New England Cottontail (*Sylvilagus transitionalis)*

Assessment 2004

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INTRODUCTION

Since 1968, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has aggressively pursued development and refinement of wildlife species assessments and implementation of cost-effective comprehensive programs that support selected goals and objectives for the next 15 years. Assessments are based on available information and the judgments of professional wildlife biologists responsible for individual species or groups of species. Precise data may not always be available or are too limited for meaningful statistical analysis; however, many trends and indications are sometimes clear and deserve management consideration.

The assessment has been organized to group information in a user-meaningful way. The Natural History section discusses biological characteristics of the species that are important to its management. The Management section contains history of regulations and regulatory authority, past management, past goals and objectives, and current management. The Habitat and Population sections address historic, current, and projected conditions for the species and its habitat. A Summary and Conclusions section summarizes the major points of the assessment.

NATURAL HISTORY

Description

Cottontails are true rabbits. Unlike hares, rabbits are born naked with their eyes shut, and placed in a fur-lined nest constructed by the female. Hares, on the other hand, are born covered with fur, eyes open, and the young are placed in a modest depression on the ground (Chapman 1975). Cottontails are members of the family Leporidae, which includes four North American genera: *Sylvilagus,* the cottontails; *Lepus*, the hares and jackrabbits; *Brachylagus,* the pygmy rabbit of the Great Basin; and *Romerolagus*, the volcano rabbit (*R. diazi*) found only on volcanic slopes in central Mexico (Chapman and Litvaitis 2003). In New England, we have two species of cottontail. The most common cottontail in southern New England is the eastern cottontail (*Sylvilagus floridanus*). This is the species of cottontail typically seen feeding on lawns and in other open areas. The eastern cottontail is not native to New England but was introduced by hunting clubs and natural resource agencies (Johnson 1972). Our only native cottontail is the New England cottontail (*Sylvilagus transitionalis*).

The New England cottontail (NEC) was first described by Otram Bangs at the turn of the nineteenth century (Bangs 1895), and is recognized as a distinct species (Holden and Eabry 1970). Recently, the taxonomic status of NEC has been revised to recognize two sister species (Ruedas et al. 1989, Chapman et al. 1992). Populations east and north of the Hudson River have 52 chromosomes and are still identified as NEC (Figure 1), whereas populations west and south of the Hudson River have 46 chromosomes and are now referred to as Appalachian cottontails (*S. obscurus*; Chapman et al. 1992).

The New England cottontail, also called *coney* or *cooney*, is a medium-sized rabbit (total length: 398 – 439 mm (15.7 – 17.3 in), weight: 995 – 1,347 g (2.2 – 3.0 lb); Chapman 1999). The coat is dark brown to buff and overlain with a blackwash that

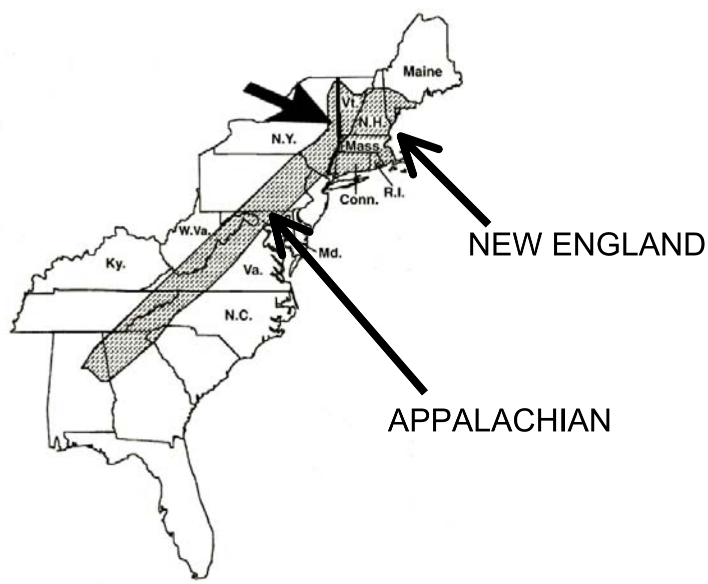


Figure 1. Distribution of recently defined sister species of cottontails in the eastern United States. Arrow in upper left indicates the Hudson River drainage that separates the two species (modified from Chapman et al. 1992).

gives it a penciled effect. The anterior edges of the ears are covered with black hair and there is a distinct black spot between the ears. These pelage characteristics can be useful to differentiate NEC from eastern cottontails (*S. floridanus*, Litvaitis et al. 1991), but inexperienced observers may need to examine additional features for reliable identification. Skulls in particular can be consistently differentiated. For NEC, the anterior portion of the supraorbital process is short or missing and the postorbital process is long and slender, rarely touching the skull (Figure 2). Additionally, the suture

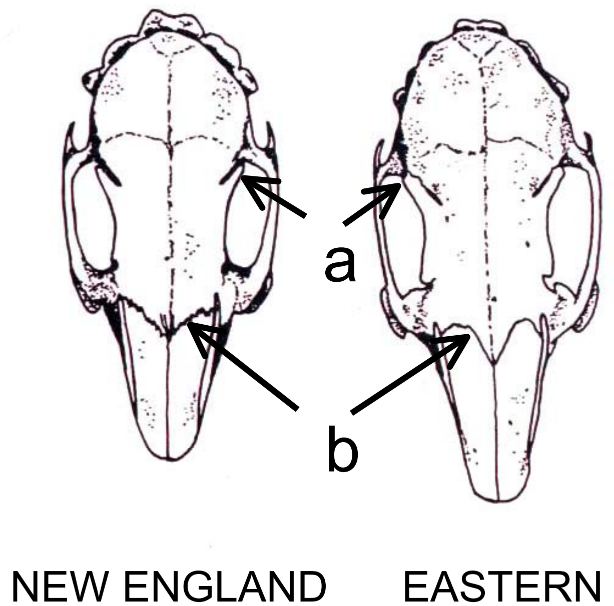


Figure 2. Skull characteristics that separate New England and eastern cottontails, including the supraorbital process (a) and the nasal frontal suture (b). Adapted from Godin (1977).

between the frontal and nasals of NEC are irregular or jagged in comparison to eastern cottontails (Figure 2; Fay and Chandler 1955, Chapman and Litvaitis 2003), and the auditory bulla of NEC is smaller than that of eastern cottontails (Hinderstein 1969).

Consistent with other rabbits and hares, female NEC are slightly heavier than males (Barbour and Litvaitis 1993). Body weight and condition of NEC also are influenced by habitat quality (Barbour and Litvaitis 1993, Villafuerte et al. 1997). On relatively small patches of habitat (≤ 2.5 ha [6.2 acres]), females ($\bar{x}$ = 1,023 g [2.25 lb]) and males ($\bar{x}$ = 956 g [2.1 lb]) weighed less than females ($\bar{x}$ = 1139 g [2.5 lb]) and males ($\bar{x}$ = 1039 kg [2.3 lb]); Barbour and Litvaitis 1993) on larger patches (≥ 5.0 ha [12.4 acres].

Population Densities

In neighboring New Hampshire, Barbour and Litvaitis (1993) found that the density of local populations of NEC was affected by the size of the habitat patch that rabbits occupied. The habitats of NEC in southern Maine and New Hampshire are comparable (J. Litvaitis, personal observations); therefore, rabbit densities in Maine are assumed to follow a similar pattern. Rabbit density averaged 2.2 rabbits / ha (0.9 rabbits / acre) on small patches (<2.5 ha [6.2 acres]), whereas on large patches (>5 ha [12.4 acres]), density averaged 1 rabbit / ha (0.4 rabbits / acre) (Barbour and Litvaitis 1993). It is assumed that rabbit densities are higher on small patches of habitat because NEC are reluctant to leave cover, especially when the habitat is highly fragmented, as it is throughout much of the current range of NEC. Consequently, rabbits in small patches tend to live at densities that are at or above the carrying capacity of the habitat.

Densities of NEC in Maine and New Hampshire appear to be similar to snowshoe hare densities in Maine. Spring densities of snowshoe hare in Maine range from 0.1 to 1.7 hares / ha (0.04 to 0.69 hare / acre) (Litvaitis et al. 1985) and over 2.4 hares / ha (0.97 hare / acre) have been observed in other studies (Homyack 2003).

Home Range and Dispersal

Several investigators have studied the movements of NEC, and estimates of home range size are quite varied. Dalke (1937) used live-trapping and estimated home ranges to vary from 0.2 to 0.7 ha (0.5 acres to 1.7 acres) in Connecticut. More recently, a telemetry study in southwestern Connecticut revealed much larger home ranges (2.2

to 7.6 ha (5.4 acres to 18.8 acres); Goodie et al. 2003). In New Hampshire, winter home ranges seem to be a function of the size of the habitat patch occupied by transmitter-equipped rabbits, with some rabbits occupying patches < 0.2 ha (0.5 acres) (J. Litvaitis, unpublished data).

There is no information on dispersal rates or distances traveled by NEC. Most adult rabbits in the genus *Sylvilagus* stay within their home range and make few long distance movements. However, subadult males normally make long one-way movements outside of their natal patch. Long-range movements for subadult females are less common (Forys and Humphrey 1996). We can get an idea of what the dispersal distance might be for NEC by looking at the dispersal patterns of species that exhibit similar behaviors to NEC. Another cottontail that has a similar affinity for cover and a similar home range size to NEC is the endangered marsh rabbit (*Sylvilagus palustris hefneri*) (Forys and Humphrey 1996). The longest dispersal for a subadult male marsh rabbit was 2.5 km (1.24 mi) (Forys and Humphrey 1999), and the narrowest strip of plant cover used by a dispersing rabbit was 3 m to 5 m (10 ft to 16 ft) wide. Alternatively, snowshoe hare, which commonly disperse 1 to 10 km (0.62 to 6.2 mi) (Windberg and Keith 1976, Keith 1990), have been used to estimate the dispersal distance of NEC (Litvaitis and Villafuerte 1996). Both species are reluctant to leave dense cover and therefore, may not travel long distance if cover is limited.

Food Habits

Dalke and Sime (1941) conducted extensive research on cottontail feeding habits in Connecticut, but made no distinction between NEC and eastern cottontails because they felt both species had similar food habitats. In that study, spring and summer diets consisted of herbaceous plants, mainly clover (*Trifolium* spp.), timothy (*Phleum pratense*), and alfalfa (*Medicago sativa*). Other plants eaten by NEC include Canadian goldenrod (*Solidago canadensis*), wild strawberry (*Waldsteinia fragarioides*), raspberry (*Rubus strigosus*.), sarsaparilla (*Aralia nudicaulis*), *Viburnum* spp., bunchberry (*Cornus canadensis*), highbush blueberry (*Vaccinium corymbosum*) and wild grasses (*Poacea*) (Pringle 1960). November and December was a transition period, when cottontails switched to woody plants. Winter diets consisted mainly of woody browse from small trees, including gray birch (*Betula populifolia*), red maple (*Acer rubrum*), apple (*Malus* sp.), aspen (*Populus tremuloides*), choke cherry (*Prunus virginiana)*, and black cherry (*P. serotina*), and shrubs or vines, especially blackberry (*Rubus occidentalis*), dewberry (*Rubus villosus*), willow (*Salix* spp.), black alder (*Ilex beticillata*), maleberry (*Lyonia ligustrina*), and highbush blueberry.

Barbour (1993) suggested that the winter diet of NEC was largely determined by forage availability, which was ultimately determined by the size of the habitat patch a rabbit occupied. Because rabbit densities tend to be higher on small patches of habitat (<2.5 ha [6.2 acres]), winter forage was less abundant per rabbit and individuals consumed a greater variety of available plants than cottontails on large patches (>5 ha [12.4 acres]). Diet quality in this study was indexed by twig diameter at point of browsing (dpb), because protein concentration declines with twig diameter (Wolff 1980). On small patches, stems with a dpb $\geq$ 3 mm (0.1 in) represented 31% of the clipped twigs encountered, compared to 20% of browsed twigs on large patches (Barbour and Litvaitis 1993). The incidence of woody bark consumption (a low quality food) by rabbits also varied, with 13% of plots sampled on small patches containing evidence of bark use, but only 2% of sample plots on large patches had evidence of bark use (Barbour and Litvaitis 1993). Because rabbits on small patches had lower body weight, consumption of bark may have been a reaction to food limitation.

<u>Cover Requirements</u>

Cottontail, like other vertebrates that utilize early successional habitats, depend more upon the structure of the vegetation (its form, height, and density) rather than specific species. In old fields, NEC are commonly associated with juniper (*Juniperus* spp.), blackberry, spirea (*Spiraea* spp), dogwoods (*Cornus* spp), viburnums, and a variety of young deciduous tree species (red maple, birch [*Betula* spp.], and aspen). Old fields are also where NEC are sometimes associated with exotics such as honeysuckle (*Lonicera* spp.), autumn olive (*Elaeagnus umbellata*), multiflora rose (*Rosa multiflora*), and Japanese barberry (*Berberis thunbergii*). On wetter sites, alder (*Alnus* spp.), willow (*Salix* spp), and high-bush blueberry are frequent dominants. Regenerating clearcuts used by NEC usually include birch, aspen, and red maple; however, conifer regeneration does not seem to attract NEC.

NEC are more restricted in habitat selection than eastern cottontails, especially with regard to their affinity for understory cover (Smith and Litvaitis 2000, and see Species Interactions Section below). Barbour and Litvaitis (1993) investigated selection of microhabitats in winter among NEC and found NEC preferred to use sites with >50,000 stem-cover units/ha (20,234 stem-cover units/acre). In addition, they documented that NEC were reluctant to venture >5 m (16 ft) from cover.

Reproduction

Among cottontails, initial reproductive activity occurs later in higher elevations and in higher latitudes (Conaway et al. 1974, Chapman et al. 1977). Onset of breeding begins as early as the first week of January in Alabama (Barkalow 1962) to as late as the last week in March in southern Wisconsin (Rongstad 1966). The breeding season lasts from mid-March to mid-September in Connecticut (Dalke 1942). From these data, we might estimate the breeding season for NEC in southern Maine to occur from late March or April to the end of August.

The onset of reproduction in male cottontails seems to be associated with the end of adverse weather (Chapman et al. 1977). Increased day length induces reproductive behavior and spermatogenesis in NEC (Bissonnette and Csech 1939). Ecke (1955) provided an excellent account of the physiology of the reproductive cycle of female eastern cottontails and it is suspected that the same pattern is followed by NEC. The following summary was taken largely from his work.

Female cottontails are in anestrus (quiescent period) during winter. At that time, follicular growth in the ovaries is greatly suppressed. The follicles may develop slightly but maturation does not occur. As the breeding season approaches, an external stimulus (probably increasing day length in combination with temperature) causes hormones to be secreted which stimulate the growth of follicles and the development of ova. The ova develop to a submature stage, at which time the rabbit is in heat. Heat is maintained until copulation occurs.

NEC have a gestation period of 28 days, and litter size ranges from 3 to 8 ($\bar{x}$ = 5) young per female. Cottontails usually copulate again immediately following parturition (Ecke 1955). It is this phenomenon that results in breeding synchrony in cottontail populations. NEC females usually have 2 or 3 litters each year (Dalke 1942). Juvenile breeding is well documented in eastern cottontails (Chapman et al. 1977) and likely occurs among NEC, perhaps at the approximate rate of Appalachian cottontails (18% of juvenile females, Chapman et al. 1977).

<u>Mortality</u>

Estimates of annual survival of juvenile or adult NEC are not available. Predation is probably the major cause of death of most cottontails. Canids, felids, mustelids, and raptors prey on cottontails, as do certain snakes (Chapman et al. 1982). Known predators of NEC include bobcats (*Lynx rufus*, Litvaitis et al. 1984), fisher (*Martes pennanti*, Giuliano et al. 1989), red fox (*Vulpes vulpes*), coyotes (*Canis latrans*; Barbour and Litvaitis 1992, Brown and Litvaitis 1995), domestic cats (*Felis domesticus*, M. Barbour, personal communication), and owls (Smith and Litvaitis 2000). The number of NEC killed by hunters in Maine is suspected to be very low. Although vehicle strikes are an important source of mortality for some rabbit populations (e.g. 33% of all mortalities for marsh rabbits; Forys and Humphrey 1996), of the >75 NEC that were radiocollared by Litvaitis and his students, there were no mortalities due to vehicle strikes. However, the majority of the NEC habitat is in densely roaded areas in southern Maine, including habitat patches along I-95. We do not know what proportion of the overall mortality rate for NEC is attributable to vehicle strikes in Maine.

Brown and Litvaitis (1995) observed a strong correlation between days with snow coverage and predation rates on NEC. Keith and Bloomer (1993) also reported that persistent snow cover and low temperatures, combined with the brown pelage and the large foot-loading (i.e., the amount of body mass distributed over the foot area) of eastern cottontails apparently made them vulnerable to intense predation in winter. The combination of severe winter weather and limited adaptations to snow likely determines the northern range limit of most cottontails, including NEC.

Although predators are the proximate cause of most mortalities, food shortages in winter may affect the physiology and behavior of cottontails, and ultimately limit populations of NEC in human-dominated landscapes. In southern New Hampshire, rabbits on small patches (<2.5 ha [6.2 acres]) encountered winter food shortages and were killed by predators at approximately twice the rate (winter mortality = 70%) as cottontails on large patches (>5 ha [12.4 acres]). On large patches, per capita forage was more abundant and cottontails were able to remain in close proximity of cover and often avoid predators (winter mortality = 35%; Barbour and Litvaitis 1993, Brown and Litvaitis 1995, Villafuerte et al. 1997). However, such large patches of habitat are rare in southern Maine (Litvaitis et al. 2003a). As a result, the persistence of remaining populations is questionable because approximately two thirds of the occupied patches in southern Maine are <2.5 ha.

Diseases

Much of what is known about the diseases and parasites of cottontails is based on research conducted on eastern cottontails (see Chapman and Litvaits [2003] for a review). NEC are assumed to succumb to the same etiological agents.

Cottontails are hosts of a variety of parasites (Chapman and Litvaitis 2003). Those ectoparasites that have received the most attention are ticks because they are vectors for Rocky Mountain spotted fever (*Rickettsia rickettsi*) and tularemia. Many tick-borne diseases are readily transmissible to humans and domestic pets, and thus are of concern from the public health standpoint. Among the more common ectoparasites of cottontails are ticks of the family Ixodidae, the fleas Pulicidae and Leptopsyllidae, and warbles, Cuterebridae (Chapman et al. 1982, Lepitzki et al. 1992). A summary of the most common ectoparasites of cottontails is given in Chapman et al. (1982).

In Maine, the tick that is of most concern to humans is the deer tick (*Ixodes scapularis*), which can transmit Lyme disease. While deer tick larvae may feed on NEC, NEC are not considered one of the primary host of the tick. Rather white-footed mice (*Peromyscus leucopus*) are the most common host of the larvae, while adult deer ticks specialize on feeding on white-tailed deer (*Odocoileus virginianus*).

Cottontails also host a variety of endoparasites (Chapman et al. 1982). Common endoparasites include nematodes of genera *Obeliscoides, Trichostrongylus, Longistriata,* and *Trichuris*; the cestodes, *Mosgovoyia* and *Taenia*; and coccidian parasites (Chapman et al. 1982, Lepitzki et al. 1992).

Cottontails are known reservoirs of tularemia although the causative agent, *Francisella tularensis*, has been documented in >100 mammalian species (Hassell

1982). The main vector of tularemia is the rabbit tick (*Haemaphysalis leporis-palustris*), but other ticks and fleas may also carry the disease. Humans contract tularemia by coming in direct contact with the flesh and blood of infected rabbits or by eating infected rabbits that are not properly cooked. Tularemia occurs widely throughout North America and the number of cases in various regions fluctuates yearly and seasonally (Yeatter and Thompson 1952). However, tularemia is generally most prevalent in the spring and fall. The disease is always fatal to the rabbit. When infected cottontails are encountered in the field, they may appear somewhat sluggish. The disease is recognized internally by a peppering of tiny white spots on the liver and spleen.

As mentioned above, the ectoparasites of cottontails carry Rocky Mountain spotted fever and many other rickettsia diseases of humans (Philip 1946, Parker et al. 1952, Cooney and Burgdorfer 1974). Rocky Mountain spotted fever is generally thought of as a disease of western North America; however, the disease is widely distributed. The primary natural means of infection in humans is through the bite of a tick, in the case of the cottontail, mainly *H. leporis-palustris, Ixodes dentatus* (Parker et al. 1952), and *Amblyomma americanum* (Philip 1946). Other diseases in which the cottontails have been implicated include *Staphylococcus aureus* (McCoy and Steenbergen 1969) eastern encephalitis (Hayes et al. 1964), and papilloma virus (Han et al. 1999, Han et al. 2000).

<u>Interactions with other species</u>

As mentioned in the Natural History section, a host of species prey on NEC, including red fox, coyote, bobcat, fisher, and owls. It is unlikely that NEC, at its current population level in Maine, is the mainstay of any predator's diet. However, during times when NEC were abundant, they were important prey for bobcat (Litvaitis 2001) and other carnivores. For example, during the early 1950's in New Hampshire, NEC were present in 43% (n = 87) of the bobcat stomachs examined, but the percent occurrence dropped to 10% (n = 108) approximately 10 years later (Litvaitis 2001). This decrease in the availability of NEC as a prey item for bobcat occurred at the same time bobcat harvests in New Hampshire decreased precipitously.

During the early 1900s, natural resource agencies and hunting clubs translocated thousands of eastern cottontails to southern New England (Johnston 1972). Although eastern cottontails have not established a population in Maine, understanding the interactions between NEC and eastern cottontails is critical for the conservation of NEC. In other jurisdictions, eastern cottontails have replaced NEC in many of their traditional habitats. This displacement of NEC by eastern cottontails is likely explained by morphological and behavioral differences that give eastern cottontails a survival advantage over NEC (Appendix A).

New England cottontails benefit from the activities of beaver; especially the role beaver play in altering successional patterns. Beaver (*Castor canadensis*) are well known for their ability to set back succession in northern forests (Johnston et al. 1993). Beaver usually initiate the following successional pattern: (1) wooded areas around streams are opened up and beaver ponds (or flowages) are created when trees are cut for food and dams are built, (2) beaver ponds are gradually filled with silt and mud, beaver abandon the area, and the area becomes a beaver meadow, and (3) the beaver meadow eventually reverts back to a forest. New England cottontail benefit from areas where beaver ponds have reverted back to meadows and shrubby areas provided they are left relatively undeveloped. In addition to providing cover and food, the riparian areas associated with streams of a beaver meadow (e.g., wooded or brushy habitat along a stream) can serve as travel corridors for NEC and other animals wanting to move between patches of suitable habitat. Riparian areas surrounding the beaver pond itself may also provide habitat for NEC. In southern Maine, where the towns are rapidly growing (O'Hara 1997), riparian areas may provide refuges of undeveloped habitat for NEC because of the unsuitability of these wetlands for building.

White-tailed deer have the ability to affect the species composition and structure of the vegetation (Reynolds 1980, Rooney 2003) NEC use for food and cover. Deer may have a positive effect on NEC when their browsing increases the lateral branching and suppresses the height of woody plants. Plants having these characteristics tend to be shrubby in form and may provide more cover for NEC. Deer browsing may also retard the rate of succession of old fields to forests (Reynolds 1980), thus prolonging the rate NEC can utilize an area. However, if deer browsing is too intense in shrubby habitats, the structure of these habitats can shift from shrubs to one dominated by forbs and grasses (Reynolds 1980). Browsing can affect the species composition of an area when deer selectively remove the most palatable plants (Rooney 2003). For NEC, this means that deer browsing may decrease the abundance of some of their preferred foods (e.g., red maple). If browsing is intense, palatable species will be replaced by less palatable ones. In southern Maine, exotics, such as Japanese barberry and honeysuckle, which are not palatable to deer, have become dominant in some areas. Although the food value of these species is low, they provide important cover for NEC.

The point at which deer browsing or deer densities become detrimental to NEC is not known.

MANAGEMENT

Regulatory Authority

Regulatory authority to manage wildlife (including hares and rabbits) was granted to the Department in 1972. Prior to this, laws pertaining to hares and rabbits were set by the legislature.

Past Goals and Objectives

None

Past Management

Until 1999, NEC and snowshoe hares were grouped as “hares/rabbits” under Maine's laws and the Department's regulatory authority. Prior to 1905, there were no laws restricting the harvest of NEC. The public laws of 1905 established the first season on hares and rabbits. The same law prohibited the use of snares and traps for the taking of hares and rabbits, except it was lawful to catch hare in box traps in the counties of Oxford, Penobscot, and Piscataquis during the open season.

In 1917, hare/rabbit season dates (September 1 to March 31) were established statewide and box trapping was allowed as well. The use of box traps was prohibited in 1929, and the opening date was changed to October 1, where it remains today (Table 1). The legislature changed season closing dates slightly (end of February to the end of March) mostly by county through 1972. In 1969, the use of dogs to hunt hares or rabbits during the deer firearms season was prohibited in six counties (Washington,

Table 1. Rabbit (Snowshoe Hare and New England cottontail) harvest regulations from 1935 to 2001. The year a regulatory change was made is noted in the far left column. Counties in bold face type had their hunting regulations changed that year.

Year	Hunting Season and Regulations
1935	Season Oct. 1 – March 31 **Franklin** and **Somerset** counties Season Oct. 1 – Feb. 28 all other counties Vinalhaven Nov. 2 to Jan. 31 Daily bag limit 4, Possession limit 8 Snares or traps not allowed, only shooting with guns Live trapping permitted with box traps in Washington and Hancock counties, $10 transportation fee for transporting live hare for sale within or beyond the borders of the state. No dead hares could be transported across state lines. (Legislature sets seasons by statute)
1937	Regulations the same as above except interstate transportation of hare was not permitted. Box traps could be used to live-trap hare and hare could be sold to the Department, if the Commissioner deemed it necessary for the distribution and conservation of hare or cottontail. No transportation fee.
1944	Season Oct. 1 – March 31 Franklin, **Oxford**, and Somerset counties Season Oct. 1 – March 15 **Waldo** county Season Oct. 1 – Feb. 28 all other counties Daily bag limit 4, Possession limit 8 Snares or traps not allowed, only shooting with guns Box traps could be used to live-trap hare and hare could be sold to the Department, if the Commissioner deemed it necessary for the distribution and conservation of hare or cottontail.
1953	Season Oct. 1 – March 1; Daily bag limit 4, possession limit 8 except in Somerset county where the daily bag and possession limit was 2. Sale of hare prohibited.
1955	Oct. 1 to March 31 in Franklin, Oxford, Knox, Somerset, **Penobscot**, **Piscataquis**, **Aroostook**, and **York** Counties Oct. 1 to February 28, all other counties. Daily bag limit 4, Possession limit 8
1957	Oct. 1 to March 31 in Franklin, Oxford, Knox, **Kennebec**, **Hancock**, **Washington**, Somerset, (***York –removed***) Penobscot, Piscataquis, and Aroostook, Counties Oct. 1 to February 28, all other counties. Daily bag limit 4, Possession limit 8. May use bow and arrow to take hare; Commissioner may purchase hare from trappers but general sale of hare or rabbits is prohibited
1959	Great Chebeague Is. closed to hare or cottontail hunting from April 1, 1959 to Sept. 30 1961 $50 fine for violation (all other laws as above)
1961	Oct. 1 to March 31 in Franklin, Oxford, Knox, Kennebec, Hancock, Washington, Somerset, **Lincoln**, Penobscot, Piscataquis, and Aroostook, Counties Oct. 1 to February 28, all other counties Daily bag limit 4, Possession limit 8. May use bow and arrow to take hare; Commissioner may purchase hare from trappers but general sale of hare or rabbits is prohibited
1963	Propagation of hare or cottontails on islands surrounded by salt water permitted

Table. 1 cont'.

Year	Hunting Season and Regulations
1965	Oct. 1 to March 31 in Franklin, Oxford, Knox, Kennebec, Hancock, Washington, Somerset, Lincoln, Penobscot, Piscataquis, **Waldo** and Aroostook, Counties Oct. 1 to February 28, all other counties. Daily bag limit 4, Possession limit 8. May use bow and arrow to take hare; Commissioner may purchase hare from trappers but general sale of hare or rabbits is prohibited. Propagation of hare or cottontails on islands surrounded by salt water permitted. Minimum $50 fine or 30 days in jail for violation of hare/rabbit laws.
1967	Oct. 1 to March 31 in Franklin, Oxford, Knox, Kennebec, Hancock, Washington, Somerset, Lincoln, Penobscot, Piscataquis, Waldo and Aroostook, Counties; Illegal to hunt hare in **Washington** county from Nov. 1 – Nov. 30 with hounds. Oct. 1 to March 20, **York** Oct. 1 to February 28 Cumberland, Androscoggin, and Sagadahoc (Other laws the same)
1969	Illegal to hunt hare/rabbit with dogs during the open season on deer in Hancock, Knox, Lincoln, Sagadahoc, Washington, and Waldo counties. (other laws are the same as above)
1971	Oct. 1 to March 31 all other counties. Oct. 1 to March 20, York Oct. 1 to February 28 Cumberland, Androscoggin, and Sagadahoc (Other laws the same)
1972	IFW granted regulatory authority.
1973	Hunting season Oct-1 to March 31 for all counties Falconry licenses were issued by the Commissioner
1978	Statewide hare/rabbit season Oct. 2 to March 31. Daily bag limit 4, Possession limit 8
1979	Statewide hare/rabbit season Oct. 1 to March 31. Daily bag limit 4, Possession limit 8
1990	Statewide hare/rabbit season Oct. 1 to March 31 except **Vinalhaven,** which was Oct. 1 to Feb. 28. Daily bag limit 4, Possession limit 8
1991	Statewide hare/rabbit season Oct. 1 to March 31 except **Vinalhaven,** which was Oct. 1 to Feb. 29. Daily bag limit 4, Possession limit 8
1992	Same as above except **Vinalhaven** seasons dates changed back to Oct. 1 to Feb. 28
1997	Prohibition of hunting rabbits with dogs during deer season dropped from summary
1998	Same as above, except season on Vinalhaven adjusted for leap year.
1999	Prohibition on use of dogs repealed; Daily bag limit on snowshoe hare stayed the same but the daily bag limit on cottontail rabbits was reduced to 1 and the possession limit was reduced to 2. (protecting the New England cottontail)
2004	Hunting of New England cottontail is no longer permitted

Hancock, Waldo, Knox, Lincoln, and Sagadahoc). This law was rescinded in 1997. The Department of Inland Fisheries and Wildlife was given regulatory authority in 1972. In 1973, March 31 became the statewide closing date for the rabbit/hare hunting season, where it still remains today (except for February 28 on Vinalhaven). 1973 was also the first year the Department issued falconry licenses, thus allowing falconers to take rabbits and hare with birds of prey.

Current Management

Few management activities, outside of setting hunting regulations, are currently directed towards NEC. Populations of NEC are largely limited by habitat conditions, specifically, understory density. Because most habitat management occurs on private lands, the Department has had little influence on the abundance and distribution of NEC.

In 1999, cottontail hunting was restricted out of concern that the NEC population was likely declining. The daily bag limit, which had remained at 4 rabbits or hares (in combination) since 1935, was changed to 4 rabbits or hares; only one of which could be a cottontail rabbit. The possession limit, which had been 8 rabbits or hares in combination, was changed to 8 rabbits or hares; only 2 of which could be a cottontail rabbit.

The purpose for restricting NEC hunting was to maintain local populations of cottontails and reduce the susceptibility NEC to high mortality rates. Hunter harvests may have little impact on NEC populations in landscapes consisting of large (>5 ha) patches of early successional habitat, with good interconnectivity (i.e., habitat corridors exist that allows rabbits to freely move between suitable habitat patches). However, in the current landscape of southern Maine, early successional habitat exists primarily in small patches with poor interconnectivity. New England cottontails, in these small patches, are more vulnerable to over-hunting (and non-human predation; Brown and Litvaitis 1995), which may lead to the extirpation of local cottontail populations.

In 2004, the low number of NEC found in recent surveys (see Population Section) and the low number of sites that had suitable NEC habitat, prompted MDIFW to propose closing the hunting season on NEC.

Concern over long-term viability of New England cottontails prompted several conservation organizations to petition the U. S. Fish and Wildlife Service (USFWS) to list the species as threatened or endangered (Biodiversity Legal Foundation et al. 2000). Currently, the USFWS is reviewing existing data to determine whether the NEC warrants listing as a threatened and endangered species. A determination on this listing is expected in 2005.

HABITAT ASSESSMENT

Past Habitat

Historically, NEC likely occupied native shrublands associated with sandy soils or wetlands and regenerating forests associated with small-scale disturbances resulting from beavers, lightning strikes, or local windstorms. Less frequent, but large-scale disturbances (including hurricanes and fires) also provided early-successional habitats. In southern Maine, the abundance of suitable habitat for NEC likely varied among forest types and proximity to the Atlantic coast (Lorimer and White 2003). Coastal areas were characterized by a greater abundance of native shrublands and young forests because of frequent natural disturbances in comparison to inland areas (Lorimer and White 2003).

Prior to European settlement, the Indians of Maine and New England had cleared considerable land for agriculture. Sieur Samuel de Champlain wrote of his 1604 and 1605 expeditions up the Penobscot River and south along what is now the Maine and Massachusetts's coastline and described the shoreline accordingly, "All along the shore there is a great deal of land cleared up and planted with Indian corn. The country is very pleasant and agreeable and there is no lack of fine trees" (Russell 1980). The agricultural practices by American Indians likely resulted in pockets of old fields that would have been suitable habitat for NEC. Evidence (i.e., bone fragment from a *Sylvilagus*) that suitable habitat existed for NEC in Maine 3000 years before present to European contact was found in archeological diggings on the Island of North Haven in Penobscot Bay (Spiess and Lewis 2001:104).

European settlement and the clearing of forests for agriculture likely increased the abundance of suitable habitat for NEC. Most of this habitat became suitable for NEC when these lands were abandoned for farming (Litvaitis 1993, Ahn et al. 2002). NEC, and other species that occupy habitats with dense understory vegetation, were abundant throughout New England in the late 1800s and early 1900s because of the abundance of old fields and regenerating forests (Figure 3). However, most of these abandoned farmlands eventually matured into closed-canopy forests (about 1960), and thereafter habitat availability for NEC declined (Figure 3).

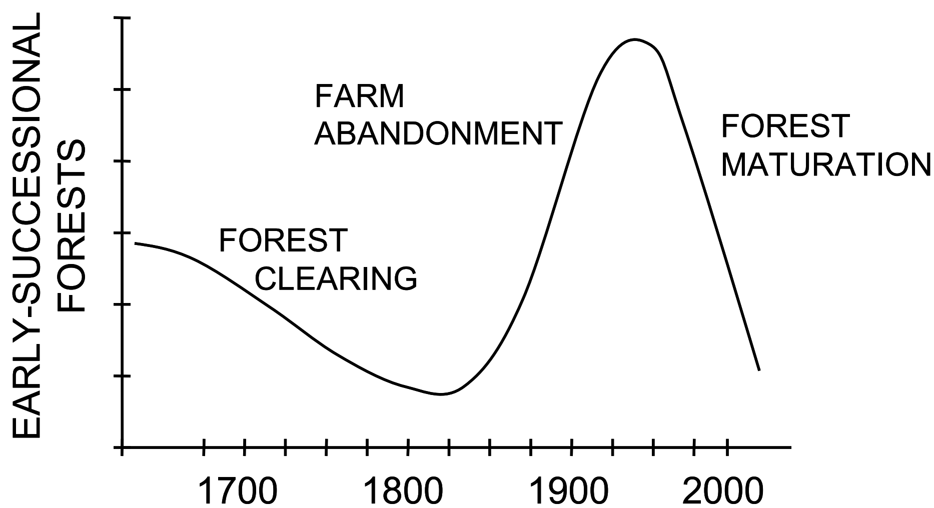


Figure 3. Suggested pattern of events that influenced the abundance of early-successional habitat in New England from 1650 until present (modified from Litvaitis 1993).

<u>Current Habitat</u>

Cottontail habitat in southern Maine can be characterized as predominantly patches of former agricultural land, with dense understory vegetation. Litvaitis et al. (2003) noted that landscapes surrounding habitat patches occupied by NEC had a greater abundance of old fields, a lower proportion of forests, and a greater density of roads than landscapes surrounding unoccupied patches, within the occupied range of NEC (Table 2). Additionally, patches occupied by NEC were usually larger, in close proximity to other suitable habitat, and had a greater density of understory vegetation than unoccupied patches of habitat (Table 2; Litvaitis et al. 2003).

Table 2. Differences in landscape (L) and patch-specific (P) features associated with patches occupied by New England cottontails (NEC) versus vacant patches of habitat in southern Maine (Litvaitis et al. 2003).

Variable	NEC	Vacant	P value
Proportion of landscape in old field (L)	0.38* (0.14)**	0.33 (0.12)	0.048
Proportion of landscape in forest (L)	0.43 (0.19)	0.57 (0.17)	<0.001
Kilometers of roads in class 1 + 2 (L)	0.85 (1.12)	0.37 (0.81)	0.013
Kilometers of all roads (L)	8.17 (3.35)	6.74 (3.23)	0.006
Distance (km) to nearest NEC patch (L)	2.41 (1.86)	4.33 (2.78)	<0.001
Stem cover- unit density (number/10 m^2) (P)	39.0 (28.4)	25.2 (11.5)	0.001
Patch area (ha) (P)	3.75 (5.81)	1.48 (1.74)	0.01
Percent of patches dominated by honeysuckle (P)	28	11	0.028
Percent of patches in old field (P)	55	32	0.019

*Mean **Standard deviation

Overall, young forest stands declined from 38.9% of all timberlands in 1971 to only 12.3% in 1995. In the current range of NEC in Maine (i.e., York and Cumberland counties; Figure 4), young forests declined (Table 3) at the nearly the same rate (1971 = 38.9% versus 1995 = 11.3%) as the historic range of NEC (Litvaitis et al. 2003a).

Table 3. Percentage of timberland dominated by seedling/sapling-sized trees in six counties that approximate the historic range of New England cottontails in Maine. Data were the result of U.S. Forest Service inventories conducted in 1971 (Powell and Dickson 1984) and 1995 (Griffith and Alerich 1996).

	County					
Year	**York**	**Cumberland**	**Androscoggin**	**Sagadahoc**	**Lincoln**	**Knox**
1971	49.2	26.1	32.3	46.2	38.2	42.0
1995	10.8	12.9	18.9	18.7	11.2	20.1

Habitat Projections and Future Management

Although remnant populations of NEC are affiliated with substantially modified habitats, it is not likely that cottontails will survive long term as urban and suburban developments increase in southern Maine. Urbanization is expected to increase substantially in southern Maine within the next 50 years, especially within the area occupied by NEC (Plantinga et al. 1999). As a result, idle agricultural lands may be converted to housing lots. Even if some of these lands remain undeveloped, a large portion of the currently occupied sites will mature into mid-successional forests that are no longer suitable for NEC. The decline of early-successional forests seems to be occurring throughout the historic range of NEC (Trani et al. 2001, Brooks 2003). This trend is expected to continue unless proactive measurements are taken (Litvaitis 2003).

Habitat management in southern Maine may be best focused on maintaining areas that contain a substantial old-field component. Old fields (e.g., idle agricultural lands) comprise 55% of the sites currently occupied by NEC in southern Maine, and this habitat is a substantial percentage (38%) of the landscapes that surround occupied patches of habitat (Litvaitis et al. 2003a). Among private lands, federal and state cost-sharing programs (e.g., the Wildlife Habitat Incentives Program [WHIP] of the Natural Resources Conservation Service) could be used to recruit landowners into organized efforts that promote early-successional habitats (Oehler 2003). A recent modification of the WHIP program provides enhanced cost sharing to landowners who are willing to commit to a 15-year management program directed towards developing essential plant and animal habitats. New England cottontails and other species affiliated with early-successional forests, old fields, and other shrub-dominated habitats could benefit from this program (Litvaitis et al. 1999; Kjoss and Litvaitis 2001).

In contemporary landscapes, populations of generalist predators effectively exploit NEC restricted to isolated patches of habitat (Brown and Litvaitis 1995, Villafuerte et al. 1997). In these circumstances, it may be most effective to establish and maintain moderate (>10 ha [24.7 acres]) to large (>25 ha [61.7 acres]) patches that can serve as core habitats (Litvaitis 2001). Expanding and maintaining suitable habitats could result in a secure core habitat that would benefit a number of species dependent on early-successional habitats, including prairie warblers (*Dendroica discolor*) and American woodcock (*Scolopax minor*) (*Partners-in-Flight* priority species in Physiographic Area 9), black racers (*Coluber constrictor*), and several species of moths and butterflies (Litvaitis et al. 1999).

POPULATION ASSESSMENT

Past Populations

Historically, the range of NEC likely spanned southeastern New York, all of Connecticut, Massachusetts, and Rhode Island, much of Vermont, southern New Hampshire, and southern Maine (Figure 4). Archaeological evidence is insufficient to determine the range of cottontail in Maine prior to European settlement. A single bone fragment from a cottontail (assumed to be NEC) was found on the Island of North Haven in strata that was deposited from 3,000 years before present until the time immediately preceding European settlement (Spiess and Lewis 2001). We can only speculate that the rabbit was, most likely, obtained on shore, near the island. Post-European settlement records of NEC in Maine include Hitchcock (1862, as cited in Jackson 1973), Couse and Allen (1877) and Nelson (1909). Later, Palmer (1937) inferred that NEC might have been a relatively recent addition to Maine fauna because populations were expanding north and east.

Part of the apparent confusion on the distribution of NEC in Maine (and elsewhere in New England) may have been a consequence of the response of this species to changes in land use during the late 1800s and early 1900s when large portions of agricultural lands, throughout the region, were abandoned. In southern Maine (Androscoggin, Cumberland, Kennebec, Knox. Lincoln, Waldo, and York counties), for example, the abundance of agricultural lands peaked in 1880 and declined through the 1940s (Ahn et al. 2002). Most of these lands reverted to shrubby habitat and young forests. Populations of NEC likely responded to this short-term increase in early-successional habitats by increasing their numbers and expanding their range.

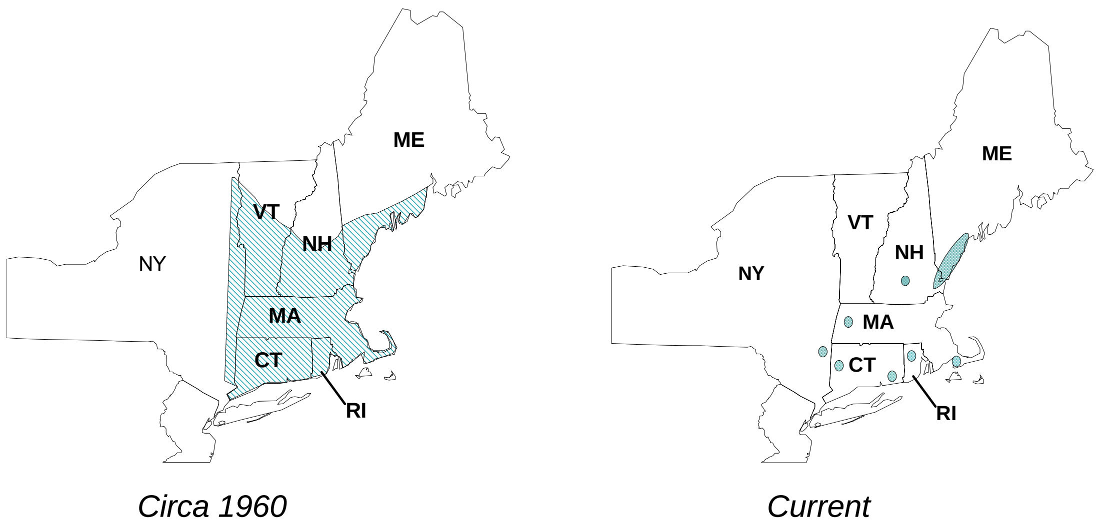


Figure 4. Historic and current distributions of New England cottontails. Historic distribution is a compilation of Hall and Kelson (1959), Johnston (1972), Jackson (1973), and C. Stevens (Univ. NH, unpublished data). Current distribution is an approximation based on preliminary results of recent surveys by Walter et al. (2001) and Litvaitis et al. (2003b).

NEC probably reached their greatest abundance and most extensive distribution during the years when young forests reached peak abundance (approximately 1910 to 1960, Litvaitis 1993). As these young forests matured, populations of NEC declined. By 1963, a survey of Maine wardens indicated that cottontails were common only in extreme southern York County and along the coastline of Cumberland County, and were extirpated from northern York County (as summarized in Jackson 1973). A live-trapping survey from 1971-1973 resulted in few captures of NEC in Gray, Cape Elizabeth, Westbrook, and Kittery, and cottontails seemed limited to coastal or near-coastal habitats (Jackson 1973).

No previous estimates of NEC population size in southern Maine are available. However, based on the historic abundance of shrublands and early-successional forests, it clear that both the geographic range and abundance of NEC in southern Maine were substantially greater than present-day populations (Figures 3 and 4).

Current Populations

Currently, NEC are restricted to approximately 1,600 km^2 (618 mi^2) of the 9,400 km^2 (3,629 mi^2) that the species once occupied in Maine (Figure 5).

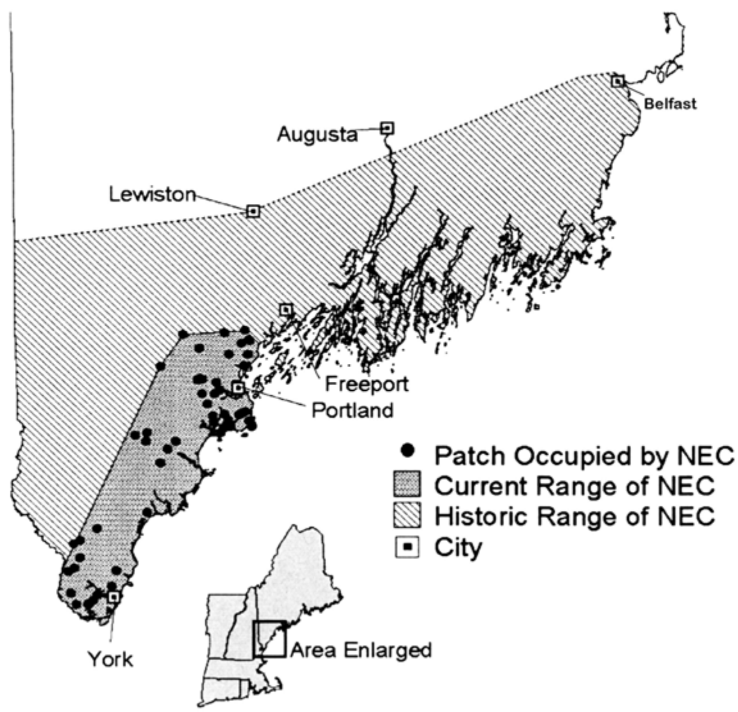


Figure 5. Historic (circa 1960) and current ranges of New England cottontails in Maine. Current range encompasses approximately17% of the historic range (from Litvaitis et al. 2003a).

Large patches of early successional habitat are rare in southern Maine (Litvaitis et al. 2003a). As a result, the persistence of remaining populations is questionable because approximately two thirds of the occupied patches in southern Maine are <2.5 ha (6.2

acres). Remaining populations of NEC are spatially structured in what are known as "metapopulations" (Figure 6).

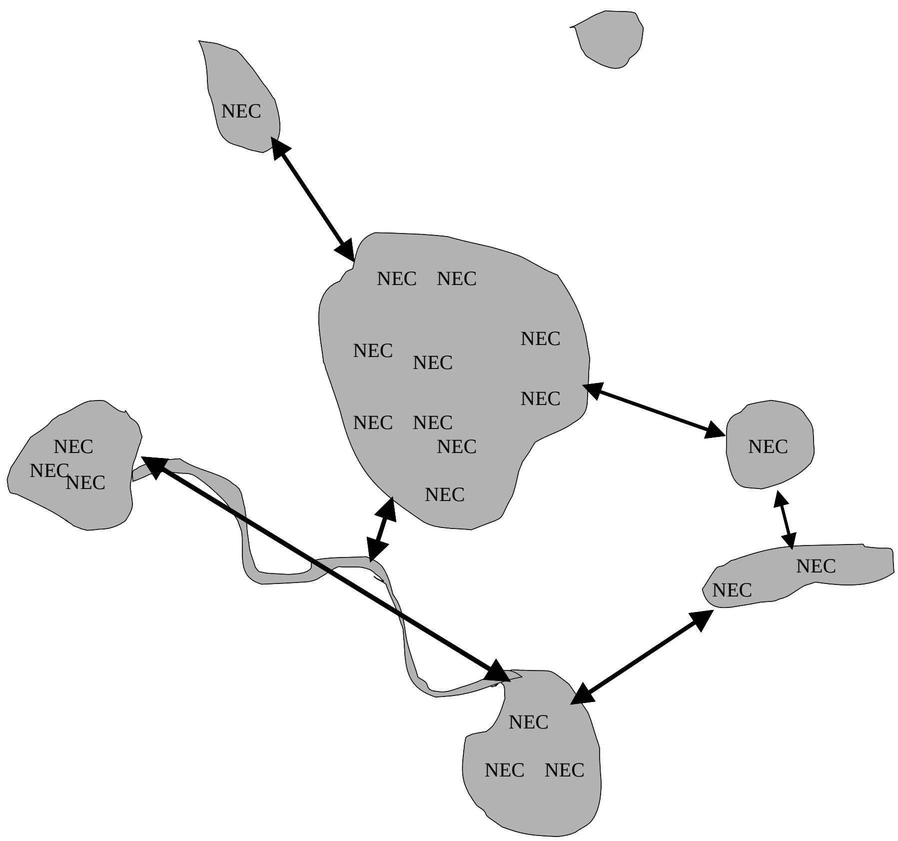


Figure 6. An illustration of a metapopulation showing patches of habitat in a fragmented landscape and how New England cottontail (NEC) might move between patches of suitable habitat. A metapopulation is a collection of subpopulations of a species, where each subpopulation occupies a suitable patch of habitat in a landscape of unsuitable habitat. The rate of local extinctions depends on the conditions within a patch, the species ability to disperse to other patches, and the location of the other patches (Meffe and Carroll 1994).

In such an arrangement, sub-populations are able to persist only because surplus rabbits from one or more large sub-populations regularly disperse to small patches of habitat (Litvaitis and Villafuerte 1996). However, if these small patches of habitat primarily act as population sinks, these metapopulations may be unstable and go extinct (Forys and Humphrey 1999).

A minimum population estimate for NEC in Maine was calculated using recent survey information on NEC and the habitats they occupied (Appendix B and C). The principal survey (i.e., Litvaitis and Johnson 2002) used a systematic sampling scheme. First, information on locations where NEC were captured within the past 10 years was obtained from MDIFW biologists. A 10-year period was used because of the ephemeral nature of most sites occupied by NEC (Litvaitis 1993). Next, the presence of NEC at these sites was verified with snowtrack surveys in combination with live-trap captures. Sites identified as still being occupied by NEC served as starting points for searches to find additional NEC sites. The search pattern for additional NEC sites was based on a grid laid over a map of southern Maine. Each cell of the grid represented a 7.5-minute USGS topographic map (land area of 13.9 km x 10 km) and served as one sampling unit. To insure adequate sampling effort throughout a sampling unit, each unit was further divided into 4 sections. Four sites were to be searched within each section (4 sites per section, 4 sections per sampling unit = 16 sites per sampling unit); however, in practice, many sections did not contain enough suitable habitat to have 4 sampling sites. Sites were considered suitable for NEC if they had dense understory cover (approximately >9,000 woody stems/ha) that was made up of primarily deciduous shrubs and trees. Suitable sites were identified and searched for NEC while following roads within the units. No minimum patch size was used during the survey.

Once selected, candidate patches were searched for evidence of lagomorphs (i.e., fecal pellets, tracks, and browsed twigs) for up to 20 minutes. Among patches considered occupied, field evidence was detected usually in <10 minutes. When conditions permitted, tracks in snow were used to verify the presence of cottontails or snowshoe hares. If cottontail tracks were encountered, livetraps (0.3 x 0.3 x 1.0 m) were baited with apples and set to determine if NEC or eastern cottontails were present. Livetraps also were used when a lack of snow or snow encrusted by ice prevented track identification.

The objective of the survey done by Litvaitis and Johnson was to determine the range of NEC in Maine. Therefore, when it was determined that NEC occupied a section of a sampling unit, any remaining suitable habitat in that section was not searched, and the survey continued in the next section of the sampling unit. Sections in which NEC were verified were classified as *occupied*. Further searches for NEC extended to sampling units adjacent to occupied units. Within the currently occupied range (Figure 5), 53 of the 230 sites surveyed contained NEC only, 76 contained snowshoe hares only, and 101 were vacant[1].

To determine the percentage of suitable sites that were missed by limiting the search to sites visible from roadways, the number of sites identified from roadways was compared to the number of sites identified using aerial photographs and ground searches in a portion of southern Maine (Litvaitis and Johnson 2002). This comparison indicated, that for this area, 86% of the suitable sites identified using aerial photographs were also searched during the roadside survey (Litvaitis and Johnson 2002).

[1] Only vacant sites and sites containing snowshoe within the NEC range were compared with the number of sites occupied by NEC. Litvaitis and Johnson (2002) searched 376 sites for NEC (Appendix A), but 146 of those sites were determined to be outside of the final range of NEC, as delineated by this study.

Observers were able to identify a high proportion of suitable sites from roadways because of the high density of roads in the area. In addition to the sites identified by Litvaitis and Johnson (2002), we estimated Maine's NEC population utilizing a smaller survey conducted at Rachel Carson National Wildlife Refuge (n = 5 occupied sites; Litvaitis et al. 2003c), and sites initially surveyed by MDIFW > 5 years ago that still had NEC (Appendix B).

The abundance of NEC in the areas surveyed was determined using information on the size of occupied patches and estimates of NEC densities in those patches. Barbour and Litvaitis (1993: Figure 1) reported a linear relationship between size of habitat patch and the mid-winter abundance of NEC. Using that relationship, the density among patches ≤ 3 ha (7.5 acres) was estimated at ~2 rabbits / ha. Among larger patches, rabbit density declined to ~1 rabbit / ha. Combining information on estimated abundance and the actual size of occupied patches yielded a mid-winter estimate of 316 rabbits in southern Maine. It is important to stress that this estimate is a minimum because not all suitable habitats were searched. However, even if this approach grossly underestimated the current population the current status of NEC in Maine would be precarious.

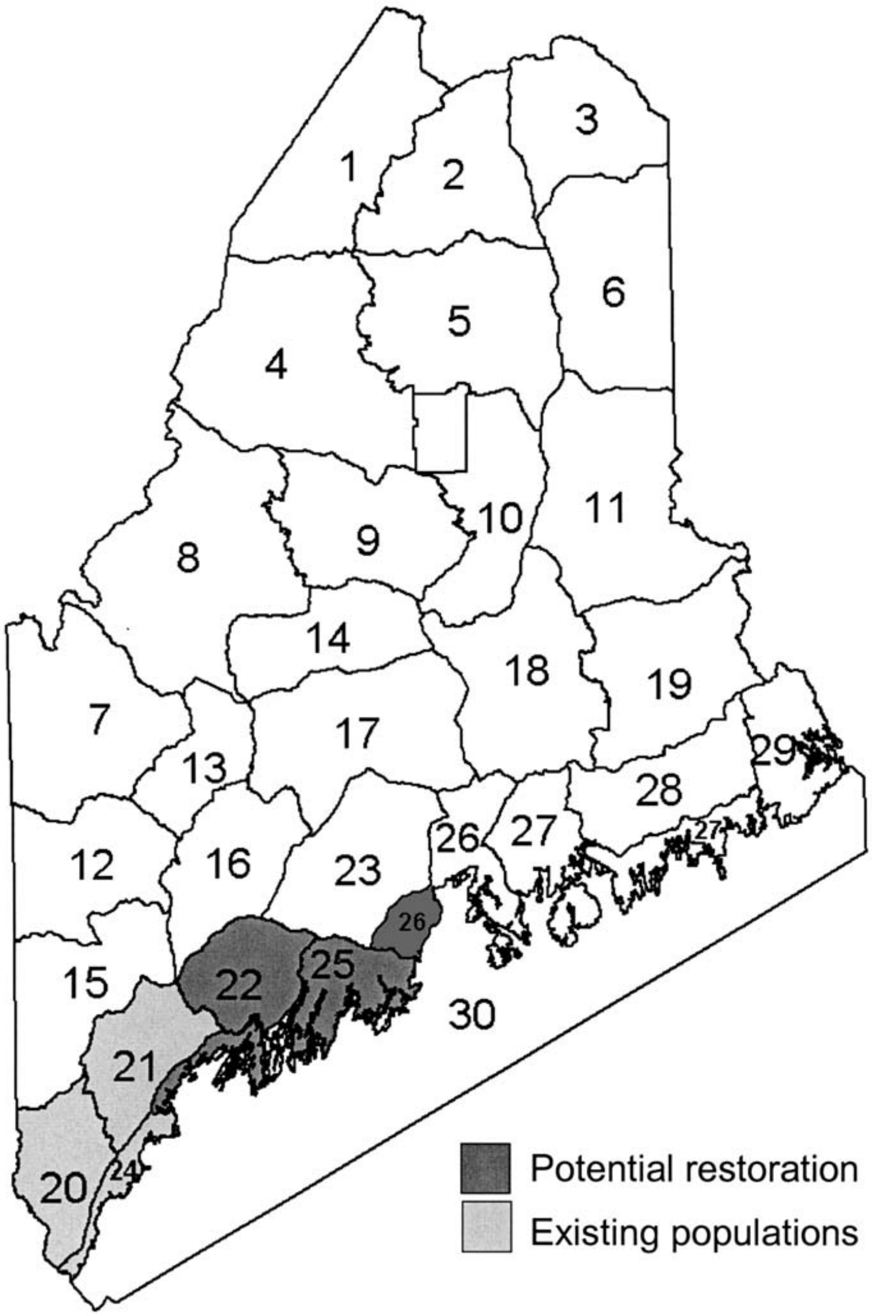
Population Projection & Future Management

Without active management, the abundance of suitable habitat for NEC in southern Maine will decline in response to development and changes in land use patterns. Therefore, it is appropriate to consider what actions should be taken to enhance long-term viability of NEC. One approach would be to establish and maintain moderate (>10 ha) to large size (>25 ha) patches that can serve as “core habitats” (Litvaitis 2001). These tracts could support populations of NEC that would be less susceptible to the limitations of the surrounding landscape matrix and large enough to withstand short-term perturbations (Litvaitis and Villafuerte 1996). Public lands within the occupied range of NEC in southern Maine may be a good starting point towards providing core habitats. For example, Rachel Carson National Wildlife Refuge and neighboring Wells National Estuarine Research Reserve are currently occupied by small populations of NEC (Litvaitis, personal observation). Expanding and maintaining suitable habitats on these holdings could result in a secure core habitat.

Once a program to develop and sustain core habitats is in place, efforts to expand suitable habitats for NEC could result in the development of a network of public and private lands. Specifically, proactive efforts could identify lands near the core habitats and these lands could be recruited to enroll in cost-sharing programs, including the Partners for Fish and Wildlife (PFW) and Landowner Incentive (LIP) programs of the USFWS; and the “Wildlife Habitat Incentive Program” (WHIP) administered by the Natural Resources Conservation Service (USDA). The PFW program provides cost-sharing and technical assistance to non-federal landowners, including private landowners, local governments, Native Americans, educational institutions, and other entities. One of the priority criteria for the PFW program is that private lands be close to a national wildlife refuge. If NEC are granted federal endangered or threatened species status by the USFWS, additional incentives for habitat conservation would be available through LIP. The primary objective of this program is to establish incentive programs that will protect or restore habitats on private lands that benefit species that are deemed to be at risk by the USFWS. The program provides technical and monetary assistance to private landowners for habitat protection and restoration. WHIP is a voluntary program for people who want to improve wildlife habitat primarily on private land. Through WHIP, the Natural Resources Conservation Service provides technical assistance and up to 75 percent cost-share assistance for the improvement of fish and wildlife habitat.

Through “Beginning with Habitat” (a collaborative program sponsored by the Maine Department of Conservation, MDIFW, Maine State Planning Office, Maine Audubon Society, Maine Cooperative Fish and Wildlife Research Unit, The Nature Conservancy, Southern Maine Regional Planning Commission, and the USFWS) the remaining blocks of habitats in southern Maine are being identified and mapped. This information is provided to town planning boards, town managers, and others to assist with their efforts to maintain open space and wildlife habitat. Identified habitat blocks can provide an exceptional starting point for identifying potential habitats that may be suitable for NEC within the currently occupied range (portions of WMD 20, 21, and 24) and areas to the northeast that were historically occupied but are now vacant (portions of WMD 22, 24, and 25; Figure 7). The resulting landscape network, and management to maintain the early successional stages required by NEC, will go a long way to assure the viability of NEC and other taxa dependent on these habitats.

Figure 7. Current distribution of New England cottontails and potential areas for restoration relative to Wildlife Management Districts in southern Maine.



USE AND DEMAND ASSESSMENT

Past Use and Demand

Two of the earliest methods for capturing rabbits in Maine were snares and box traps. Box traps were used into the early 20th century until they were banned in 1929. Other methods of hunting cottontails include using dogs to flush or chase rabbits, stalking, and falconry.

Maine's records on hunting harvests do not differentiate between the harvests of snowshoe hare and NEC. Anecdotal reports indicate that NEC were commonly hunted in the 1950s and 1960s and that falconers regularly targeted NEC through the 1970s (Scott Keniston, personal communication).

Current Use and Demand

Nonconsumptive Use

In 1993, 73% of Maine residents 16 years or older participated in primary nonconsumptive wildlife activities (i.e., nonconsumptive activities not incidental to other activities), whereas 16% of the residents hunted, and less than 1% trapped (U.S. Dept. of Interior et al. 1993). Nonconsumptive use of cottontails is likely limited to occasional "backyard" viewing or glimpses of rabbits while hiking or hunting. In addition to actual sightings, following rabbit tracks after a fresh snowfall is fascinating to some wildlife enthusiasts (especially younger ones). At this time there are no specific surveys of Maine residents indicating the percentage of people who enjoy watching small mammals, such as NEC.

Consumptive Use

Because of the scarcity of NEC, few of these animals were harvested by hunters or falconers in Maine in the last 15 years. Most NEC were harvested incidentally to hunting snowshoe hare. Beginning in Fall 2004, NEC can no longer be legally hunted in Maine. The hunting season for NEC was closed because of the small population of NEC in Maine, and the decline in suitable habitat. If NEC populations were adequate, they would likely have a high potential for consumptive use, provided the amount of huntable land in southern Maine does not decrease substantially. Other small game, such as snowshoe hare and ruffed grouse are sought after by large number of hunters in Maine. A total of 76,000 residents and nonresidents hunted small game in Maine in 1996 (U.S. Dept of Interior et al. 1996). Small game hunters made up 36% of all the resident and nonresident hunters in Maine that year. The majority (87%) of small game hunters were Maine residents, whereas only 13% of small game hunters were nonresidents. Snowshoe hare were the second most popular animal pursued by small game hunters, with ruffed grouse being the most popular (U.S. Dept of Interior et al. 1996).

<u>Use and Demand Projections</u>

Unless land-use patterns in south coastal Maine deviate substantially from current projections, and unless habitat management for NEC improves the suitability of undeveloped uplands, opportunities see these animals will decrease. It is unlikely that these animals will be hunted again, unless a major population recovery occurs in Maine and elsewhere in the U.S.

SUMMARY AND CONCLUSIONS

The New England cottontail (NEC), also called *coney* or *cooney*, is a medium-sized rabbit. NEC are restricted to habitats with dense understory vegetation. This cottontail prefers sites >50,000 stem-cover units/ha (>20,234 stem-cover units/acre) and is reluctant to venture >5 m (>16 ft) from cover. This association with dense cover is an obvious adaptation to avoid predators. Predation is the major cause of death of cottontails. Known predators of NEC include bobcats, fishers, red foxes, coyotes, domestic cats, and owls.

Historically, NEC likely occupied native shrublands associated with sandy soils or wetlands and regenerating forests associated with small-scale disturbances resulting from beavers, lightning strikes, or local wind storms. Less frequently, hurricanes and wild fires also generated early-successional habitats. The abundance of suitable habitat for NEC likely varied among forest types and proximity to the Atlantic coast. Coastal areas were characterized by a abundance of native shrublands and young forests because of frequent natural disturbances and agriculture related clearing by Indians.

Prior to 1960, the range of NEC included southeastern New York, all of Connecticut, Massachusetts, and Rhode Island, much of Vermont, southern New Hampshire, and southern Maine. European colonization and subsequent clearing of forests in the region lead to increased availability of suitable habitat for NEC. Although clearing land in itself was not beneficial for NEC, after much of the cleared land was abandoned these lands reverted back to the young forests and shrubby habitat favored by NEC. New England cottontail and other species affiliated with dense understory vegetation reached unprecedented levels of abundance in the late 1800s and early 1900s when regenerating forests dominated the region. Most of these young stands matured into closed-canopy forests (about 1960) and subsequently populations of NEC quickly declined.

Until 1999, NEC and snowshoe hares were grouped as “hares/rabbits” under Maine's laws and the Department's regulatory authority. Prior to 1905, there were no laws restricting the harvest of NEC. The public laws of 1905 established the first season on hares and rabbits. The same law prohibited the use of snares and traps for taking hares and rabbits, except it was lawful to catch hare in box traps in the counties of Oxford, Penobscot, and Piscataquis during the open season.

In 1917, hare/rabbit season dates (September 1 to March 31) were established statewide and box trapping was allowed as well. The use of box traps was prohibited in 1929, and the opening date was changed to October 1, where it remains today. The legislature changed season closing dates slightly (end of February to the end of March) mostly by county through 1972. The Department of Inland Fisheries and Wildlife was given regulatory authority in 1972. In 1973, March 31 became the statewide closing date where it remains today (except for February 28 on Vinalhaven). In 1999, cottontail hunting was restricted out of concern that the NEC population was likely declining. The daily bag limit, which had remained at 4 rabbits or hares (in combination) since 1935, was changed to 4 rabbits or hares; only one of which could be a cottontail rabbit. The possession limit, which had been 8 rabbits or hares in combination, was changed to 8 rabbits or hares; only 2 of which could be a cottontail rabbit. The Department recommended that the hunting season on NEC be closed in 2004 out of concern that the population of NEC was declining.

Currently, NEC are restricted to approximately 1,600 km^2 (618 mi^2) of the 9,400 km^2 (3,629 mi^2) that the species once occupied in Maine. Within the occupied range, the total mid-winter population is estimated to be 316. Occupied habitats of NEC in southern Maine can be characterized as patches of former agricultural land, with dense understory vegetation. Landscapes that surround these patches are substantially fragmented by suburbanization and dense road networks. Approximately two thirds of the patches occupied by NEC in southern Maine are <2.5 ha. Rabbits on these small patches likely experience very high rates of predation resulting in limited recruitment. These patches of habitat can be viewed as demographic sinks (where mortality exceeds reproduction). Therefore, it is not likely that cottontails will survive long term as urban and suburban developments increase in southern Maine. Urbanization is expected to increase substantially in southern Maine within the next 50 years, especially within the area occupied by NEC, coastal regions south of Portland. Even if some of these lands remain undeveloped, active management will be needed to maintain these lands in a successional stage that is favorable for NEC. The decline of early-successional forests seems to be occurring throughout the historic range of NEC and this trend is expected to continue unless proactive measures are taken.

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Appendix A. Interactions Between New England and Eastern Cottontail Rabbits

During the early 1900s, natural resource agencies and hunting clubs translocated thousands of eastern cottontails to southern New England (Johnston 1972). Chapman and Morgan (1973) reported that cottontails transplanted in the Northeast included individuals from several subspecies, and that subsequent interbreeding by these rabbits resulted in offspring that were genetically diverse. The authors speculated that increased genetic variability had substantial ramifications on behavioral interactions among native and transplanted cottontails. Specifically, Chapman and Morgan (1973) speculated that offspring of transplanted eastern cottontails were able to expand their realized niche by moving into habitats that this species did not occupy prior to translocations. These habitats included those that were formerly occupied exclusively by NEC (and populations now considered to be Appalachian cottontails). NEC and eastern cottontails use similar foods (Dalke and Sime 1941) and cover (Eabry 1968, Linkkila 1971, Johnston 1972). Because eastern cottontails are approximately 20% heavier than NEC (Litvaitis et al. 1991), interference competition (Case and Gilpin 1974) has been proposed as an explanation for the regional decline of NEC (Fay and Chandler 1955, Reynolds 1975). This conjecture was supported by roughly simultaneous expansion of populations of eastern cottontails and decline among populations of NEC in the northeastern United States (Chapman and Morgan 1973, Probert and Litvaitis 1996), inferring that expanding populations of eastern cottontails (Figure 8) had a detrimental effect on populations of New England cottontails.

The ability of eastern cottontails to dominate and exclude NEC from sites that NEC occupied exclusively was evaluated by Probert and Litvaitis (1996). These investigators examined interactions between individuals in small enclosures and also monitored use of microhabitats in a large enclosure where abundance of cover and food varied. Among behavioral dyads (dyad = an individual of each species released into a small enclosure) where one individual dominated another, eastern cottontails were the

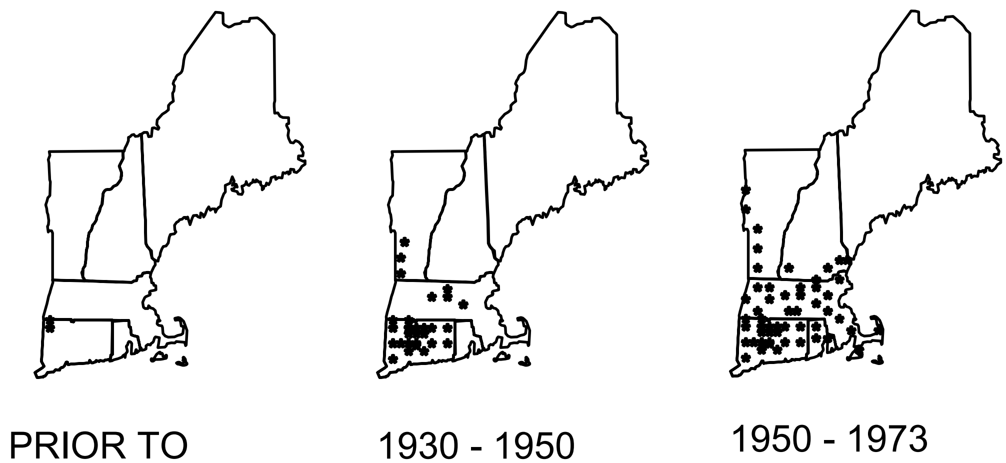

Figure 8. Expansion of eastern cottontails into New England (from Probert and Litvaitis 1996). Note that eastern cottontails have not colonized Maine.

dominant rabbit in 58% of the trials (Probert and Litvaitis 1996). This was not different from a random expectation. Additionally, no consistent differences were detected in microhabitat selection in the large enclosure. Probert and Litvaitis (1996) concluded that interference competition did not explain the overall change in distribution and abundance of cottontails in the northeast United States. Eastern cottontails may benefit by being able to occupy habitats with less cover than required by NEC. As a result, eastern cottontails may colonize disturbance patches sooner and maintain access to these habitats simply on a system of “prior rights” (Probert and Litvaitis 1996).

This speculation was supported by a subsequent comparison of foraging strategies used by eastern and NECs (Smith and Litvaitis 2000). The response of both species was monitored in a large enclosure where cover was available in one portion of the enclosure and proximity of food (quality and quantity) in relation to cover varied among trials. In trials with low-quality food in cover and high-quality food in open areas, NECs sacrificed food quality for safety by remaining in or close to cover. Eastern cottontails, on the other hand, avoided low-quality food and maintained physical condition by foraging at sites away from cover that contained high-quality food. When all food was removed from cover, NECs were reluctant to forage in the open, lost a greater proportion of body weight, and succumbed to higher rates of predation than did eastern cottontails. The behavioral differences between these species of cottontails may be partly attributed to morphological differences. Specifically, Smith and Litvaitis (1999) reported that eastern cottontails had a larger exposed surface area of the eyes than NEC. This difference apparently enabled eastern cottontails to detect a simulated predator (moving model of an owl) at greater distances ($\bar{x}$ = 21.2 m [69.6 ft]) than NEC ($\bar{x}$ = 9.4 m [30.8 ft], Smith and Litvaitis 1999:58). When results of the foraging trials were applied to habitat-use patterns of free-ranging cottontails, Smith and Litvaitis (2000) estimated that NEC could only exploit 32% of the available habitat without experiencing intense predation, whereas eastern cottontails could exploit 99% of the habitats. These results suggest that the consequences of widespread forest maturation and fragmentation in the northeastern United States that have been detrimental to NEC apparently have been less deleterious to eastern cottontails. These differences in behavior and morphology probably explain the shift in composition of cottontail populations in the northeastern United States.

Appendix B. Summary information on all sites surveyed for the presence of New England cottontails (NEC) in southern Maine. Sites with hyphenated site numbers were surveyed as part of a cooperative study between MDIFW and the University of New Hampshire, i.e., Litvaitis and Johnson (2002). All GPS locations were collected using NAD 83. "Conditions" refers to relative tracking conditions, ranging from 0 = worst to 10 = optimum (note: the condition of many sites was not recorded). "Tracks" and "Pellets" refers to the amount of time (measured in minutes) it took to encounter lagomorph tracks or fecal pellets (0 = not encountered). "Resident" refers to the species of lagomorph that was found on the patch, where: 0 = vacant, 1 = New England cottontail, and 3 = snowshoe hare. Data includes sites visited by MDIFW personnel as part of the Southern Maine Ecoregional Surveys. Sites identified by a 2-digit site number were surveyed as part of a comprehensive survey of all possible NEC habitats on Rachel Carson National Wildlife Refuge (Litvaitis et al. 2003c). Sites 6e, 6h, and Wells Reserve are sites previously (> 5 years ago) surveyed by MDIFW that were not included in the above surveys. The presence of NEC on these sites was reconfirmed in August 2004 through conversations with private individuals working at these sites.

Site	Date	Quad	Latitude	Longitude	County	Township	Conditions	Tracks	Pellets	Resident	Area (ha)
1-2U1	01/10/01	Q1-2	43-06-02.6	70-45-08.7	York	Kittery	8	0	0	0	
1-2S2	01/23/01	Q1-2	43-6-57.61	70-46-8.11	York	Eliot	7	1	4	1	1
1-2U3	1/7/01	1-2	43-07-5.89	70-45-16.91	York	Kittery		0	0	0	
2-1S1	01/05/01	Q2-1	43-07-07.7	70-43-47.0	York	Kittery	9	3	4	1	11.4
2-2U2	01/10/01	Q2-2	43-06-24.2	70-40-25.9	York	Kittery	8	0	0	0	
2-1S3	01/12/00	2-1	43-06-58.09	70-43-56.12	York	Kittery		1	4	1	0.6
4-2U1	01/12/01	Q4-2	43-14-51.5	70-47-49.6	York	Berwick	7	0	0	0	
4-4S2	01/07/01	Q4-4	43-08-32.5	70-47-09.5	York	Eliot	7	1	4	1	0.5
4-2S3	01/19/00	4-2	43-11-44.38	70-47-50.41	York	South Berwick		1	4	1	0.4
4-2S4	01/19/00	4-2	43-13-47.44	70-45-35.27	York	South Berwick		1	4	1	1
4-2S5	01/12/00	4-2	43-12-20.46	70-46-44.13	York	South Berwick		1	4	1	1
5-4S1	12/23	Q5-4	43-9-45.38	70-39-20.53	York	York	10	1	0	1	4.3
5-4S2	12/23	Q5-2	43-12-0.6	70-38-33.03	York	York	10	1	1	1	0.5
5-4U3	01/10/01	Q5-4	43-09-34.2	70-39-00.8	York	York	8	0	0	0	
5-3S4	01/11/00	5-3	43-07-37.76	70-42-45.65	York	Kittery		1	4	1	0.8
5-3S5	1/11/00	5-3	43-08-20.0	70-42-8.79	York	York		1	4	1	0.5
6-1U1	01/10/01	Q6-1	43-11-19.3	70-37-13.9	York	York	8	0	0	0	
6-1U2	01/10/01	Q6-1	43-12-14.7	70-37-10.0	York	York	8	0	0	0	
7-4U1	01/04/01	Q7-4	43-16-25.9	70-52-33.2	York	Berwick	9	0	0	0	
7-4U2	01/04/01	Q7-4	43-18-31.8	70-54-03.7	York	Berwick	9	0	0	0	

7-2U3	01/04/01	Q7-2	43-20-36.5	70-55-19.2	York	Lebanon	9	0	0	0	
8-2U1	01/07/01	Q8	43-21-18.6	70-45-25.9	York	North Berwick	8	0	0	0	
8-2L2	01/07/01	Q8	43-20-09.6	70-46-29.2	York	North Berwick	8	3	4	3	
8-1U3	01/07/01	Q8-1	43-21-48.3	70-49-27.2	York	North Berwick	8	0	0	0	
8-1U4	01/07/01	Q8-1	43-20-12.3	70-50-33.5	York	Berwick	8	0	0	0	
8-1U5	01/07/01	Q8-1	43-19-46.2	70-51-0.00	York	Berwick	8	0	0	0	
8-3U6	01/07/01	Q8-3	43-18-22.3	70-51-30.6	York	Berwick	8	0	0	0	
8-4U7	01/07/01	Q8-4	43-18-00.6	70-47-14.2	York	North Berwick	8	0	0	0	
8-4S8	01/07/01	Q8-4	43-15-49.8	70-46-50.6	York	Berwick	8	1	4	1	1.4
8-4S9	01/23/01	Q8-4	43-16-22.87	70-45-38.96	York	North Berwick	7	1	4	1	15.7
8-4L10	1/27/01	8-4	43-17-58.5	70-46-09.8	York	North Berwick		3	4	3	
8-4U11	01/07/01	8-4	43-17-57.2	70-45-06.7	York	North Berwick		0	0	0	
9-1L1	01/07/01		43-18-26.5	70-43-21.9	York	North Berwick	8	3	4	3	
9-1L2	01/12/01	Q9-1	43-19-24.5	70-44-15.4	York	North Berwick	7	3	4	3	
9-3S3	1/11/00	9-3	43-18-15.3	70-42-25.72	York	Wells		1	4	1	0.2
9-3U4	1/11/01	9-3	43-18-18	70-42-58	York	North Berwick		0	0	0	
9-3U5	1/11/01	9-3	43-17-54	70-43-9	York	North Berwick		0	0	0	
9-2L6	1/11/01	9-2	43-21-9	70-39-1	York	Wells		3	4	3	
9-2U7	1/11/01	9-2	43-19-57	70-37-42	York	Wells		0	0	0	
10-1L1	01/05/01	Q10-1	43-19-39.3	70-36-21.7	York	Wells	9	3	4	3	
10-3U2	01/10/01	Q10-3	43-16-10.0	70-35-46.3	York	Ogunquit	8	0	0	0	
10-2U3	01/10/01	Q10-2	43-22-15.5	70-33-12.0	York	Kennebunk	8	0	0	0	
10-3U4	12/23	Q10-3	43-15-38.0	70-37-10.0	York	Ogunquit	10	0	0	0	
10-3U5	1/11/01	10-3	43-16-45	70-37-13	York	Wells		0	0	0	
10-3U6	1/11/01	10-3	43-17-56	70-36-54	York	Wells		0	0	0	
10-1U7	1/11/01	10-1	43-19-31	70-36-20	York	Wells		0	0	0	
10-1L8	1/9/01	10-1	43-20-38	70-37-22	York	Wells		3	4	3	
10-2S9	02/15/01	10-2	43-20-50.06	70-32-57.22	York	Wells					
12-2L1	01/04/01	Q12-2	43-28-01.7	70-55-26.3	York	Acton	9	3	4	3	
12-2U2	01/04/01	Q12-2	43-26-51.9	70-53-47.2	York	Lebanon	9	0	0	0	
12-4U3	01/04/01	Q12-4	43-24-44.1	70-55-16.5	York	Lebanon	9	0	0	0	
12-4U4	01/04/01	Q12-4	43-23-38.4	70-53-33.6	York	Lebanon	9	0	0	0	
12-4U5	01/12/01	Q12-4	43-25-28.3	70-54-09.6	York	Lebanon	7	0	0	0	
12-4U6	01/12/01	Q12-4	43-23-53.7	70-52-34.5	York	Lebanon	7	0	0	0	

13-4U1	01/12/01	Q13-4	43-25-12.6	70-45-26.1	York	Sanford	7	0	0	0	
13-4U2	01/12/01	Q13-4	43-23-52.3	70-47-09.1	York	North Berwick	7	0	0	0	
13-4U3	01/12/01	Q13-4	43-24-04.5	70-48-02.0	York	North Berwick	7	0	0	0	
13-3U4	01/12/01	Q13-3	43-23-55.4	70-49-46.3	York	Lebanon	7	0	0	0	
13-3U5	01/12/01	Q13-3	43-23-43.3	70-50-04.6	York	Lebanon	7	0	0	0	
13-3L6	01/12/01	Q13-3	43-24-56.4	70-51-53.1	York	Lebanon	7	3	4	3	
13-2U7	01/12/01	Q13-2	43-27-28.5	70-45-46.6	York	Sanford	7	0	0	0	
13-2U8	01/12/01	Q13-2	43-27-43.9	70-46-49.0	York	Sanford	7	0	0	0	
13-2U9	01/12/01	Q13-2	43-28-05.8	70-46-27.5	York	Sanford	7	0	0	0	
14-2U1	01/08/01	Q14-2	43-28-34.3	70-39-52.2	York	Lyman	9	0	0	0	
14-2U2	01/08/01	Q14-2	43-27-57.0	70-43-14.3	York	Alfred	9	0	0	0	
14-4L3	01/08/01	Q14-4	43-24-02.7	70-40-38.2	York	Sanford	9	3	4	3	
14-3U4	01/08/01	Q14-3	43-23-53.1	70-41-36.9	York	Sanford	9	0	0	0	
14-3U5	01/08/01	Q14-3	43-24-12.1	70-43-53.5	York	Sanford	9	0	0	0	
14-3L6	01/08/01	Q14-3	43-24-45.5	70-44-33.3	York	Sanford	9	3	4	3	
14-3U7	01/12/01	Q14-3	43-24-13.7	70-44-27.2	York	Sanford	7	0	0	0	
14-3U8	01/12/01	Q14-3	43-24-43.6	70-44-46.7	York	Sanford	7	0	0	0	
14-2L9	2/8/01		43-29-13.92	70-37-39.12	York	Lyman		3	4	3	
15-1U1	01/08/01	Q15-1	43-28-46.3	70-37-26.4	York	Lyman	9	0	0	0	
15-2L2	01/08/01	Q15-2	43-28-39.9	70-33-52.0	York	Arundel	9	3	4	3	
15-2L3	01/08/01	Q15-2	43-28-33.4	70-33-12.0	York	Arundel	9	3	4	3	
15-4U4	01/08/01	Q15-4	43-25-34.7	70-30-44.9	York	Arundel	9	0	0	0	
15-4U5	01/08/01	Q15-4	43-23-49.4	70-31-48.5	York	Kennebunk	9	0	0	0	
15-3U6	01/08/01	Q15-3	43-23-18.1	70-35-31.1	York	Kennebunk	9	0	0	0	
15-3L7	12/23	Q15-3	43-24-34.2	70-33-26.6	York	Kennebunk	10	1	1	3	
15-3L8	12/23	Q15-3	43-24-42.2	70-33-38.6	York	Kennebunk	10	1	0	3	
15-2L9	12/23	Q15-2	43-28-34.8	70-30-11.8	York	Biddeford	10	1	0	3	
15-2L10	12/23	Q15-2	43-27-58.7	70-31-5.2	York	Arundel	10	1	1	3	
15-3U11	1/9/01	15-3	43-25-59	70-34-17	York	Kennebunk		0	0	0	
15-2S12	2/24/01		43-28-10.86	70-30-26.52	York	Biddeford		1	4	1	1
15-2L13	2/24/01		43-28-27.60	70-30-53.58	York	Biddeford		3	4	3	
15-4L14	2/7/01		43-24-28.68	70-31-58.14	York	Arundel		3	4	3	
16-1U1	01/08/01	Q16-1	43-28-12.4	70-29-10.6	York	Biddeford	9	0	0	0	
16-1U2	01/08/01	Q16-1	43-26-56.5	70-29-54.7	York	Arundel	9	0	0	0	

16-1L3	12/23	Q16-1	49-29-21.5	70-29-34.9	York	Biddeford	10	1	1	3	
16-2U4	01/14/01	Q16-2	43-28-14.5	70-24-58.9	York	Biddeford	7	0	0	0	
16-2U5	01/14/01	Q16-2	43-27-45.2	70-25-30.3	York	Biddeford	7	0	0	0	
16-2L6	01/14/01	Q16-2	43-27-08.0	70-23-46.9	York	Biddeford	7	3	4	3	
16-4U7	01/14/01	Q16-4	43-25-17.3	70-24-25.5	York	Biddeford	7	0	0	0	
16-4L8	01/14/01	Q16-4	43-24-42.3	70-24-58.0	York	Kennebunkport	7	3	4	3	
16-4L9	01/14/01	Q16-4	43-24-14.8	70-25-42.0	York	Kennebunkport	7	3	4	3	
16-3U10	01/14/01	Q16-3	43-23-47.0	70-26-58.2	York	Kennebunkport	7	0	0	0	
16-3U11	2/24/01		43-24-47.70	70-27-38.64	York	Kennebunkport		0	0	0	
16-3U12	2/7/01		43-23-36.42	70-27-2.76	York	Kennebunkport		0	0	0	
16-3L13	2/7/01		43-24-36	70-28-39.24	York	Kennebunkport		3	4	3	
17-1U1	01/14/01	Q17	43-26-32.6	70-21-12.1	York	Biddeford	7	0	0	0	
18-2U1	01/04/01	Q18-2	43-35-21.6	70-52-37.3	York	Shapleigh	9	0	0	0	
18-2L2	01/04/01	Q18-2	43-34-24.5	70-55-46.7	York	Acton	9	3	4	3	
18-2U3	01/14/01	18-2	43-36-4.2	70-52-28.7	York	Shapleigh		0	0	0	
19-4U1	01/12/01	Q19-4	43-31-06.4	70-45-14.6	York	Alfred	7	0	0	0	
19-3U2	01/14/01	19-3	43-32-33.3	70-50-57.5	York	Shapleigh		0	0	0	
19-3U3	01/14/01	19-3	43-32-45.1	70-51-9.2	York	Shapleigh		0	0	0	
19-1U4	01/14/01	19-1	43-36-7.3	70-49-6.6	York	Shapleigh		0	0	0	
19-4U5	01/14/01	19-4	43-32-53.7	70-47-5.7	York	Alfred		0	0	0	
20-2L1	01/08/01	Q20-2	43-34-14.6	70-39-56.0	York	Waterboro	9	3	4	3	
20-3U2	01/08/01	Q20-3	43-27-57.0	70-43-14.3	York	Alfred	9	0	0	0	
20-2U3	01/11/01	Q20-2	43-35-08.4	70-37-42.6	York	Hollis	7	0	0	0	
20-3U4	2/8/01		43-30-13.26	70-42-55.80	York	Alfred		0	0	0	
20-3L5	2/8/01		43-32-30.84	70-41-43.08	York	Waterboro		3	4	3	
21-4S1	01/08/01	Q21-4	43-32-33.3	70-33-09.8	York	Dayton	9	1	4	1	2.9
21-1L2	01/11/01	Q21-1	43-35-14.6	70-35-52.1	York	Hollis	7	3	4	3	
21-3L3	01/11/01	Q21-3	43-33-43.8	70-36-14.8	York	Dayton	7	3	4	3	
21-2U4	01/25/01	Q21-2	43-36-52.4	70-31-21.0	York	Buxton		0	0	0	
21-1U5	01/25/01	Q21-1	43-36-31.8	70-34-28.4	York	Hollis		0	0	0	
21-2L6	01/25/01	21-2	43-35-05.5	70-32-59.0	York	Buxton		3	4	3	
21-4L7	01/25/01	21-4	43-31-03.0	70-33-01.3	York	Dayton		3	4	3	
21-3U8	01/25/01	21-3	43-31-13.4	70-37-23.1	York	Lyman		0	0	0	
21-4L9	01/26/01	21-4	43-31-43.7	70-30-22.0	York	Saco		3	4	3	

21-4U10	01/26/01	21-4	43-32-01.2	70-32-17.6	York	Dayton		0	0	0	
21-4S11	01/26/01	21-4	43-31-16.9	70-33-13.2	York	Dayton		1	4	1	1.9
21-3U12	01/26/01	21-3	43-32-21.2	70-34-36.3	York	Dayton		0	0	0	
21-1U13	01/26/01	21-1	43-33-38.8	70-33-54.8	York	Dayton		0	0	0	
21-3S14	01/26/01	21-3	43-32-13.6	70-35-23.6	York	Dayton		1	4	1	1
21-1L15	01/26/01	22-1	43-33-44.3	70-36-14.7	York	Dayton		3	4	3	
21-1U16	01/26/01	21-1	43-36-05.3	70-35-22.1	York	Hollis		0	0	0	
21-1L17	01/26/01	21-1	43-35-21.6	70-36-15.1	York	Dayton		3	4	3	
21-3L18	2/8/01		43-31-0.36	70-35-11.82	York	Dayton		3	4	3	
21-4U19	2/8/01		43-30-9	40-32-55.86	York	Biddeford		0	0	0	
22-2U1	12/23	Q22-2	43-34-16.0	70-24-25.3	Cumberland	Scarborough	10	0	0	0	
22-3S2	12/23	Q22-3	43-31-25.4	70-27-28.1	York	Saco	10	1	0	1	6
22-1U3	01/13/01	Q22-1	43-34-03.3	70-28-59.4	York	Saco	7	0	0	0	
22-1U4	01/13/01	Q22-1	43-33-55.2	70-27-12.4	York	Saco	7	0	0	0	
22-1U5	01/13/01	Q22-1	43-36-57.9	70-27-05.3	Cumberland	Scarborough	7	0	0	0	
22-2U6	01/13/01	Q22-2	43-36-53.1	70-25-30.6	Cumberland	Scarborough	7	0	0	0	
22-2L7	01/13/01	Q22-2	43-36-33.2	70-23-58.2	Cumberland	Scarborough	7	3	4	3	
22-2U8	01/13/01	Q22-2	43-36-39.4	70-22-34.2	Cumberland	Scarborough	7	0	0	0	
22-3S9	01/24/01	22-3	43-30-13.4	70-29-01.7	York	Saco		1	4	1	1.3
22-3U10	01/24/01	22-3	43-31-42.9	70-28-01.8	York	Saco		0	0	0	
22-3U11	01/23/01	22-3	43-33-25.2	70-29-39.0	York	Saco		0	0	0	
22-3L12	01/24/01	22-3	43-33-25.2	70-29-39.0	York	Saco		3	4	3	
22-1U13	01/24/01	22-1	43-34-03.0	70-28-33.4	York	Saco		0	0	0	
22-1U14	01/24/01	22-1	43-34-22.2	70-27-04.9	York	Saco		0	0	0	
22-1U15	01/24/01	22-1	43-36-01.3	70-28-26.1	Cumberland	Scarborough		0	0	0	
22-2U16	01/24/01	22-2	43-37-22.7	70-25-41.4	Cumberland	Gorham		0	0	0	
22-2U17	01/24/01	22-2	43-34-32.2	70-23-11.9	Cumberland	Scarborough		0	0	0	
22-2U18	01/24/01	22-2	43-35-21.8	70-22-37.2	Cumberland	Scarborough		0	0	0	
22-4U19	01/25/01	22-4	43-30-53.2	70-25-39.2	York	Saco		0	0	0	
22-4U20	01/25/01	22-4	43-31-29.2	70-25-42.5	York	Saco		0	0	0	
22-2L21	01/25/01	22-1	43-34-46.6	70-25-45.5	Cumberland	Scarborough		3	4	3	
22-3L22	01/24/01	22-3	43-31-01.6	70-26-29.6	York	Saco		3	4	3	
22-3L23	2/24/01		43-32-23.22	70-27-32.46	York	Saco		3	4	3	
22-4U24	2/24/01		43-32-14.34	70-25-6.36	York	Saco		0	0	0	

23-1S1	12/23	Q23-1	43-37-6.3	70-21-29.5	Cumberland	Scarborough	10	1	1	1	5.3
23-1U2	01/13/01	Q23-1	43-36-07.8	70-21-52.7	Cumberland	Scarborough	7	0	0	0	
23-1U3	01/13/01	Q23-3	43-36-01.6	70-21-45.1	Cumberland	Scarborough	7	0	0	0	
23-1U4	01/13/01	Q23-1	43-35-19.9	70-21-45.7	Cumberland	Scarborough	7	0	0	0	
23-2S5	01/13/01	Q23-2	43-35-41.0	70-18-03.7	Cumberland	Scarborough	7	1	4	1	2.6
23-2S6	01/13/01	Q23-2	43-34-47.4	70-17-19.9	Cumberland	Scarborough	7	1	4	1	2.3
23-2U7	01/13/01	Q23-2	43-34-35.6	70-17-22.1	Cumberland	Scarborough	7	0	0	0	
23-2L8	01/13/01	Q23-2	43-34-27.5	70-16-40.1	Cumberland	Scarborough	7	3	4	3	
23-2S9	01/13/01	Q23-2	43-33-43.7	70-16-49.9	Cumberland	Scarborough	7	1	4	1	1.8
23-1U10	01/12/01	Q23-1	43-34-45.4	70-20-10.2	Cumberland	Scarborough	7	0	0	0	
23-1S11	01/12/01	Q23-1	43-34-26.7	70-20-06.3	Cumberland	Scarborough	7	1	4	1	1.7
23-1L12	01/23/01	23-1	43-36-13.5	70-22-08.1	Cumberland	Scarborough		3	4	3	
23-1S13	01/23/01	23-1	43-35-23.0	70-20-21.5	Cumberland	Scarborough		1	4	1	0.9
23-4S14	01/23/01	23-4	43-33-32.5	70-18-13.5	Cumberland	Scarborough		1	4	1	0.3
23-4S15	01/23/01	23-4	43-32-48.6	70-18-46.2	Cumberland	Scarborough		1	4	1	2.5
23-4L16	01/23/01	23-2	43-33-40.6	70-17-46.1	Cumberland	Scarborough		3	4	3	
23-2S17	01/23/01	23-2	43-35-35.4	70-15-14.0	Cumberland	Cape Elizabeth		1	4	1	0.6
23-3U18	01/23/01	23-3	43-32-34.7	70-20-52.5	Cumberland	Scarborough		0	0	0	
23-3U19	01/23/01	23-3	43-31-41.1	70-21-47.9	York	Old Orchard		0	0	0	
23-2X20	01/23/01	23-2	43-36-37.7	70-15-20.8	Cumberland	Cape Elizabeth		4	0	4	
23-4S21	1/26/01	23-4	43-34-1.26	70-17-42.96	Cumberland	Scarborough		1	4	1	18
24-1S1	01/13/01	Q24-1	43-35-43.6	70-14-45.7	Cumberland	Cape Elizabeth	7	1	4	1	1.6
24-1S2	01/13/01	Q24-1	43-36-03.6	70-14-00.6	Cumberland	Cape Elizabeth	7	1	4	1	7.7
24-1S3	01/13/01	Q24-1	43-34-40.1	70-13-14.9	Cumberland	Cape Elizabeth	7	1	4	1	1
24-1S4	01/13/01	Q24-1	43-33-41.8	70-12-43.9	Cumberland	Cape Elizabeth	7	1	4	1	21.2
25-4L1	01/14/01	25-4	43-39-54.1	70-54-38.9	York	Newfield		3	4	3	
25-3L2	01/14/01	25-3	43-38-2.4	70-56-36.8	York	Newfield		3	4	3	
26-1U1	01/12/01	26-1	43-43-48.4	70-30-16.4	Cumberland	Gorham		0	0	0	
26-1U2	01/12/01	26-1	43-42-55.2	70-49-27.8	York	Limerick		0	0	0	
26-1U3	01/12/01	26-1	43-41-42.6	70-48-51.5	York	Limerick		0	0	0	
26-3U4	01/12/01	26-3	43-39-12.2	70-49-58.4	York	Limerick		0	0	0	
27-2U1	01/05/01	Q27-2	43-44-11.0	70-39-44.3	York	Limington	9	0	0	0	
27-1U2	01/05/01	Q27-1	43-42-46.3	70-43-58.8	York	Limington	9	0	0	0	
27-4L3	01/12/01	27-4	43-37-51.3	70-39-42	York	Hollis		3	4	3	

27-4U4	01/12/01	27-4	43-38-23.5	70-40-21.8	York	Hollis		0	0	0	
27-3U5	01/12/01	27-3	43-40-47.4	70-41-22.7	York	Limington		0	0	0	
27-1L6	01/12/01	27-1	43-42-43.0	70-44-29.2	York	Limington		3	4	3	
28-2U1	01/05/01	Q28-2	43-44-17.8	70-30-12.9	Cumberland	Gorham	9	0	0	0	
28-1U2	01/05/01	Q28-1	43-44-00.2	70-34-07.6	Cumberland	Standish	9	0	0	0	
28-2L3	01/11/01	Q28-2	43-42-13.9	70-30-11.7	Cumberland	Gorham	7	3	4	3	
28-4L4	01/11/01	Q28-4	43-41-13.9	70-31-28.5	York	Buxton	7	3	4	3	
28-2S5	01/28/01	28-2	43-42-40.9	70-30-50.8	Cumberland	Gorham		1	4	1	4.3
28-1U6	1/26/01	28-1	43-43-59.10	70-35-32.4	Cumberland	Standish		0	0	0	
28-4L7	1/25/01	28-4	43-37-39.78	70-31-59.4	York	Buxton		3	4	3	
28-1L8	1/26/01	28-1	43-43-25.26	70-34-31.32	Cumberland	Standish		3	4	3	
28-1L9	1/26/01	28-1	43-43-42.54	70-34-22.62	Cumberland	Standish		3	4	3	
29-4U1	01/05/01	Q29-4	43-38-58.8	70-25-31.4	Cumberland	Gorham	9	0	0	0	
29-2U2	01/05/01	Q29-2	43-42-19.5	70-24-26.5	Cumberland	Gorham	9	0	0	0	
29-1L3	01/05/01	Q29-1	43-43-06.8	70-27-55.7	Cumberland	Gorham	9	3	4	3	
29-4S4	01/11/01	Q29-4	43-40-51.2	70-22-37.8	Cumberland	Westbrook	7	1	4	1	0.5
29-4S5	01/11/01	Q29-4	43-41-00.5	70-22-53.3	Cumberland	Westbrook	7	1	4	1	2.2
29-4L6	01/11/01	Q29-4	43-41-18.4	70-24-19.5	Cumberland	Gorham	7	3	4	3	
29-4S7	01/11/01	Q29-4	43-40-38.8	70-23-29.9	Cumberland	Gorham	7	1	4	1	2.5
29-2U8	01/11/01	Q29-2	43-44-30.4	70-23-44.0	Cumberland	Windham	7	0	0	0	
29-4S9	01/25/01	Q29-4	43-40-44.6	70-23-21.5	Cumberland	Gorham	7	1	4	1	30.5
29-4U10	1/27/01	29-4	43-39-2.7	70-23-52.2	Cumberland	Gorham		0	0	0	
29-4U11	1/27/01	29-4	43-39-48.3	70-25-53.3	Cumberland	Gorham		0	0	0	
29-4U12	1/26/01	29-4	43-39-5.5	70-25-35.3	Cumberland	Gorham		0	0	0	
29-4U13	1/27/01	29-4	43-40-8.7	70-24-50.4	Cumberland	Gorham		0	0	0	
29-2L14	1/27/2001	29-2	43-42-22.3	70-24-27.8	Cumberland	Gorham		3	4	3	
29-2L15	1/27/2001	29-2	43-42-26.7	70-24-56.2	Cumberland	Gorham		3	4	3	
29-2U16	1/27/2001	29-2	43-43-26.3	70-23-55.9	Cumberland	Windham		0	0	0	
29-2U17	1/27/2001	29-2	43-44-27.5	70-23-41.0	Cumberland	Windham		0	0	0	
29-2U18	1/27/2001	29-2	43-44-26.2	70-23-35.6	Cumberland	Windham		0	0	0	
29-1U19	1/28/2001	29-1	43-43-13.4	70-27-15.4	Cumberland	Gorham		0	0	0	
29-1U20	1/28/2001	29-1	43-44-18	70-26-50.1	Cumberland	Gorham		0	0	0	
29-1L21	1/28/2001	29-1	43-44-39.9	70-29-13.3	Cumberland	Gorham		3	4	3	
29-1U22	1/28/2001	29-1	43-43-10.8	70-27-59.7	Cumberland	Gorham		0	0	0	

29-4U23	1/25/2001	29-4	43-40-16.26	70-25-7.80	Cumberland	Gorham		0	0	0	
29-2L24	1/25/2001	29-2	43-43-23.82	70-25-55.50	Cumberland	Gorham		3	4	3	
29-3L25	1/25/2001	29-3	43-37-57.72	70-27-15.66	Cumberland	Gorham		3	4	3	
29-2L26	1/24/2001	29-2	43-44-38.58	70-23-17.34	Cumberland	Windham		3	4	3	
29-4L27	1/24/2001	29-4	43-39-3.48	70-24-7.80	Cumberland	Gorham		3	4	3	
29-3U28	1/25/2001	29-3	43-39-49.8	70-27-34.44	Cumberland	Gorham		0	0	0	
30-2S1	12/26	Q30-2	43-44-33.4	70-17-22.3	Cumberland	Falmouth	10	1	1	1	1.5
30-3S2	12/23	Q30-3	43-38-38.5	70-19-59.1	Cumberland	South Portland	10	1	1	1	6.4
30-3S3	12/23	Q30-3	43-40-24.4	70-19-41.7	Cumberland	Portland	10	1	1	1	0.9
30-3U4	01/25/01	Q30-3	43-40-19.0	70-20-22.3	Cumberland	Westbrook	8	0	0	0	
30-3S5	1/26/01	30-3	43-39-10.92	70-19-16.56	Cumberland	Portland		1	4	1	1.4
30-3S6	1/25/01	30-3	43-38-42.3	70-22-29.22	Cumberland	Westbrook		1	4	1	7
31-1L1	12/26	Q31-1	43-44-25.4	70-13-11.7	Cumberland	Falmouth	10	3	3	3	
31-1S2	12/26	Q31-1	43-43-02.1	70-14-16.3	Cumberland	Falmouth	10	1	1	1	0.8
31-1S3	12/26	Q31-1	43-44-38.8	70-13-43.1	Cumberland	Falmouth	10	1	1	1	5
31-1L4	1/24/01	31-1	43-43-45.84	70-13-22.62	Cumberland	Falmouth		3	4	3	
31-1U5	1/24/01	31-1	43-44-50.82	70-14-46.14	Cumberland	Falmouth		0	0	0	
32-2U1	2/12/01	Q32-1	43-44-54.5	70-00-29.6	Cumberland	Harpswell	0	0	0	0	
35-3L1	01/14/01	35-3	43-45-31.5	70-57-2.9	York	Parsonsfield		3	4	3	
36-4L1	01/14/01	Q36-4	43-46-39.9	70-45-14.9	York	Limington	7	3	4	3	
37-3U1	01/14/01	Q37-3	43-46-05.9	70-43-12.3	York	Limington	7	0	0	0	
37-2U2	01/14/01	Q37-2	43-51-39.4	70-38-45.6	Cumberland	Sebago	7	0	0	0	
37-3L3	3/4/01		43-46-13.2	70-43-31.7	York	Limington		3	4	3	
37-4L4	3/4/01		43-45-47.4	70-39-57.9	York	Limington		3	4	3	
37-3U5	3/4/01		43-46-56.6	70-41-57.1	York	Limington		0	0	0	
37-3U6	2/20/01		43-47-06.2	70-41-14.6	York	Limington		0	0	0	
37-3U7	2/20/01		43-46-37.6	70-43-42.5	York	Limington		0	0	0	
37-2U8	2/20/01		43-49-51.4	70-40-20.3	Cumberland	Baldwin		0	0	0	
38-3U1	2/20/01		43-46-44.2	70-33-30.2	Cumberland	Standish		0	0	0	
39-3U1	12/27	Q39-3	43-46-17.2	70-27-20.4	Cumberland	Gorham	5	0	0	0	
39-3U2	12/27	Q39-3	43-46-29.7	70-27-38.5	Cumberland	Gorham	5	0	0	0	
39-3L3	12/27	Q39-3	43-46-07.8	70-29-10.6	Cumberland	Gorham	5	3	3	3	
39-3L4	12/27	Q39-3	43-46-53.1	70-29-37.6	Cumberland	Standish	5	3	3	3	
39-4U5	12/27	Q39-4	43-46-49.4	70-23-12.0	Cumberland	Windham	5	0	0	0	

39-4S6	12/27	Q39-4	43-45-29.1	70-23-13.3	Cumberland	Windham	5	1	4	1	2.7
39-4S7	12/27	Q39-4	43-47-27.5	70-26-23.6	Cumberland	Windham	5	1	4	1	2.1
39-3U8	2/20/01		43-45-12.0	70-28-02.6	Cumberland	Gorham		0	0	0	
40-1U1	12/26	Q40-1	43-51-12.2	70-19-16.2	Cumberland	Gray	10	0	0	0	
40-1L2	12/26	Q40-1	43-51-39.8	70-19-12.7	Cumberland	Gray	10	3	3	3	
40-2L3	12/26	Q40-2	43-51-28.5	70-18-23.4	Cumberland	Gray	10	3	3	3	
40-2L4	12/26	Q40-2	43-50-40.8	70-16-04.6	Cumberland	North Yarmouth	10	3	3	3	
40-2U5	12/26	Q40-2	43-50-56.4	70-15-03.6	Cumberland	North Yarmouth	10	0	0	0	
40-2L6	12/26	Q40-2	43-51-54.5	70-15-47.2	Cumberland	North Yarmouth	10	3	3	3	
40-2U7	12/26	Q40-2	43-52-25.1	70-17-15.5	Cumberland	Gray	10	0	0	0	
40-1U8	12/26	Q40-1	43-51-49.7	70-22-09.9	Cumberland	Gray	10	0	0	0	
40-1L9	12/26	Q40-1	43-52-01.2	70-21-02.5	Cumberland	Gray	10	3	3	3	
40-3U10	12/26	Q40-3	43-48-18.0	70-22-17.5	Cumberland	Windham	10	0	0	0	
40-4S11	12/26	Q40-4	43-47-46.2	70-18-22.7	Cumberland	Cumberland	10	1	1	1	7.8
40-4S12	12/27	Q40-4	43-46-15.8	70-15-01.1	Cumberland	Cumberland	5	1	2	1	0.3
40-4L13	1/24/01	40-4	43-45-14.16	70-17-28.08	Cumberland	Falmouth		3	4	3	
40-4L14	1/24/01	40-4	43-46-8.52	70-17-53.28	Cumberland	Falmouth		3	4	3	
40-3L15	1/24/01	40-3	43-46-30.12	70-19-39.06	Cumberland	Falmouth		3	4	3	
41-3L1	12/27	Q41-3	43-46-03.9	70-14-09.3	Cumberland	Cumberland	5	3	3	3	
41-3L2	12/27	Q41-3	43-46-19.2	70-14-02.0	Cumberland	Cumberland	5	3	0	3	
41-3U3	12/27	Q41-3	43-46-20.0	70-12-38.2	Cumberland	Cumberland	5	0	0	0	
41-3L4	12/30	Q41-3	43-47-26.6	70-13-06.4	Cumberland	Cumberland	10	3	3	3	
41-1U5	12/30	Q41-1	43-51-19.0	70-13-11.0	Cumberland	North Yarmouth	10	0	0	0	
41-1L6	12/30	Q41-1	43-49-37.6	70-11-23.6	Cumberland	Yarmouth	10	3	3	3	
41-1L7	12/30	Q41-1	43-52-06.5	70-12-38.3	Cumberland	North Yarmouth	10	3	3	3	
41-1L8	12/30	Q41-1	43-51-35.4	70-11-30.8	Cumberland	Pownal	10	3	3	3	
41-2U9	12/30	Q41-2	43-52-30.6	70-10-50.4	Cumberland	Pownal	10	0	0	0	
41-2U10	12/30	Q41-2	43-51-43.9	70-08-30.5	Cumberland	Freeport	10	0	0	0	
41-1L11	12/30	Q41-1	43-49-59.8	70-13-08.4	Cumberland	North Yarmouth	10	3	3	3	
41-3S12	12/27	Q41-3	43-46-42.7	70-13-23.4	Cumberland	Cumberland	5	1	4	1	1
41-3S13	12/27	Q41-3	43-46-49.1	70-13-36.3	Cumberland	Cumberland	5	1	4	1	0.4
41-3S14	12/30	Q41-3	43-48-11.3	70-14-12.3	Cumberland	Cumberland	10	1	4	1	0.6
41-2U15	2/12/01		43-49-15.0	70-08-37.2	Cumberland	Freeport	0	0	0	0	
41-3L16	1/23/01	41-3	43-49-16.80	70-12-4.80	Cumberland	Yarmouth		3	4	3	

41-3L17	1/23/01	41-3	43-49-20.58	70-12-19.02	Cumberland	Yarmouth		3	4	3	
41-3L18	1/23/01	41-3	43-48-43.26	70-12-4.44	Cumberland	Yarmouth		3	4	3	
41-3L19	1/23/01	41-3	43-48-43.38	70-12-7.62	Cumberland	Yarmouth		3	4	3	
41-1L20	1/23/01	41-1	43-49-36.54	70-13-30.90	Cumberland	North Yarmouth		3	4	3	
41-1L21	1/23/01	41-1	43-49-48.78	70-13-25.92	Cumberland	North Yarmouth		3	4	3	
42-1L1	12/24	Q42-1	43-50-15.4	70-04-31.0	Cumberland	Freeport	10	3	4	3	
42-1U2	12/24	Q42-1	43-50-02.1	70-03-44.5	Cumberland	Freeport	10	0	0	0	
42-2U3	12/24	Q42-2	43-51-33.7	70-01-30.5	Cumberland	Brunswick	10	0	0	0	
42-2L4	12/24	Q42-2	43-51-55.4	70-01-22.7	Cumberland	Brunswick	10	3	4	3	
42-1U5	12/24	Q42-1	43-51-42.2	70-04-22.8	Cumberland	Freeport	10	0	0	0	
42-4L6	2/12/01	Q42-4	43-45-57.8	70-00-43.0	Cumberland	Harpswell	0	0	4	3	
42-4U7	2/12/01	Q42-4	43-45-42.7	70-00-48.8	Cumberland	Harpswell	0	0	0	0	
42-4U8	2/12/01	Q42-4	43-45-25.9	70-00-46.8	Cumberland	Harpswell	0	0	0	0	
42-4U9	2/12/01	Q42-4	43-45-03.4	70-00-30.6	Cumberland	Harpswell	0	0	0	0	
43-3U1	2/12/01	Q43-3	43-48-06.6	69-59-05.0	Cumberland	Harpswell	0	0	0	0	
43-4U2	2/12/01	Q43-4	43-48-41.4	69-53-42.3	Cumberland	Harpswell	0	0	0	0	
43-1U3	1/9/01	43-1	43-52-20	69-58-52	Cumberland	Brunswick		0	0	0	
43-1U4	1/9/01	43-1	43-52-3	69-58-50	Cumberland	Brunswick		0	0	0	
43-1U5	1/9/01	43-1	43-51-59	69-58-33	Cumberland	Brunswick		0	0	0	
43-1U6	1/9/01	43-1	43-52-4	69-57-42	Cumberland	Brunswick		0	0	0	
44-1U1	1/9/01	44-1	43-52-20	69-51-8	Sagadahoc	West Bath		0	0	0	
44-3U2	1/9/01	44-3	43-47-59	69-50-49	Sagadahoc	Phippsburg		0	0	0	
48-1L1	03/04/01		43-56-23	70-42-52.4	Cumberland	Sebago		3	4	3	
48-1L2	3/4/01		43-58-15.6	70-42-34.4	Cumberland	Bridgton		3	4	3	
48-2U3	3/4/01		43-58-32.6	70-41-27.6	Cumberland	Bridgton		0	0	0	
48-3U4	2/20/01		43-53-09.5	70-41-25.0	Cumberland	Sebago		0	0	0	
49-2L1	3/4/01		43-57-32.6	70-33-36.1	Cumberland	Casco		3	4	3	
49-2U2	2/20/01		43-56-21.2	70-31-21.2	Cumberland	Casco		0	0	0	
50-1L1	1/2	Q50-1	43-58-13.0	70-26-10.5	Cumberland	Raymond	8	3	3	3	
50-1U2	2/21/01		43-57-58.4	70-27-59.2	Cumberland	Raymond		0	0	0	
50-1U3	2/21/01		44-00-00.3	70-27-45.5	Cumberland	Casco		0	0	0	
50-2U4	2/21/01		43-58-48.6	70-25-40.3	Cumberland	Raymond		0	0	0	
50-4U5	2/21/01		43-55-39.0	70-22-39.0	Cumberland	Gray		0	0	0	
51-4U1	1/2	Q51-4	43-54-09.0	70-15-38.7	Cumberland	New Gloucester	8	0	0	0	

51-1L2	1/2	Q51-1	43-56-58.7	70-20-20.7	Cumberland	New Gloucester	8	3	4	3	
51-1L3	1/2	Q51-1	43-56-27.5	70-19-55.9	Cumberland	New Gloucester	8	3	3	3	
51-1U4	1/2	Q51-1	43-59-18.6	70-21-55.1	Androscoggin	Poland	8	0	0	0	
51-1U5	1/2	Q51-1	43-58-01.0	70-21-58.7	Cumberland	New Gloucester	8	0	0	0	
52-3L1	12/30	Q52-3	43-54-07.1	70-12-22.5	Cumberland	Pownal	10	3	3	3	
52-3U2	12/30	Q52-3	43-54-18.7	70-13-56.5	Cumberland	Pownal	10	0	0	0	
52-3U3	12/30	Q52-3	43-54-46.8	70-11-58.0	Cumberland	Pownal	10	0	0	0	
52-4U4	12/30	Q52-4	43-55-10.8	70-09-46.4	Cumberland	Pownal	10	0	0	0	
52-4L5	12/30	Q52-4	43-55-53.1	70-09-25.9	Androscoggin	Durham	10	3	3	3	
53-4U1	12/25	Q53-4	43-55-01.1	70-01-09.2	Cumberland	Brunswick	10	0	0	0	
53-4U2	12/25	Q53-4	43-54-40.4	70-00-19.6	Cumberland	Brunswick	10	0	0	0	
53-4L3	12/25	Q53-4	43-54-39.0	70-00-39	Cumberland	Brunswick	10	3	0	3	
53-4L4	12/25	Q53-4	43-55-24.5	70-02-35.5	Cumberland	Brunswick	10	3	0	3	
53-3L5	12/25	Q53-3	43-52-41.2	70-06-05.2	Cumberland	Freeport	10	3	3	3	
53-3U6	12/25	Q53-3	43-54-54.8	70-05-20.3	Cumberland	Freeport	10	0	0	0	
53-3L7	12/25	Q53-3	43-55-30.5	70-05-23.2	Cumberland	Freeport	10	3	3	3	
53-1U8	12/25	Q53-1	43-58-24.6	70-03-39.8	Androscoggin	Durham	10	0	0	0	
53-4L9	12/25	Q53-4	43-55-43.7	70-00-04.6	Cumberland	Brunswick	10	3	3	3	
54-2U1	1/10/01	54-2	43-56-18	69-56-11	Sagadahoc	Topsham		0	0	0	
54-2L2	1/10/01	54-2	43-58-14	69-53-44	Sagadahoc	Topsham		3	4	3	
54-2U3	1/10/01	54-2	43-58-44	69-53-24	Sagadahoc	Bowdoinham		0	0	0	
54-2U4	1/10/01	54-2	43-57-56	69-56-9	Sagadahoc	Topsham		0	0	0	
55-3U1	1/9/01	55-3	43-53-52	69-50-31	Sagadahoc	West Bath		0	0	0	
61-2U1	2/13/01	61-2	44-04-25.4	70-24-49.9	Androscoggin	Poland		0	0	0	
61-1U2	2/19/01	61-1	44-04-06.1	70-27-04.6	Androscoggin	Poland		0	0	0	
62-1L1	2/19/01	62-1	44-04-19.3	70-19-56.7	Androscoggin	Poland		3	4	3	
62-2L2	2/19/01	62-2	44-04-47.0	70-17-12.6	Androscoggin	Auburn		3	4	3	
62-3L3	2/19/01	62-3	44-02-42.2	70-18-18.6	Androscoggin	Auburn		3	4	3	
62-3L4	2/19/01	62-3	44-00-36.2	70-21-57.7	Androscoggin	Poland		3	4	3	
62-4L5	2/19/01	62-4	44-01-45.3	70-17-17.1	Androscoggin	Auburn		3	4	3	
63-4U1	2/19/01	63-4	44-03-00.2	70-08-17.5	Androscoggin	Lewiston		0	0	0	
63-3L2	2/19/01	63-3	44-03-5.5	70-13-46.1	Androscoggin	Auburn		3	0	3	
63-2L3	2/19/01	63-2	44-04-45.9	70-19-54.8	Androscoggin	Poland		3	4	3	
63-2L4	2/19/01	63-2	44-05-00.1	70-10-40.6	Androscoggin	Lewiston		3	4	3	

63-4L5	2/19/01	63-4	44-03-00.7	70-08-16.3	Androscoggin	Lewiston		3	4	3	
63-3U6	2/19/01	63-3	44-02-21.4	70-13-23.0	Androscoggin	Auburn		0	0	0	
63-3U7	2/11/01		44-02-57.6	70-14-9.3	Androscoggin	Auburn		0	0	0	
63-3U8	2/11/01		44-01-24.9	70-12-51.7	Androscoggin	Auburn		0	0	0	
64-3L1	2/13/2001	Q64-3	44-03-12.0	70-04-18.1	Androscoggin	Lisbon	0	0	4	3	
64-2L2	2/13/2001	64-2	44-04-04.0	70-02-19.2	Androscoggin	Sabattus	0	0	4	3	
64-4L3	2/13/2001	64-4	44-02-23.5	70-00-49.1	Sagadahoc	Bowdoin	0	3	4	3	
64-3U4		64-3	44-02-13.3	70-07-3.4	Androscoggin	Lisbon		0	0	0	
65-1U1	2/13/2001	65-1	44-05-18.4	69-59-21.6	Sagadahoc	Bowdoin	0	0	0	0	
65-3L2	1/10/2001	65-3	44-00-59.2	69-56-39.9	Sagadahoc	Bowdoin		3	4	3	
65-3U3	2/13/2001	65-3	44-01-20.2	69-59-22.1	Sagadahoc	Bowdoin	0	0	0	0	
65-4L4	1/10/2001	65-4	44-00-59.7	69-54-59.6	Sagadahoc	Bowdoinham		3	4	3	
65-4L5	2/13/2001	65-4	44-03-38.1	69-54-22.7	Sagadahoc	Bowdoinham	0	3	4	3	
65-2U6	2/13/2001		44-05-12.5	69-54-12.8	Sagadahoc	Bowdoinham	0	0	0	0	
65-4L7	1/10/2001	65-4	44-1-45	69-56-8	Sagadahoc	Bowdoin		3	4	3	
65-4U8	1/10/2001	65-4	44-3-34	69-54-25	Sagadahoc	Bowdoinham		0	0	0	
30	1/2003		43-33-47.7	70-16-56.4						3	
31	1/2003		43-34-13.2	70-16-51						0	
32	1/2003		43-34-27.6	70-16-40	Cumberland	Scarborough				1	2
33	1/2003		43-35-29.1	70-16-36.6						3	
34	1/2003		43-35-06.4	70-15-50.2						3	
35	1/2003		43-34-50.7	70-14-56	Cumberland	Cape Elizabeth				1	4
36	1/2003		43-30-03.8	70-23-49.9						0	
37	1/2003		43-29-44	70-23-16						0	
38	1/2003		43-24-29.3	70-23-26.9						0	
39	1/2003		43-25-31.7	70-23-48.1						0	
40	1/2003		43-24-11.6	70-25-46.4						0	
41	1/2003		43-23-09.6	70-26-34.7						0	
42	1/2003		43-23-32	70-26-36.8						0	
43	1/2003		43-21-21	70-31-44.8						0	
44	1/2003		43-21-35.5	70-31-37.5						0	
45	1/2003		43-21-34	70-31-53.9						0	
46	1/2003		43-21-07.3	70-33-33.5						0	
47	1/2003		43-17-59	70-34-58.3						0	

48	1/2003		43-20-17.5	70-33-51.8						0	
49	1/2003		43-19-56.4	70-33-32.9	York	Wells				1	8
50	1/2003		43-19-52.2	70-34-11.4	York	Wells				1	<2
51	1/2003		43-18-55.7	70-34-48.9						0	
52	1/2003		43-17-40.1	70-34-58.5						0	
53	1/2003		43-17-11.8	70-34-55.4						0	
54	1/2003		43-16-57.3	70-35-06.2						0	
55	1/2003		43-16-44	70-35-30.1						0	
57	1/2003		43-06-31.7	70-39-33.1						0	
83	1/2003		43-35-04.3	70-15-34	Cumberland	Scarborough				1	<2
6e	n/a		43.5606	70.2634	Cumberland	Cape Elizabeth				1	>2
6h	n/a		43.5795	70.3543	Cumberland	Scarborough				1	2
Wells Reserve	n/a		43.3436	70.5514	York	Wells				1	40.5

Appendix C A minimum population estimate for New England cottontail (NEC) was calculated using recent survey information (Appendix B) and estimates of NEC densities based on patch size (Barbour and Litvaitis 1993). Patches ≤ 3 ha (7.5 acres) were estimated to have 2 NEC / ha, while patches > 3 ha (7.5 acres) were estimated to have 1 NEC / ha. The estimate for the number of cottontails living in each habitat patch is given below. It was not feasible to search every potential habitat patch in Maine for NEC; therefore, the total number of NEC determined by this method should be considered a minimum estimate.

Site	Area (ha)	Number of NEC in patch
32	2.0	4
35	4.0	4
49	8.0	8
50	2.0	4
83	2.0	4
1-2S2	1.0	2
15-2S12	1.0	2
21-3S14	1.0	2
21-4S1	2.9	6
21-4S11	1.9	4
2-1S1	11.4	11
2-1S3	0.6	1
22-3S2	6.0	6
22-3S9	1.3	3
23-1S1	5.3	5
23-1S11	1.7	3
23-1S13	0.9	2
23-4S21	18.0	18
23-2S17	0.6	1
23-2S5	2.6	5
23-2S6	2.3	5
23-2S9	1.8	4
23-4S14	0.3	1
23-4S15	2.5	5
24-1S1	1.6	3
24-1S2	7.7	8
24-1S3	1.0	2
24-1S4	21.2	21
28-2S5	4.3	4

Site	Area (ha)	Number of NEC in patch
29-4S4	0.5	1
29-4S5	2.2	4
29-4S7	2.5	5
29-4S9	30.5	30
30-2S1	1.5	3
30-3S2	6.4	6
30-3S3	0.9	2
30-3S5	1.4	3
30-3S6	7.0	7
31-1S2	0.8	2
31-1S3	5.0	5
39-4S6	2.7	5
39-4S7	2.1	4
40-4S11	7.8	8
40-4S12	0.3	1
41-3S12	1.0	2
41-3S13	0.4	1
41-3S14	0.6	1
4-2S3	0.4	1
4-2S4	1.0	2
4-2S5	1.0	2
4-4S2	0.5	1
5-3S4	0.8	2
5-3S5	0.5	1
5-4S1	4.3	4
5-4S2	0.5	1
8-4S8	1.4	3
8-4S9	15.7	16
9-3S3	0.2	1
Wells	40.5	41
6h	2.0	2
6e	2.0	2
	Total	**316**