Rhode Island to identify areas where landowners could create habitat patches of at least 10 ha in conjunction with existing patches of habitat (Buffum 2012). Many land parcels were classified by the GIS model as low priority for creating habitat as a result of these exclusions. However, visits by the authors of the current study to sites where NEC have recently been detected suggest that the species occupies both wetlands and open areas in Southern New England. This agrees with a the findings of landscape analysis of NEC based on surveys conducted between 2000 and 2004, which reported that presence was associated with the availability of developed and wetland attributes (Tash and Litvaitis 2007).

The objective of this study was to provide guidance for the selection of sites for creating habitat for NEC. We used the locations of NEC and EC sampled between 2008 and 2013 in conjunction with existing GIS datasets to assess habitat preferences in five states in the Northeastern US where the two species are sympatric (Figure 1). Our study addressed the following research question: How likely are NEC and EC to occupy sites near wetlands, open areas, and developed areas?

2. Methods

We selected an equal number of NEC and EC locations for the study and assessed habitat attributes within 75 m of points where NEC or EC had been detected. This area (1.77 ha) exceeds most home range estimates for NEC, although these are highly variable, ranging from 0.1 ha to 7.6 ha (Litvaitis et al. 2008). We assumed an average dispersal area of NEC of 3 km based on previous studies (Fenderson et al. 2011, Fenderson et al. 2014), and compared the habitat attributes of the occupied areas (within 75 m) to the available habitat within habitat within the dispersal area (within 3 km) and two intermediate areas (within 150 m and within 1 km). We compiled the coordinates of all available NEC and EC samples collected between 2007 and 2013 from five states where the two species are sympatric: Connecticut, Massachusetts, New Hampshire, New York, and Rhode Island. We started with 2,542 samples from these five states that had been analyzed by the University of Rhode Island Wildlife Genetics and Ecology Laboratory, and then requested the state wildlife offices to provide the locations of additional samples analyzed in other laboratories. Our total number of 3,649 samples included 441 NEC and 3,208 EC samples. To avoid overlap between our primary sampling areas (within 75 m of cottontail locations) and at the same time maximize sample size we used the ArcGIS RAN tool to randomly select NEC locations with a minimum separation of 150 m, which generated 168 samples. We classified the samples into four zones (Figure 2) corresponding to the four of the five currently distinct populations of NEC identified in previous studies, the fifth population being in Maine (Litvaitis et al. 2006, Fenderson et al. 2011, Fuller and Tur 2012). Then we selected an equal number of EC. For more details on the selection of samples, see Buffum et al (2015).

Figure 1. Locations of NEC (N=168) and EC (N=168) selected for the current study, by zone.



We developed nine attributes for proximity to wetlands. We used NRCS soil maps from the Web Soil Survey (NRCS 2013) to develop three attributes: whether the site was (a) in very poorly drained soils; (b) within 10 m of very poorly drained soils; or (c) within 50 m of very poorly drained soils. We used the National Wetland Inventory dataset of the US Fish and Wildlife Service (USFWS 2014) to develop six wetland indicators: whether the site was (a) in freshwater wetland; (b) within 10 m of freshwater wetland; (c) within 50 m of freshwater wetland; (d) in wetland forest or shrubland; (e) within 10 m of wetland forest or shrubland; and (f) within 50 m of wetland forest or shrubland. We compared the likelihood of occupancy by NEC and EC among these categories using chi-squared tests. We also compared the percent of sites falling in these categories with the percent of the total area within 3 km covered by this category.

We used the Coastal Change Analysis Program (CCAP) dataset of the US National Oceanic and Atmospheric Administration (NOAA 2010) to generate six attributes related to developed areas and agriculture/pasture/grassland areas. We combined three CCAP categories (cultivated crops, pasture or hay, and grassland/herbaceous) to create three attributes: (a) within agriculture/pasture/grassland; (b) within 10 m of agriculture/pasture/grassland; and (c) within 50 m of agriculture/pasture/grassland. We combined four CCAP categories (developed/high intensity, developed/medium intensity, developed/low intensity, developed–open space, and bare land) to create three attributes for developed areas: (a) within developed areas; (b) within 10 m of developed areas; and (c) within 50 m of developed areas. We compared the likelihood of occupancy by NEC and EC in sites in each of these six categories using chi-squared tests. We also compared the percent of sites falling in these categories with the availability of each site type within 3 km.

We conducted GIS analyses using ArcGIS 10.2 (Environmental Systems Research Institute, Redlands, CA) and the Geospatial Modelling Environment 0.7.2.1. We conducted statistical analyses using IBM Statistics v. 22 (International Business Machines Corp.). All reported results are for two-sided tests unless otherwise noted.

3. Results

We assessed nine indicators of proximity to wetlands, and found no significant differences in likelihood of occupancy by NEC and EC in these categories. When we compared the percent of sites falling in these categories with the availability of each site type within 3 km (the percent of the total area within 3 km covered by each category) the occupancy by NEC was generally slightly higher than the availability within 3 km, but the differences were not significant (Table 2). Occupancy by EC, on the other hand, was generally slightly lower than the availability within 3 km, and significantly lower for sites in poorly drained soils or within 10 m of very poorly drained soils.

Table 2. Comparison of cottontail occupancy of site classes (wetland) and availability of site classes within 3 km.

Species	Site class	Percent occupancy of site class (a)	Percent availability of site class within 3 km (b)	Significance of difference between percent occupancy (a) and percent availability (b)
NEC (N=168)	In very poorly drained soils	5	6	NS
	Within 10 m of poorly drained soils	8	8	NS
	Within 50 m of poorly drained soils	14	16	NS
	In freshwater wetland	10	6	NS
	Within 10 m of freshwater wetland	12	9	NS
	Within 50 m of freshwater wetland	21	19	NS
	In wetland forest or shrubland	8	5	NS
	Within 10 m of wetland forest or shrubland	10	7	NS
	Within 50 m of wetland forest or shrubland	18	15	NS
EC (N=168)	In very poorly drained soils	2	6	$t(167) = -3.033$, <0.01
	Within 10 m of poorly drained soils	4	8	$t(167) = -2.929$, <0.05
	Within 50 m of poorly drained soils	12	15	NS
	In freshwater wetland	5	6	NS
	Within 10 m of freshwater wetland	8	9	NS
	Within 50 m of freshwater wetland	18	19	NS
	In wetland forest or shrubland	5	5	NS
	Within 10 m of wetland forest or shrubland	7	6	NS
	Within 50 m of wetland forest or shrubland	14	14	NS

NS = not significant

We assessed six attributes of proximity to agriculture/pasture/grassland and developed areas, and found no significant differences in likelihood of occupancy by NEC and EC in these categories. When we compared the percent of sites falling in these categories with the availability of each site type within 3 km (the percent of the total area within 3 km covered by each category), occupancy by NEC was generally slightly higher than the availability within 3 km but the differences were not significant (Table 3). Occupancy by EC was significantly higher than the availability within 3 km for five of the six attributes.

Table 3. Cottontail occupancy of site classes (agriculture/pasture/grassland and developed) and availability of site classes within 3 km.

Species	Site class	Percent occupancy of site class (a)	Percent availability of site class within 3 km (b)	Significance of difference between percent occupancy (a) and percent availability (b)
NEC (N = 168)	In agriculture/pasture/grassland	10	9	NS
	Within 10 m of agriculture/pasture/grassland	12	13	NS
	Within 50 m of agriculture/pasture/grassland	32	27	NS
	In developed area	24	23	NS
	Within 10 m of developed area	29	28	NS
	Within 50 m of developed area	47	43	NS
EC (N = 168)	In agriculture/pasture/grassland	17	10	t(167) = 2.540, p<0.05
	Within 10 m of agriculture/pasture/grassland	21	13	t(167) = 2.455, p<0.05
	Within 50 m of agriculture/pasture/grassland	42	27	t(167) = 4.103, <0.001
	In developed area	30	24	NS
	Within 10 m of developed area	37	29	t(167) = 2.598, <0.01
	Within 50 m of developed area	51	43	t(167) = 2.481, p<0.05

NS = not significant

4. Discussion

Achieving the target set by the NEC Technical Committee of restoring 14,500 ha of habitat by 2020 will be a major challenge, especially because almost half of the area is planned for implementation on private land (Fuller and Tur 2012). The Natural Resources Conservation Service of the US Department of Agriculture actively encourages landowners to create habitat for NEC by offering technical and financial assistance (NRCS 2014), but many landowners have negative views about forest clearcutting (Berlick et al. 2002, Askins et al. 2007, Buffum et al. 2014), the approach currently recommended for habitat creation (Arbuthnot 2008, NEC Regional Technical Committee 2013). We believe that the findings of our study will support an expanded program of habitat creation in Rhode Island by fine tuning the GIS model to identify sites for habitat creation in Rhode Island (Buffum 2012).

We assessed nine indicators of wetlands and compared the percent of cottontail locations in each wetland type to the availability within the 3 km dispersal area. Unexpectedly we did not find any indications that NEC preferred or avoided wetlands, even though a previous study reported that

NEC was associated with availability of wetlands within 1 km in two of the three study zones (Tash and Litvaitis 2007). However, our results suggested that EC were less likely to occupy sites with poorly drained soils, even though they have been reported to use a wider range of wetland habitats than NEC (DeGraaf et al. 2006). Thus our findings suggest that site selection for creation of NEC habitat should favor rather than avoid sites near wetlands. The dense understory cover in many wetland sites may be particularly important in winter when cottontail mortality is the highest (Villafuerte et al. 1997). Our findings also support the idea that NEC may be able to coexist with EC by occupying relatively stable habitats such as shrub-dominated wetlands, as long as they occupy these habitats before the arrival of EC.

Unfortunately the Rhode Island forestry best management practices do not permit clearcutting in wetlands, but require post-harvest stocking levels in wetlands of at least 60% (Cassidy and Aron 2003). So the only option for improving NEC habitat in forested wetlands would be thinning by either felling or girdling trees to reduce the stocking level to 60%, which would promote the development of a denser understory vegetation. Since the RI GIS model is intended to identify sites for clearcuts, we recommend excluding all hydric soils from the model, even though this will reduce the area of potential sites as compared to the existing model, which only excludes sites that are very poorly drained. But the findings of our study endorse the approach of the RI GIS model of including both wetland and upland shrub when identifying existing patches of habitat.

We also analyzed six attributes related to proximity to agriculture/pasture/grassland and developed areas by comparing the percentage of cottontail locations in each category to the availability of these categories within the 3 km dispersal distance, and found strong differences between NEC and EC. There were no indications that NEC preferred or avoided agriculture/pasture/grassland or developed areas, although NEC often occupied these site types which are widely available in the region. EC, on the other hand, appeared to prefer sites near both agriculture/pasture/grassland and developed areas, which agrees with the findings of previous studies (Edwards et al. 1979, Swihart and Yahner 1982, Morgan and Gates 1983, Swihart and Yahner 1984, DeGraaf et al. 2006, Hunt et al. 2014). The implications of our findings for site selection are complex. On the one hand, continuing to exclude these areas when selecting sites for habitat creation will eliminate locations that may be suitable for NEC.

However, selecting these areas for habitat creation may facilitate the expansion of EC because they have a much stronger preference for these site types than NEC. EC also are able to colonize new sites more quickly than NEC (Litvaitis et al. 2008). For this reason, we recommend maintaining the current exclusion of these sites in the GIS model for site selection in Rhode Island. Our findings generally agree with a 2007 study which reported that presence of NEC was not associated with the availability of agriculture lands in two of the three study zones, although the species was associated with the extent of developed areas in two of the three sites (Tash and Litvaitis 2007).

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