Statement of Work

We propose to conduct a pilot study to compare the effectiveness of two sprayed pesticides: one a relatively safe compound composed of food quality rosemary oil suitable for use in the problematic circumstance of pastures for horses and other grazing animals; the other a synthetic compound, though not labeled for use in pastures, is approved for use by homeowners and commercial applicators to control deer ticks.

Over the last two decades, deer ticks, the vectors of Lyme disease and now two other infectious diseases have become well established in much of northern New England. In Maine, where reported Lyme cases are rising exponentially (1), coastal and inland areas are particularly infested, although deer ticks are now found statewide (2). The illness has become a major concern for both human and veterinary health care providers. In addition, two deer tick–transmitted diseases not previously seen in northern New England, anaplasmosis and babesiosis, have emerged, the former now infecting both dogs and horses as well as humans. While a handful of human anaplasmosis cases have been reported, the disease in dogs has become a major concern in southern Maine where, in a statewide canine serosurvey, dogs in coastal towns were up to 76% seropositive (3). Horses suffer from both Lyme disease and anaplasmosis with fever, lameness, anorexia, edema, ataxia. Their treatment can be expensive and is not always successful. Table 1 summarizes the results of a survey we have just completed of 192 sera from horses from York, Cumberland, Kennebec and Knox Counties in Maine which again revealed high positivity ($\leq$ 80%) for both diseases in some coastal towns. Alpacas, llamas, goats and other animals important to Maine's farm economy are also vulnerable to tick-born disease.

County	**# Tests**	***Anaplasma phagocytophilum* % Positive**	***Borrelia burgdorferi* % Positive**
York	11	9.6	33.3
Cumberland	46	17.4	32.6
Kennebec	20	5	15
Knox	12	8.3	41.7

Table 1. Seroprevalence of antibodies to the agents of anaplasmosis and Lyme disease in a random sample of horses from 4 southern Maine counties.

While an effective anti-Lyme vaccine is available for dogs, none exist for either humans or horses, narrowing the approaches for disease prevention to integrated methods for tick control. For grazing farm animals this includes applying acaricides to pastures. Integrated pest management for pastures is more complicated than that recommended for homeowners. Although traditional pesticides such as carbaryl and synthetic pyrethroids may be EPA-approved even when animals are in the pasture, owners are reluctant to have their animals exposed, not only externally to sprayed vegetation, but internally, as they graze. Additional concerns about environmental contamination and adverse effects on non-target organisms emphasize the need for the least toxic pesticides that can effectively kill ticks.

EcoEXEMPT®IC2 (IC2) is a botanical product of essential oils including rosemary, peppermint oil, oil of wintergreen and vanillin. It is a food grade pesticide exempted for registration by the EPA and stated by its manufacturer to be safe for indoor and outdoor use, in environmentally sensitive areas, and around children and pets. Its label states that it is effective against ticks, but no specific

information about deer ticks is provided. The manufacturer has supplied us with a supplemental label for the material's use in pastures and other grazing areas.

In the fall of 2007 we had the opportunity to conduct a preliminary evaluation of IC2 on pastures in two southern Maine towns where deer ticks are well-established. The owners wished their pastures to be treated with an environmentally safe compound with a minimal reentry time. Working with a professional applicator (Mr. Ted St. Amand – see Budget Justification) we measured the abundance of adult deer ticks before and twice after the application of this compound. Prior to the application, from 9.5 to 69 ticks/hr were flagged in the pastures, whereas both one week after treatment and in early May, 2008, no *I. scapularis* could be flagged in any of the treated pastures. Ticks were plentiful (29->100/hr) in untreated control areas adjacent to the treated pastures in both towns at each sampling. The apparent effectiveness of this treatment on this adult cohort of deer ticks calls for a more rigorous examination of the ability of this botanical acaricide, relative to a commonly used synthetic acaricide, to suppress deer ticks at and through each stage of their life cycle. Understanding the impact on each stage is important in timing of spray application and integration with other control methods where area-wide treatment or perimeter spraying could be prohibitively expensive.

Accordingly, we propose to establish six 1-hectare study sites. These will be established on a private preserve in Cape Elizabeth, Maine, long used for research by our laboratory where deer ticks are abundant (≈50 adults/flagging hour, 1999-2007). The sites will be chosen to have similar deciduous forest habitat and be separated by at least 100m. Within each, ten randomly-selected 10m x 10m sampling plots will be marked off, an area suitable for flagging within 5 minutes. Tick abundance will be measured as the number collected per hour from a $1m^2$ corduroy flag dragged over leaf litter for nymphs and larvae or swept over vegetation for adults. Ticks will be identified to species in the laboratory. Three sites will be sprayed in early July and three separate sites in mid-October to observe effects on deer tick nymphs and adults, respectively. Each time, one site will be treated with IC2 (4 oz./gal., 4 gal./1000 ft^2), one with IC2 vehicle (water only),and one with Bifenthrin (SPECKoZ®, 0.06% biphenthrin, 1.0 oz./1000 ft^2). Ticks will be flagged prior to, and one week after both applications. They will be flagged again in late August and mid-October following the summer application, and in the spring following the fall application. We will test for significant differences in mean tick abundance.

Evidence that an available botanical acaricide that is environmentally safe and allows a brief reentry time compares favorably with a commonly used synthetic acaricide would provide an attractive option, not only for the owners of grazing farm animals, but also for the managers of parks, land trusts and other properties with high public access where disease vector ticks are abundant but environmentally sensitive conditions would preclude the use of synthetic pesticides.

References

1. Beckett, G. A. 2008. Maine Center for Disease Control & Prevention. Personal Communication.
2. Rand, P. W., E. H. Lacombe, R. Dearborn, B. Cahill, S. Elias, C. B. Lubelczyk, G. A. Beckett, and R. P. Smith, Jr. 2007. Passive surveillance in Maine, and area emergent for tick-borne diseases. J. Med. Entomol. 44(6): 1118-1129.
3. Rand, P. W. 2008. Final report: statewide canine vector-borne disease serosurvey, 2007. The Maine Veterinarian, Winter 2008.