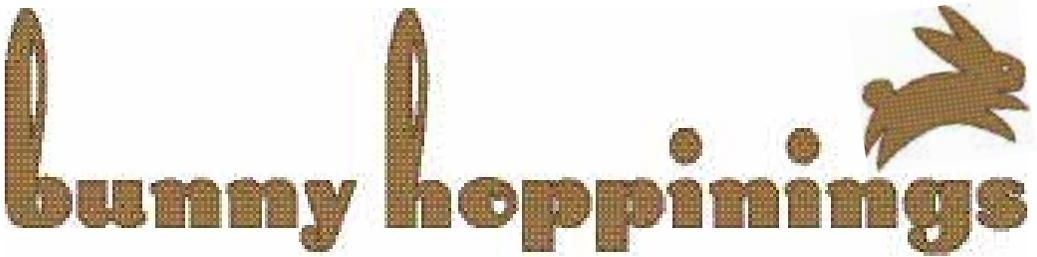


# bunny hoppinings



**Our only native cottontail has been replaced by a nearly identical-looking alien, seemingly body-snatched before our eyes in just the last 50 years. The range of our only native hare is likely to retreat northward beyond our borders in the next 50 years. What do we really know about our vanishing rabbits?**

by Peter G. Mirick

It's hard not to love bunnies. Everybody does: coyote, fox, fisher, mink, weasel, larger hawks and owls, big snakes, house cats, bobcats, domestic dogs, and people. Not to mention any number of trematodes, cestodes, nematodes, lice, fleas, and ticks. Bunnies seem to have evolved as the ultimate prey: profusely abundant, fast reproducing, easily dispatched (once you catch them), and possessing a satisfying amount of nutritious meat. They are the daily bread of a thousand predators, a broad band in the upper foundational layer of temperate food chains across the globe. So popular are they that several species have been transplanted intercontinentally, allowing some to become invasive species that have significantly impacted the ecosystems into which they were introduced.

Here in the Commonwealth we have only two native species, the New England cottontail, *Sylvilagus transitionalis*, and the snowshoe hare, *Lepus americanus*. Neither could be said to be thriving. The New England cottontail has exhibited an extreme ( $> 75\%$ ) decline in numbers and range over just the past few decades, largely replaced on the landscape by the introduced eastern cottontail, *Sylvilagus floridanus*. Its continued survival appears to be in imminent jeopardy and it is now a candidate for federal endangered species listing. Meanwhile, the snowshoe hare, a northern mammal ideally adapted to

boreal forest regions with cold winters and deep snow cover, could almost be a poster child for the wildlife implications of climate change. Maybe it's time we gave our Bay State bunnies a little more attention.

## Lagomorphs

Cottontails, which are rabbits, should not be confused with hares, which are hares, and since people seem to have a predilection to use the terms interchangeably, and since both can be lumped under the vernacular *bunny*, we might as well set the record straight. Rabbits and hares are lagomorphs, meaning they belong to the Order Lagomorpha, which also includes a diverse family of exceptionally cute little furballs called pikas (none of which live in New England, unfortunately, but some of which, because they live in isolated alpine habitats or "sky islands" in the form of mountains from which they cannot depart alive, may already be critically endangered by climate change). Lagomorphs were once classified as rodents despite their unique dentition (in particular, a set of rounded "peg teeth" directly behind their upper incisors) and they were not taxonomically emancipated from the rats and mice until 1912. They may actually be more closely related to the primates than they are to the rodents.

Rabbits and hares share a number of obvious characteristics including a high reproductive rate and long, indepen-



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*Hares are bigger, longer-legged, and just plain tougher and lankier than cottontails. This Snowshoe Hare, in summer coat, also has coarser fur than a cottontail.*

dently controlled ears that offer superb directional hearing and also function as thermal radiators when their owners become overheated. They have a cleft upper lip that aids them in food manipulation. Their skeletal structure is evolved to handle the multiple g-force stresses of fast acceleration and sudden changes in direction when in full flight. Their hind legs are longer and much stronger than their front legs, and although they will use a digitigrade walking gait, their standard locomotion is a plantigrade hop. They tend to be nocturnal, or at least crepuscular (active at dawn and dusk), and most have excellent vision. Their typically large eyes and narrow skull, somewhat reminiscent of the woodcock's in design, allow them continual, near-360° monitoring of their surroundings; a very useful ability for animals that could accurately be labeled "universal prey." When injured or captured, all of our lagomorphs are likely to produce surprisingly loud squeals full of heart rending terror. Otherwise they rarely make any noise at all other than some soft calls exchanged between mothers

and young. This is to be expected in a non-social species: they just don't have much need for auditory communication that could alert predators to their presence. Our lagomorphs do thump their feet when alarmed, however, and thus may altruistically alert nearby individuals to the approach of danger.

## Refecation

All three of our lagomorphs practice refecation, a sort of "pseudoruminantion" that allows them to extract maximum benefit from their food without having to carry the four stomachs of a ruminant around with them. They do this with the aid of a special food storage/fermentation vat of an organ called the *cecum*, located between the small and large intestines. The short version goes like this:

The rabbit consumes bark and greenery, the stomach churns it up, and the small intestine absorbs whatever nutrients are present before squirting it all into the large intestine. The large intestine, which cannot absorb nutrients, separates the high fiber, low nutrient material from the high nutrient, low fiber material passing



*More delicate in size, bone structure, and ability to withstand cold and snow, the Eastern Cottontail has a finer, shorter coat than its larger snowshoe cousin.*

through it. The low nutrient material is packed into hard pellets and deposited as waste, resulting in those familiar batches of “rabbit raisins” all outdoors people readily recognize. The high nutrient material is sent back into the cecum where bacterial action breaks it down into sugars, amino acids, and other absorbable nutrients. Following fermentation, and always timed to be deposited during the animal’s daily resting period, the cecum squirts the wholesome mixture back into the large intestine, which packs it into special soft, greenish pellets, called *cecotropes*, and sends them out to be immediately reingested by the rabbit. The nutrients are then absorbed in the small intestine on the second pass. Thus the animal acquires a number of precious nutrients and crucial vitamins that would otherwise have been lost as waste. It is quite a feat of bioengineering.

In general, hares are larger than rabbits, some species reaching weights of 10 pounds or more, with longer ears, longer legs and feet, larger nostrils (for rapid air cycling), and lankier bodies built for speed. Hares are just plain tougher

than rabbits (although not necessarily so when served at the table) and they don’t dig or live in burrows. They are solitary in their habits and have never been domesticated. They typically feed at night and spend their days quietly concealed in thick, overhanging cover or in the shadow of a rock ledge or boulder. No carefully prepared, fur-lined nests for them. A mother hare (doe) simply picks a secluded spot, flattens a small area in the vegetation, and gives birth to precocial young, called *leverets*, that enter the world fully furred and with their eyes open. Leverets can get around when just a day old, and if threatened, they rarely go meekly into that red maw, but growl and fight for their lives. The doe nurses them just once a day, during evening twilight, and they are fully weaned and on their own at 4-5 weeks of age.

Rabbits are generally more delicate creatures than hares, rarely reaching weights of 5 pounds. (The biggest in North America is the swamp rabbit, *S. aquaticus*, a semi-aquatic rabbit that famously attacked President Jimmy Carter in 1979.) Worldwide, most species live in comfortable burrows. The European

rabbits that were the main characters in Richard Adams' *Watership Down* (and which were domesticated by the Romans some 3,000 years ago) live in social groups in communal burrow systems called *warrens*. Cottontails are an exception among the rabbits in that they follow the minimal burrowing habits and solitary lifestyle of the hares, although they will make occasional use of hollow logs, woodchuck holes, or natural cavities under stumps and rocks, especially during periods of cold, wet weather. More often they spend their days in a *form*, a cup-like "bed" concealed in long grass, weeds, or thick brush that fits the animal's lower contours and insulates it from weather and prying eyes. Cottontail does dig shallow hollows and line them with layers of grass, fecal pellets, and their own fur to make a nest. Their young are altricial, born nearly naked and with

their eyes closed. It takes them more than two weeks to grow fur, open their eyes and develop sufficiently to leave the nest, but like hares, they mature very quickly and are weaned and fully independent at 4-5 weeks of age.

## Snowshoe

Although the European hare, the European rabbit, and the black-tailed jack-rabbit were stocked in Massachusetts in the last century, establishing resident populations in (respectively) Berkshire County, the Boston Harbor Islands, and on Nantucket Island, these populations now appear to have failed. The snowshoe hare was also stocked extensively in the Commonwealth in the last century, mostly in response to a major decline of the population following the drastic changes in habitat and land use that occurred in



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*Typical of all New England lagomorph behavior, these Snowshoe Hares feed in close proximity to cover where they can instantly retreat if a predator (such as the Red Fox, inset) is detected. The ability to perceive the presence of a predator earlier than the competition is believed to be one of the Eastern Cottontail's superior survival skills; one of the reasons it has been able to replace the New England Cottontail in all but the most predator-impenetrable habitats.*



*This Snowshoe Hare in winter coat displays the oversize hind feet – an adaptation for living in snowy, northern regions – that gave the species its common name.*

the 19<sup>th</sup> century. Tens of thousands of wild-caught, Canadian snowshoes (most from New Brunswick) were released by the Division of Fisheries & Wildlife and authorized sportsmen's groups from 1891 through the 1980s.

Snowshoes are natives, however, and the stocked animals did little more than temporarily supplement existing numbers, providing additional game for hunters and their dogs just as stocked trout provide supplemental game for anglers. While the snowshoe population has certainly declined in range and numbers – and will likely continue to do so as habitat succession, habitat destruction, and climate change continue – for now it remains locally common in scattered habitats throughout the state except for Dukes and possibly Nantucket counties.

The snowshoe hare weighs from 2-5 pounds and grows to a length of 15-22 inches, making it a little bigger and longer than either of our cottontails (14-18 inches; 2-3 pounds). It ranges from Alaska to Newfoundland, along most of the northern border of the United States, and far southward along higher-elevation

fingers of distribution that follow the Appalachian, Rocky, and Sierra Nevada mountain ranges. It gets its name from its exceptionally large hind feet. These feet are heavily furred, even on the soles, and their four digits can be spread widely apart. This provides the animal with exceptional predator-escaping footing in soft snow, allows them to stand on their hind feet in snow to reach overhead food sources, and leaves a track as distinctive as Karl Malden's nose. When in a hurry they can cover ground in 8-10-foot jumps and hit speeds of 30 mph.

The snowshoe is also called the “varying hare” because its coat changes color twice each year, going from a summer brown to a winter white and back again. These molts take about 10 weeks to complete and take place from October-December and March-May. The autumn molt begins on the ears and feet and ends on the back, while the spring molt starts on the face and body and ends on the ears and feet. The timing of these color changes is always a gamble: sometimes the snows come early or late, and in Massachusetts, of course, sometimes there is no snow cover at all for periods in the



*Winter fodder for both Snowshoe Hare and our cottontails consists of bark, buds, and twigs.*

seedlings in the cold ones. Trappers have noted they sometimes eat meat used to bait traps, so they probably take a few nibbles on carrion, especially bones, if the opportunity presents itself. Most individuals have a home range of 10-25 acres and display daily movements covering around 5 acres, but much depends on the quality of the habitat and the proximity of food sources to the cover of the daytime bed. It is common for individuals to use the same trails habitually, especially in swamp habitats, producing well-worn paths like those of a porcupine. The preferred habitats where the highest densities of snowshoes occur are lowland conifer forests, young aspen stands, and spruce and cedar swamps, but snowshoes can be found almost anywhere in mixed forest/swamp/old field habitats throughout most of the state.

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middle of winter. While a brown animal (like either of our cottontails) can stick to thickets and shadowy hollows for cover and manage to survive our temperate winters (especially in years when snows are light and not long-lasting; they suffer if winters are long and the snow is deep), it appears that a white animal on a brown forest floor is a high contrast beacon for predators. This means that if the snow line retreats north as climate change progresses, it is likely that the range of the snowshoe will retreat along with it.

## Varying Tastes

Snowshoes eat a great variety of vegetation, and, like their coats, their tastes change with the seasons. They go from clover, grasses, ferns, and berries in the warmer months to bark, buds, and tree

Snowshoes breed from March through August. Courting may involve violent, even mortal battles between males. Mating events are usually preceded by long chases, bizarre vertical leaps, and much jumping over/running under each other, with both sexes urinating on each other during the process. (Cottontails do the same thing; talk about being “mad as a March hare”!) Females in Massachusetts usually produce 2 to 4 litters per year, with litters numbering 2 to 4 leverets. Those that survive are sexually mature by the following spring, but very few survive for more than 2 or 3 years.

There are many interesting aspects to the snowshoe, perhaps the foremost being that northern populations display cyclic fluctuations between abundance and scarcity, with peak-to-peak inter-

vals lasting about a decade. Population density can vary between 1 and 10,000 animals per square mile! While predation has been ruled out (hare density influences predator density, not the other way around) research continues to try to determine if these famous fluctuations, first documented in the 19<sup>th</sup> century, are influenced by disease, food availability, social issues (overcrowding), or some other factor or group of factors. The species is known to suffer from a unique “shock disease” that can affect entire populations and appears to be unrelated to any pathogen. Afflicted animals suffer liver degeneration and hypoglycemia, but the cause of the fatal syndrome remains a mystery.

## Cottontail Issues

The most common rabbit in Massachusetts today is undoubtedly the eastern cottontail (EC), the one you see munching weeds in the backyard around sunset; the one that mowed through all your string beans and sprouting flowers overnight last May; but also the one that did not dig up your bulbs (because rabbits, unlike rodents, don’t dig up bulbs and shouldn’t be falsely accused of such



Photo © by Bill Byrne

shenanigans). It is now a ubiquitous mammal in Massachusetts, thriving wherever it can find a little cover and lots of low greenery (which pretty much describes suburbia). Most authorities believe the first ones stocked in the Commonwealth were released by hunters on Nantucket sometime in the last quarter of the 19<sup>th</sup> century.

Hunters loved the EC because, unlike the New England cottontail (NEC), which tends to “go to ground” immediately when pursued, this rabbit usually runs, taking its pursuers on lengthy, circuitous chases. During the heyday of wildlife introductions in the first half of the 20<sup>th</sup> century, more than 16,000 ECs were transported from the midwestern states and released here, and another 4,600 were raised at a MDFW game farm and released. Today the EC can be found in every county of the Commonwealth and appears to greatly outnumber and hold more ground in all of them than the NEC, which is now extirpated from Dukes and Nantucket counties and may already be absent from at least a couple of others.

The EC now ranges over most of the continent below the Canadian border, but it appears to have evolved in the multitudinous edge habitats of the prairies and seems best adapted to mixed field/forest habitat. Conversely, the NEC appears best adapted to high density thicket habitats; those which occur ephemerally following abandoned beaver ponds, forest fires, ice storms, tornadoes, hurricanes, and flooding, to name a few. Thickets are areas with high stem density, and this appears to be crucial for NEC habitat.

High stem density areas where NECs may be found include young forests (regenerating after natural disturbances like those mentioned above, or after timber harvest); agricultural lands reverting to “old field” habitats; areas that have been mechanically cleared and are regenerating dense woody cover (such as powerline cuts and railroad corridors); shrub

*While New England Cottontails are often impossible to positively distinguish from Eastern Cottontails unless they are in the hand, it is now very probable that any cottontail seen in a suburban setting rather than in (or in close vicinity to) extremely dense thicket habitat is an Eastern Cottontail.*

swamps and brushy areas near beaver flowages; dense upland shrub thickets (composed of native shrubs, brambles, and greenbriar); and coastal shrublands with frequent wind and salt spray.

It is unlikely that either species can live in contiguous, mature, closed-canopy forest; they both need open-canopy habitats, but one needs small openings, while the other can use any size opening. Civilization is prone to making big openings, and unlike nature, it doesn't typically allow them to close up and reopen again.

## EC vs. NEC

As John Litvaitis of the University of New Hampshire so elegantly demonstrated with his continuing research on the two species (see our #4, 2002 issue), the EC can pick up the airborne approach of a Great Horned Owl at a distance of 70 feet, while the NEC, with its smaller, less effective eyes, doesn't react until the predator

has closed the gap to 30 feet. NECs seem well aware of their sensory limitations and do not venture beyond the edges of the high stem density habitats that have cradled them for thousands of years. The EC does not have this limitation, however. A habitat generalist, it is better adapted to fragmented forests and farmlands than its more specialized cousin, and it thrives in the mixed field/forest edges of suburbia. The NEC appears to require habitats of sufficient stem density and impenetrability that predators are not cause for alarm unless they get within 30 feet.

Both species are frustratingly similar in their looks, habits, and behavior. They have two or three litters a year, from March or April through September, five to six young per litter. Like the snowshoe hare, they switch from a summer diet of grasses and leafy vegetation to a winter diet of bark, twigs, and buds. They can both jump 10-15 feet when they are in a hurry, and both can hit speeds ap-



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*Research conducted on our cottontails to date indicates that the New England Cottontail can only compete effectively with the Eastern Cottontail in very high stem density, early successional habitats. This habitat is of limited duration; continual natural (fire, ice) or artificial (logging) disturbance is necessary to maintain it.*



*Unlike baby hares, called leverets, which are born open-eyed and fully furred, baby cottontails are altricial, born almost furless and with eyes closed. This pair of young cottontails is about 3 weeks old. Interestingly, despite their differences at birth, our hare and cottontails take about the same amount of time to be weaned.*

proaching 20 mph in a dash. While home range sizes of up to 40 acres have been reported, the late MassWildlife biologist Jim McDonough, who conducted ground-breaking research on cottontails in the 1950s, found the average home range size was less than 1.5 acres. He also found the NEC bred later in the spring than did the EC, but springs being what they are in New England, it is doubtful this provides the EC with any significant advantage over the NEC.

But something has tipped the scales, something has caused the formerly widespread native's range to contract and become spotty, and the spots, based on the limited survey data available, to become smaller, and in many cases to wink out altogether. The NEC's range has shrunk by 86%, and some 60% of the spots or "habitat patches" where it still occurs are now considered population sinks. These are habitat patches with characteristics that drew in NECs from some other patch, but are not of sufficient size or quality to maintain a local, productive population. Such poor quality habitat patches "drain" the population rather than replenish it with new NECs.

In Massachusetts the NEC was once found statewide. However, a survey con-

ducted from 1990-1993 found NECs in only 6 counties. The EC was found in 13 of 14 counties. To our north, the situation is not any better. A 2008 New Hampshire survey found NECs in only nine of 23 sites where they were found in 2003, while Maine found NECs in only 14 of 80 sites previously occupied in 2004.

Concerns about the NEC's long-term population decline prompted the USFWS to propose the NEC as a candidate for listing under the U.S. Endangered Species Act. It is no surprise then that the NEC is identified a "species of greatest conservation need" (SGCN) in the wildlife action plans of every state within the NEC's range, including MassWildlife's Comprehensive Wildlife Conservation Strategies (state wildlife action plan) which you can view online at [www.mass.gov/masswildlife](http://www.mass.gov/masswildlife).

## **Habitat is the Key**

The statistics on the NEC beg the question: What is causing this population decline? Just as "location, location, location" is the prime factor in real estate, "habitat, habitat, habitat" is the prime factor in supporting the NEC. John Litvaitis, a leading researcher of the NEC, has concluded that the loss of the species' primary habitats to development,

fragmentation, and forest succession is its main problem. It would seem that for the NEC, neither natural nor human disturbances have created sufficient habitat to counteract these landscape changes and land practices.

Adding to the NEC's problem, there is also evidence that the EC may be out-competing the NEC for habitat. The NEC was known to use a much broader variety of habitats prior to the introduction and expansion of the EC population. This suggests that the EC outcompetes the NEC in most habitats except those with very high stem density (thickets). Since thicket habitat is of limited size and fleeting in duration, NECs must be able to move on to the next patch when the one they are inhabiting begins to mature into something else.

If the ECs already dominate much of the intervening habitats, then odds are good that NECs will have to travel further – and travelling through unfamiliar territory is always perilous – in their search for new, higher quality habitat where they will have more of an advantage. Even though captive trials indicate neither species displays an advantage in physical domination of the other, the EC is likely more adaptable and competitive over a broader range of habitats, possibly due to its advantage in earlier detection of predators. Still, the NEC is vanishing from parts of its range where the EC is not present, so factors other than competition with the EC are involved.

One possibility is that invasive plants may be a contributing factor in the NEC's decline. One of the few dietary studies on the two cottontails suggested that the EC is adapted to a wider variety of foods than the NEC. Is it possible then that the EC can feed on more of these aliens than the NEC? Have alien plants usurped so much of the habitat from native plants that the NEC can no longer feed its provincial tastes? Currently we just don't know.

## Management and Surveys

So what conservation actions can be taken to stem and reverse the downward trend of the NEC population and maintain viable and healthy numbers throughout the range of the species? Massachusetts, along with five other states (New Hampshire, Connecticut, Rhode Island, Maine,

and New York), is now working together with the USFWS and other conservation partners both public and private in the Rangewide New England Cottontail Initiative. The Initiative is focused on creating and restoring 1,200 acres of NEC habitat by creating 50 new habitat patches across the species' range. The target goal is to increase the NEC numbers by at least 720 animals and support a viable, long-term population. The Rangewide NEC Initiative is just gearing up to begin in 2010 and will use federal and state matching funds over the next 3 years.

In addition to this habitat initiative, Massachusetts and its partner states and organizations will be trying to address another challenge: how to survey for NECs and identify potential NEC habitat statewide. The root of the challenge is that there is no easy way to tell the difference between living NECs and ECs (although there are obvious differences in skull characteristics) so there is no way for biologists to solicit a voluntary army of observer/reporters to help us keep tabs on the situation (as we could with, say, robins, porcupines, or even garter snakes). Unless you have the rabbit in hand, it is almost impossible to examine their often subtle external differences in sufficient detail to be certain of the species. About all you can tell at a glance is that if it has a white spot or blaze on the forehead, it's an EC, not an NEC, all of which lack this marking. Unfortunately, the converse isn't true, since about half of the ECs also lack this marking.

Fortunately, DNA testing of fresh pellets, like skull analysis, can be used to accurately distinguish between the two species. In the past, MassWildlife used skulls from roadkilled, injured, sick, and harvested rabbits to survey our rabbit species. Most of the skulls were voluntarily collected and submitted to us by the public. The surveys were conducted in 1979, 1981, 1991-1993, and 2000-2003. Future efforts to identify and monitor NEC occurrence within Massachusetts and at specific management sites will likely involve both skull collections and DNA analysis of pellets. Other conservation efforts may include introductions of NECs from managed source habitats or supplemental breeding sites (such as one we attempted to establish on Grape Island in Weymouth in 1985).

One thing that will definitely be part of our NEC conservation efforts is the creation of thicket habitat: the young forest and shrubland, high stem density habitat that is not only crucial to the conservation of the NEC, but also a host of other species from insects to ruffed grouse to bobcats. This is where MassWildlife's Forestry and Upland Habitat Program takes center stage. Among its primary goals for all forest lands controlled by the agency is to bring 15-20% of that forest habitat to a young age through active management and timber harvesting.

While active forest management through logging is sometimes controversial, it is necessary to maintain forest diversity – and forest is the primary habitat of New England. If we don't conduct this kind of forest management, we risk losing the natural diversity of our native wildlife species. A quilt or mosaic should not be made of identical components, and neither should the New England forest. It is as simple as that. There is considerable incentive to increase the pace of young forest creation when the NEC seems to be disappearing so rapidly.

The NEC can be conserved on managed habitat (thicket) patches through

timber harvesting, brush mulching, mowing, and prescribed burning (which throughout its evolution were provided by the work of beavers, floods, and forest fires). The NEC should, as the local species best adapted to the local (though now thoroughly fragmented) thickets, be able to hold its own in competition with the EC flatlanders in this specific habitat. The habitat patches will need to be a minimum of 10- 25 acres in size, and ideally adjacent to or connected to each other so that animals can disperse safely between them.

Questions about the distances between patches and how they relate to NEC survival must be answered to understand how best to increase and support NEC populations. As their ephemeral habitat is lost or degraded due to development, fragmentation, and forest maturation, the NEC will continue to face many potential threats on a landscape that must now be, to the NEC, an alien countryside the likes of which their evolution in New England could never have prepared them.

Stay tuned. The unfolding story of New England's lagomorphs is far from over....



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