Report by the Dover Board of Health concerning the health hazard of Lyme Disease, its relationship to deer ticks and deer density.

Lyme disease in humans is due to an infection with the bacterium (spirochete) called *Borrelia burgdorferi*. It is the most common tick-borne disease in the US. The white-footed mouse is the primary animal reservoir for *Borrelia*, with some small birds as secondary. Black-legged ticks or deer ticks (*Ixodes scapularis*) are the responsible carrier (vector) of *Borrelia* between mice and humans.

In order to evaluate the health hazard posed to humans by infected deer ticks, it is essential to understand the 2-year life cycle of the deer tick as summarized below and shown in Figure 1 (Page 2).

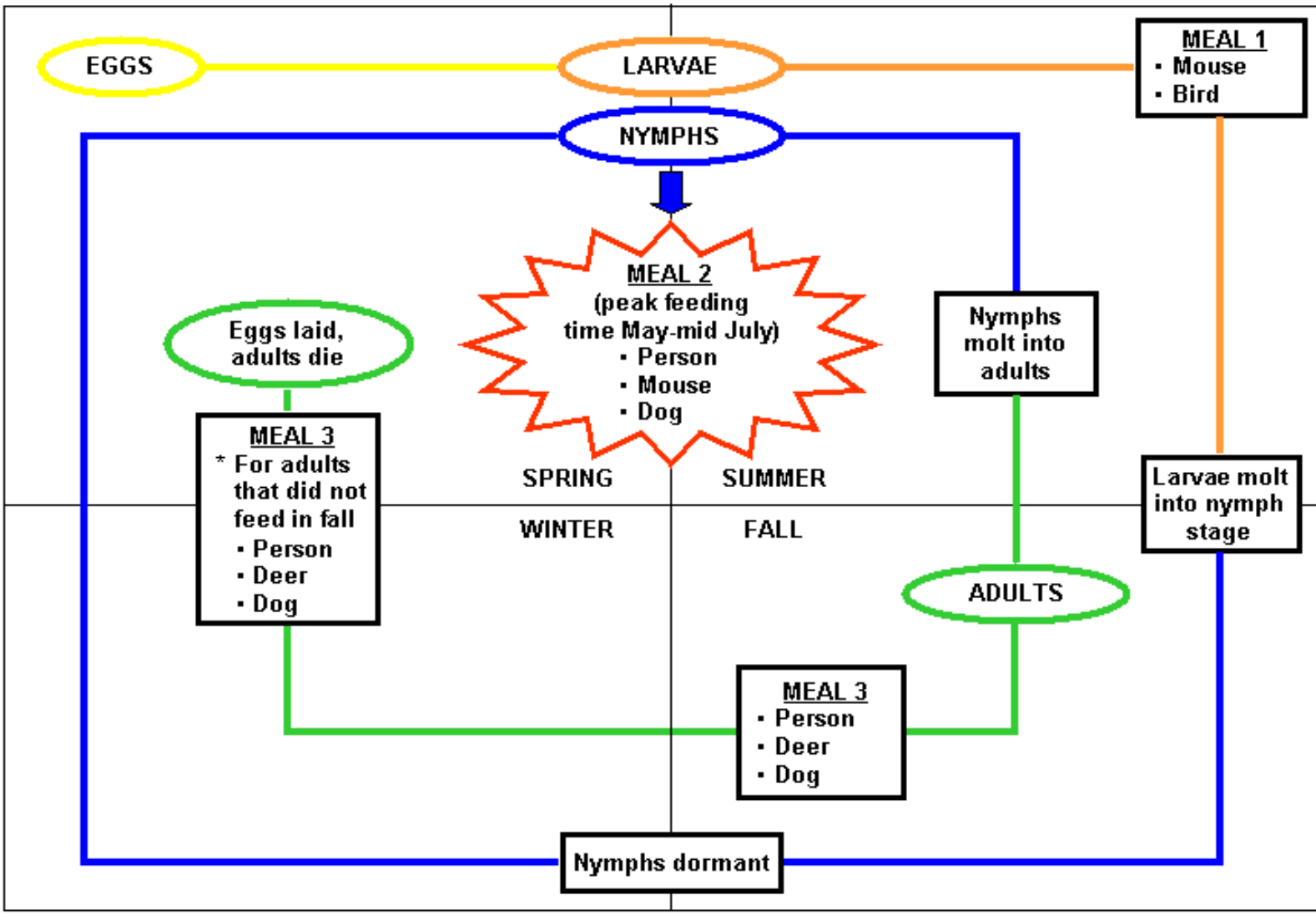
In summary:

- **In the spring and summer of year one, tick eggs hatch into larvae which get their first blood meal from mice or birds. This first blood meal may or may not carry the *Borrelia* infection. Larvae molt into nymphs which become dormant for the fall and winter.**

- **In the spring of year two, nymphs feed (2nd meal) on mice, dogs, or persons from May through July. Nymphs that were not yet infected can get infected at this time on mice. In feeding on a person, an infected nymph may transmit *Borrelia.***

- **In the fall of year two, nymphs molt into adult male and female ticks. The females feed (third meal) on deer and other large mammals (person, dog). Ticks mate on the deer, lay eggs (about 2000 per female adult tick), and die. In feeding on a person, an infected adult tick may transmit *Borrelia*. (Male blacklegged ticks attach to a host to wait for females, but do not take a blood meal.)**

Figure 1



Statistics indicate that more humans are infected through the bites of nymphs as they are tiny and difficult to see rather than through the bites of adult ticks which are more likely to be discovered and removed.

Ixodes ticks search for host animals from leaf litter and from the tips of grasses and shrubs. Ticks crawl onto animals or persons as they brush against them, they do not jump or fly.

There is no evidence that a person can get Lyme disease from the air, food, or water; from sexual contact; from insects such as mosquitoes, flies or fleas; or directly from wild or domestic animals.

In 2008, the Dover BOH conducted an informal survey of LD incidence. A brief questionnaire was mailed to every household in Dover. It was not intended to be a scientific measure, rather an estimate of LD prevalence and risk in our town.

Of the 2000 cards distributed, 778 were returned which amounted to a response rate of 39% . Residents were asked to respond to the following question:

Have you had or are you currently recovering from LD or have sought medical treatment for a tick bite?

487 with YES = 66% and 251 with NO = 34%

In addition:

- **39 individuals reported to have been treated more than once**
- **More than a few cases had to be hospitalized**
- **47 dogs were diagnosed with LD**

Based on these results official LD incidence data as published by the CDC and Mass DPH were consulted and analyzed. One has to keep in mind that although every case of LD is supposed to be reported to CDC and DPH, LD is suspected to be underreported because of the sometimes uncertain diagnosis and the significant administrative load on the treating physician. Nevertheless, these are the official scientific data available. LD incidence rates are defined as number of reported LD cases per 100,000 individuals which is the accepted way of reporting medical incidence rates. For reference, an annual incidence rate of >100/100,000 is considered 'very common' both for disease and AE (Adverse Event) incidence.

For 2008, Massachusetts had the 4th highest LD incidence rate nationwide with 61 cases per 100,000 (after NH with 92; Delaware with 88; Connecticut with 78). Within Massachusetts, Norfolk county had a LD incidence rate of 44 in 2006, 59 in 2007 and of 68/ 100,000 in 2008.

For Dover relevance to Tick and Deer density, however, LD incidence rates were analyzed even more specifically. All of Massachusetts is divided by Mass Wildlife into Wildlife Management Zones. Dover is located in Zone 10, defined West by the 495 Beltway, North by the NH border and South by routes 1A and 128.

The following LD incidence rates (number of reported LD cases per 100,000 individuals) represent the change over the last 10 years in Dover and some adjacent towns within Zone 10 by comparing rates in 1999 to 2008.

	1999	2008
Needham	0	103
Wellesley	18	34
Newton	8	28
Medfield	40	187
Framingham	0	35
Millis	0	114
Natick	0	83
Walpole	0	170
Holliston	0	181
Medway	0	144
Sudbury	0	142
Westwood	0	240
Sherborn	0	380

	1999	2006	2007	2008
Dover	**0**	**90**	**215**	**270**

It is readily apparent that LD incidence rates in Dover have significantly increased over the past 10 years and are among the highest within Zone 10 and Massachusetts.

Spatial relationship between white-tailed deer population and abundant infestation of ticks has been observed repeatedly. (Wilson, 1985, Spielman 1985, Armstrong 2001)

Without going into great detail, two studies evaluating this relationship are worthy of specific summary presentations.

Great Island Experiment, Lewis Bay, Cape Cod, MA (Wilson et al 1988)

At the beginning of the experiment in 1981, the deer density on the island was 30 to 50 deer per square mile. LD incidence was that 16 % of the population had had LD or other tick-borne diseases. Baseline levels of immature ticks were established over a two-year period from 1981 to 1983. During 1984 the deer population was reduced by an extended 1-year hunt to fewer than 6 deer per square mile and kept at that level from then on forward. Beginning with 1985, tick density progressively decreased to 1/10th of the 1983 level and has remained there ever since. Between 1986 and present, there have been 2 cases of LD and one case of babiosis on the island.
This experiment provides critical evidence for the association between deer abundance, tick density, and risk of infection.

Crane Beach Reservation Experiment (Deblinger 1993) Ipswich, MA

This study focused exclusively on the abundance of deer and of deer ticks before, during, and after controlled deer hunting over a period of 9 years. The following are summary data before and after controlled hunting:

	1985	1991
number of deer per square mile	**100**	**< 10**
Larvae in mice	**21/mouse**	**10/mouse**
Nymphs	**460/mouse**	**187/mouse**

Thus, this study as well shows that there is a correlation between deer density and immature tick density.

It is often argued that in the absence of deer, ticks will feed on other mammals, i.e., deer are not essential in the propagation of LD.

This theory is not borne out by the facts as researched over the last 2 decades by Telford and coll. and summarized in a 2002 review. Based on their evidence, it was estimated that if a deer herd is in progressive, steady decline only about 10 % of adult ticks will ultimately latch on to other large mammals like coyotes, raccoons etc., but 90 % will fail to get the essential 3rd blood meal for reproduction. It is concluded that it is primarily the deer that are responsible for the increased reproduction of ticks (irrespective of them being infected or not) which explains the fact that epidemic LD in NE US occurs primarily at sites where white-tailed deer are abundant.

As for specific data for Dover deer density together with the increasing incidence of LD, Mass Wildlife estimated the deer density of Zone 10 in 1980 as 2.2 deer per square mile, while in 2008 it was found to be approximately 20 deer per square mile. Obviously, the distribution of deer within Zone 10 is not homogenous, a town like Dover with lots of open space is much more likely to provide better feeding conditions than a town like Framingham or even Needham. Presently, Mass Wildlife goal for a healthy deer herd density in Zone 10 is 6-8 deer per square mile. It is of interest to note that Zone 9 (West of Dover) presently is estimated to have 15 deer / square mile and Zone 11 (Southeast of Zone 10) 18 deer /square mile, both targeted by Mass Wildlife with a goal of 8 deer / square mile.

At least three processes appear to be responsible for the emergence of the deer tick pathogen as a public health burden within the last two decades: 1) the relatively recent proliferation of deer due to the absence of predators together with the reduction of hunting; 2) creation of habitat by the abandonment of farmland and subsequent succession to thick secondary vegetation and 3) increased use of 'woods' for human recreation and habitation.

Although not directly related to the health risk of LD, an excessive deer herd can have a significant environmental impact. Danger of reduction or even elimination of native plant and sapling undercover as well as small animal species has been reported as a consequence of overabundance of deer. I would like to summarize the experience of another community in Zone 10.

Sudbury permitted bow and shotgun hunting of deer on conservation land up until 1985, at which time all hunting was banned due to the rapid increase in development, population and human use of conservation lands. By 1998 the deer population had exploded, and shrub and sapling layers were found to be mostly depleted. The town investigated several different options to reduce and control the excessive deer population, but decided in 1998 to re-introduce yearly regulated bow hunting, strictly controlled and monitored. Beginning in 1999 underbrush was found to recover and reports of deer-car collisions were reduced. By 2005, healthy underbrush was restored, and presently deer density is continuously monitored and managed by the use of legal hunters and by wildlife tracking. Significantly, based on Mass DPH data, the incidence of LD in Sudbury has been stable at 145/ 100,000 over the last 3 years while in Dover over the last 5 years, the incidence of LD increased progressively.

Therefore, in order to stabilize and subsequently reduce the risk of infection of LD, the Dover Board of Health researched various options to reduce the deer population, clearly in combination with several other means of Public Health care, like education on personal and property protection and management. Based on numerous discussions with experts at Mass Wildlife, the best approach for Dover to progressively reduce deer density is to open Town Land and Open Spaces for strictly regulated and monitored deer hunting.

Similar to the approach used in Sudbury and Crane Beach, Mass Wildlife suggests but does not limit the following criteria to be implemented for regulated hunting:
- hunters would receive a special permit for limited number of animals only;
- would be required to be residents of town or of bordering towns,
- have 5 years hunting experience,
- attend pre-hunting seminars and teaching,
- pass a shooting proficiency test.
- distribution of significant signage and information about hunting dates and times to residents of Dover.

It is worthwhile to note the Massachusetts hunting safety record. There has not <u>ever</u> been any accident of hunter versus non-hunter in Massachusetts (data provided by Mass Wildlife).

Thus, from a Mass Wildlife perspective, beginning a controlled hunt to progressively reduce Dover deer density to a healthy and reasonable deer population would:

- ensure present and future well-being of the species and the habitat
- provide a sustained availability of deer for licensed hunters, wildlife photographers and wildlife viewers
- allow for compatibility between deer populations and human land-use practices.

More importantly, however, from a Board of Health perspective, controlled hunting to progressively reduce Dover deer density would result in a corresponding progressive reduction of deer tick reproduction with a simultaneous progressive reduction in risk of infection of LD.

In summary, the Dover Board of Health <u>concludes</u> that:

The incidence of LD poses a health threat to the residents of our town.

The rate of infection of the ticks primarily by white-footed mice and the rate of reproduction of the ticks on the deer are independent phenomena. Together, however, they are responsible for the increased risk of LD.

Therefore, in order to manage this health threat, the BoH <u>recommends</u> a three-pronged approach:

- **Continuous Education of Adults and School children about the means of personal protection from tick bites**
- **Continuous education of residents and organizations about the means to create tick-safe zones on private and recreational properties in Dover**
- **Responsible management of the deer population via progressive reduction of deer density by allowing strictly regulated and monitored deer hunting on Open Town Land and Spaces.**

References:

Armstrong et al. Risk of human Lyme disease in a Lone Star tick-infested community. Bull WHO 79:916-925

Deblinger R D et al. 1993 Reduced Abundance of Immature Ixodes dammini following incremental removal of Deer. J Med Entomol 30 (1): 144-150

Spielman A et al. 1985 Ecology of Ixodes dammini borne human babiosis and Lyme disease. Ann Rev Entomol 30:439-460

Telford, S R 2002 Tick-transmitted Zoonoses in the Eastern United States. In Conservative Medicine and Challenges for the Future, Part V, Chapter 24, 2002

Telford, S R et sl. 1997. Emergence of tick-borne diseases. Sci Med 4:24-33

Telford S R et al. 1999. Acorns have little to do with Lyme disease risk: mouse density and the risk of acquiring a deer tick transmitted zoonosis. Nantucker Island 1991- 1998. Presented at the eighth International Congress on Lyme borreliosis, June 220-24, 1999

Wilson M L et al. 1985 Correlation between abundance of Deer and that of the Deer Tick, Ixodes dammini. Ann Entomol Soc Am 78: 172-176

Wilson et al. 1988 Reduced abundance of immature Ixodes dammini correlated with that of deer. J Med Entomol25:224-228

Wilson M L and Deblinger R D 1995. Vector management to reduce the risk of Lyme disease . In: Ginsburg, H S et al. Ecology and environmental management of Lyme disease . 126-156 Rutgers University Press , NJ.

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