

Shelter Island and Fire Island 4-Poster Deer and Tick Study

Progress Report

April 30, 2010

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INTRODUCTION

The 4-Poster device is a passive feeding station designed to control ticks that utilize white-tailed deer (*Odocoileus virginianus*) as a host. As deer feed on bait (corn grain) at a device, acaricide-treated rollers brush against the animal's neck, head and ears where many adult ticks feed. Deer are a key host for adult blacklegged (*Ixodes scapularis*) and for immature and adult lone star ticks (*Amblyomma americanum*). Several studies (Carroll et al. 2002, Pound et al. 2000a, Pound et al. 2000b, Solberg et al. 2003) have shown large reductions in tick populations in the years following use of 4-Poster devices. In 2008, this study was initiated as a condition of the New York State Special Local Need Registration (SLN NY-070005) for the 4-Poster Tickicide (EPA Registration Number 39039-12) to investigate human and wildlife-associated risks. Our objectives were to: (1) evaluate changes in deer movement and behavior related to 4-Poster devices and the subsequent impact on residential community (2) document non-target animal visitation to devices, (3) quantify permethrin residues in and on deer, and (4) evaluate the efficacy of the 4-Poster technology for control of blacklegged and lone star ticks. In this paper, we report a preliminary evaluation of 4-Poster device use by deer and non-target wildlife as well as comparisons of deer home ranges within study (treatment) and control areas. The work is being conducted on Shelter Island and Fire Island, where 4-Posters are being deployed, and in the Village of North Haven, which is included as a control site. In this paper, we report a research progress and preliminary evaluation of the 4-Poster deer and tick study from November 2009 to April 2010.

2010 PROGRESS

Detailed methodology for study objectives was provided in the October 31, 2009 progress report which is currently available on our study website (<http://wildlifecontrol.info/TickStudy/Pages/Study%20Reports%20and%20Posters.aspx>). The final summary report will provide a comprehensive overview of all study objectives, methodology, and results. Final reports will be submitted after field data collection and thorough analysis and the deadline is contingent upon available funding.

Objective I. Human and wildlife-associated risks due to change in deer movement and behavior.

Monitoring Vegetative Deer Damage

Supplemental food sources (i.e. 4-Poster devices) can contribute to increased browse pressure near the available food source (Doenier et al. 1997, Schmitz 1990). An informal and preliminary review of field surveys on Shelter Island and North Haven suggest a history of heavy to severe vegetative damage in residential areas and natural habitat. The heavy vegetative damage evident prior to 4-Poster device use on Shelter Island may confound evaluation of browsing damage near devices.

The final 2010 sampling season evaluating deer browse damage on natural and ornamental vegetation was completed during March 9 – March 25, 2010 and all vegetation data has been entered. Initial evaluations offer a preliminary summary but formal analysis and thorough review will be provided in the final summary research report.

During 2009 and 2010 we observed low plant diversity in the natural forest ecosystem and a multi-year history of heavy to severe deer browsing. Although few plant species were observed with heavy and moderate browse damage and a larger number of plant species were observed with light to no browse damage (Table 1a), our sampling plots either lacked regeneration or were dominated by vegetation that is low preference deer browse. The resulting forest structure is comprised of mature trees and sparse understory primarily of low preference species such as oriental bittersweet, tartarian honeysuckle, multiflora rose, or rubus spp. (Table 1a). The forest overstory is primarily comprised of oak (scarlet, white, black, red, chestnut, post), American beech, and black cherry with maples (primarily red), black locust, hickory (*Carya* spp.) and sassafras as secondary components; little to no regeneration of these tree species was present within sampling plots. Using a Fisher's Exact test, initial evaluation revealed no significant differences in the proportion of plants observed in each browse level category (no browse, light, moderate, heavy, and severe) between 2009 and 2010 on both Shelter Island and North Haven. These preliminary results suggest little to no change in deer damage within the natural forest ecosystem has occurred while using 4-Poster technology.

As a response to heavy deer pressure on gardens and amenity plants, many residents choose to use deer-resistant varieties around their homes. Deer browse intensity sampling at homes provided evidence that a large number of property owners are selecting amenity plants that are not preferred by deer such as boxwoods, barberry, Andromeda, osmathus, American holly, leucothoe, dwarf Alberta spruce, and many others (Table 1b). However, many ornamental plants have been heavily and severely damaged by deer and these include azalea, juniper spp., cherry and mountain laurel, Japanese holly, euonymus, privet, as well as others (Table 1b). Deer damage varied between sites and in some sites plants (e.g. rhododendrons and forsythia) were heavily damaged by deer but in other locations minimal damage was evident on the same plant species. Variability in browse intensity was also observed within plant genera during ornamental vegetation sampling. For example, Pfitzer juniper was often not browsed

while torulosa juniper was severely browsed and although American and English hollies are good choices to plant to avoid deer damage, Japanese and grape hollies are often heavily and severely browsed.

Using a Fisher's Exact test, initial evaluation of deer damage to ornamental plants on Shelter Island revealed significantly lower proportions of plants that were moderately and heavily browsed during 2010 (3% and 7%, respectively) compared to 2009 (15% and 14%, respectively; $p \leq 0.030$). No significant differences in the proportion of ornamental plants with no, light, and severe deer damage were observed between 2009 and 2010 on Shelter Island. Similar to Shelter Island, the proportion of heavily browsed ornamental plants on North Haven was significantly lower in 2010 (9%) compared to 2009 (20%, $p = 0.032$). On North Haven, the proportion of plants with no, light, and moderate deer damage did not differ between 2009 and 2010 and too few plants were severely damaged to make any statistical inferences. During the 2010 sampling season, we observed new growth on many amenity plants previously browsed heavily by deer (2009) which suggests some decrease in deer pressure is evident. The decrease in deer browse of ornamental plants on both Shelter Island and North Haven suggests annual deer harvest programs and subsequent changes in deer population numbers maybe contributing to the differences between 2009 and 2010 rather than the 4-Poster devices (bait stations). However, more thorough review of the vegetation data is currently underway.

Deer-Vehicle Collisions

Supplemental feeding sites (i.e. 4-Poster devices) have been linked to increased deer activity and concentrated deer numbers in areas within close proximity to the bait source (McCullough 1997). Increases in deer activity and altered movements to and from 4-Poster devices may have negative impacts on residential communities due to increased deer-vehicle collisions (DVC).

Records of DVCs on Shelter Island and North Haven during 2008 and 2009 were obtained and entered. I am beginning to describe the spatial distribution of DVC locations (Figure 1) using the Getis-Ord G_i^* statistic in ArcGIS 9.2 to determine areas where DVCs are significantly clustered (hotspots) or are more likely to occur (Getis and Ord 1996). Hotspot analysis will be conducted for DVC point locations during 2005-2007 and for DVC point locations during 2008-2010. Clustering of DVCs near 4-Poster devices will be identified and DVC hot spots will be characterized in relation to attributes that could influence the likelihood of DVC occurrence such as human activity (e.g. traffic volume, road speed limit, road density), habitat features (e.g. percent impervious land cover, percent forest canopy cover), and distance to the nearest 4-Poster device.

DVCs occurring during 2010 will be obtained through the fall and a complete assessment of the impact of 4-Poster devices on deer movement and deer-vehicle collisions will then be conducted.

White-tailed Deer Live-Capture & Movement Monitoring

Deer live-capture, ear tagging, and collaring activities were minimal during November 2009 – April 2010; GPS collar malfunction issues necessitated the re-capture of 2 does and the malfunctioning collars were replaced during January - March 2010. We began the 2010 study season with a total of 78 (29 males, 49 females) marked deer on Shelter Island and 36 marked deer on North Haven (9 males, 27 females). Thirteen GPS and 13 VHF collared deer remain active on Shelter Island and 8 GPS and 7 VHF collared deer remain active on North Haven for the final study year (Table 2).

The home ranges and core areas of GPS and VHF collared deer have been derived for the 4-Poster deployment duration (March/April – November) during 2008 and 2009 (Figure 2). Mean home range size on Shelter Island is 220 acres (0.3 mi^2) and on North Haven it is 150 acres (0.2 mi^2) while mean core area size is 30 acres (0.05 mi^2) in both areas (average VHF telemetry locating error is 75 meters). Figure 2 provides visual depiction of a subset of our collared animals but serves as an excellent example of the distribution we have across both Shelter Island and North Haven. On average throughout Shelter Island, two 4-Poster devices are located within a doe's home range. Some deer travel much larger distances than others and in turn have larger home ranges; up to 8 devices have been detected within the home ranges of does that occupy larger areas. One doe (B21's home range is delineated by the deep red color polygon in northern most section of Study Area B; Figure 2) did not have a device within in her home range and no changes in this doe's movements occurred to suggest she uses nearby devices (Figure 2). Thus, the 4-Poster bait does not appear to strongly influence her movements.

The fidelity deer exhibit to the spatial locations of home ranges and core areas occupied each year is being evaluated to examine the influence 4-Poster bait stations may have on behavior. For example, the home ranges A08 (Shelter Island, treatment area) occupied during 2008 and 2009 overlapped by more than 86% and similar results were observed for 002 (North Haven, control area; Figure 3). These preliminary results suggest minimal changes in deer site fidelity behaviors are occurring in response to 4-Poster bait stations.

The movements of 2 GPS collared does, B15 and B23, serve as examples of deer incorporating larger areas of habitat into their home ranges (Figure 4). Although relatively few collared deer exhibit these large movements and most remain in much smaller areas each year, these are important behaviors to consider when employing effective tick management strategies at small scale levels. Interestingly, the location data for both B15 and B23 suggest that devices (corn) are not solely driving their movements. In biological terms of least-cost path (minimizing the cost or energy required to reach a destination or achieve some benefit, which in this case is corn), we would expect deer to minimize travel distances to obtain corn from the close and easily accessible devices. However, both deer encountered devices at much shorter distances than the maximum distances traveled (up to 6 miles). Upon spatial and temporal examination of movement data such as those of B15, it appears seasonality (or phenology) may playing a larger role in these movements. The collared does traveled larger distances during late April or early May when they are preparing to give birth to their fawns and remained in those

locations until mid- to late July when their fawns would be much more independent and able to manage the trek back (3-6 miles).

Deer movement analysis plans were finalized during winter 2010 and after data from the 2010 study year are collected, final analyses will be conducted. Preliminary evaluation of the movements and home ranges of deer suggest limited changes in response to the continually available and renewed bait available at 4-Posters on Shelter Island. Understanding deer use and movement patterns may likely have important implications for effective tick management using the 4-Poster technology. Additionally, evaluating deer behavioral responses to supplemental food at 4-Poster devices will allow us to provide device use recommendations to minimize human-wildlife conflicts in suburban environments.

Wildlife Use of 4-Poster Devices: Implications in Tick Control and Disease Transmission

Assessments of Deer and Non-Target Wildlife Device Use through Corn Consumption Index and Trail Camera Census

Corn consumption records supplied by the pesticide applicator facilitate estimation of the mean number of deer using a device each month during 2008-2010 (assuming negligible consumption by non-target wildlife).

The average deer use of devices increased between 2008 and 2009 from 235 deer/device/month to 405 deer/device/month, respectively. Devices were likely used more heavily by wildlife during the second season (2009) of deployment due to higher total deer population numbers, improved geographic distribution of devices across the landscape, and learned behavioral responses by deer over time. Spatial examination of the deer use estimates for each device during 2008-2010 (Figure 5 & 6) effectively informs optimal device placement to maximize wildlife use and potential permethrin treatment (tick control). Throughout the first 2 study year, 4-Poster device use by deer has been highest within Study Area A (422 deer/device/month) compared to Study Area B (337 deer/device/month, $p=0.03$; Figure 5 & 6).

Using trail camera photos collected during 2008-2009, the relative activity index (total number of visits [photos] divided by the total sampling effort [number of camera days]) of each animal at devices has been provided (Figure 7). These camera surveys document the different number of animals using devices, which animals use devices to the greatest extent, and the seasonality of device use by each animal. This provides insight into device use by and treatment success of multiple tick hosts for comparison with changes in tick numbers over time. Throughout 2008 and 2009, feeding activity at devices has been dominated by deer, raccoons, squirrels, and birds (Figure 7). Deer and raccoons consistently contact the permethrin treated rollers when feeding from devices, squirrels infrequently contact the rollers, and birds have never been observed contacting the rollers. The amount of activity by deer and raccoon at devices was similar between the 2008 and 2009 study years ($p > 0.56$); their activity gradually increases from spring into early summer, declines in late summer, and then peaks in early fall followed by a rapid

decline into the fall season (Figure 7). The seasonality of deer and raccoon activity at devices provides valuable information regarding successful tickicide treatment of hosts during the seasons when blacklegged and lone star ticks are most active. Consistently high use by deer and raccoon occurs into the summer when lone star ticks are most active suggesting potentially good host treatment for lone stars but declining host activity at devices during the fall may influence successful treatment and tick control during an important season for blacklegged ticks.

Two-sample t-tests were used to compare the relative activity of deer and raccoons at devices in Study Area A compared to Study Area B. These comparisons are consistent with the deer use index based on the corn consumption, suggesting deer use has been highest in Study Area A (37 deer photos/camera day during 2008, 35 deer photos/camera day during 2009) compared to Study Area B (24 deer photos/camera during 2008, 25 deer photos/camera day during 2009; $p=0.004$). The relative activity of raccoons at devices does not differ between study areas ($p>0.1$).

The deer use estimates obtained from both corn consumption records and trail camera data are consistent with collared deer movement data within Study Area A and Study Area B. Most deer collared within Study Area A remain there throughout a 4-Poster deployment season (March-November) while deer collared within the northern sections of Study Area B often travel larger distances across the landscape, frequently using the southern portion of Study Area B into the Mashomack Nature Preserve. The movements of B15 and B23 provide visual examples of the aforementioned movement behavior by deer collared within Study Area B (Figure 4). The home ranges of our collared deer (Figure 2) also provide interesting comparisons of movement of B deer out of the study area and throughout other portions of Shelter Island (e.g. Mashomack Nature Preserve). B21's home range is delineated by the deep red color polygon in northern most section of Study Area B; B21 was the only collared deer that did not have a 4-Poster device within her home range and she has never been detected using devices during monthly trail camera census. The behavior of this collared deer not only suggest 4-Poster devices may potentially have minimal impact on deer behavior but also may have interesting implications in decreased tick control efficacy for areas where deer movements are larger and behaviors may contribute to reduced device use.

Ultimately, data informing deer and wildlife use of devices will be used in conjunction with deer movement assessments to inform changes in wildlife-human conflicts as a result of 4-Poster device use. We also hope to use this information paired with tick count data to better understand the role of device use and tickicide exposure for deer and other wildlife in changing localized tick numbers over time.

Assessments of Disease Transmission at 4-Poster Devices

Chronic Wasting Disease (CWD), is a rare and fatal, neurological disease occurring naturally only in mule deer, white-tailed deer, and Rocky Mountain Elk. CWD is a type of transmissible spongiform encephalopathy (TSEs) thought to be caused by prions. Transmission of this disease occurs through direct contact with saliva, urine, and feces as well as indirectly through contact with environmental contamination (i.e. shared food and

water resources). The disease progressively infects the brain, causing emaciation and abnormal behavior, and resulting in death. CWD is a fatal disease with no known treatment and there is no evidence suggesting it poses a risk to humans or domestic animals. Bait sites may facilitate indirect and direct contact between deer, potentially increasing transmission of diseases such as CWD (Miller et al 2004, Mathiason et al 2006). Thus, potential transmission rates among wild deer where 4-Poster devices are used as a tick management strategy are being evaluated.

The 4-Poster technology successfully treats wildlife hosts with tickicide through the use of corn as an attractant. Thus, 4-Posters result in indirect contact and some direct contact between deer. We are using trail cameras to monitor indirect and direct contact between deer at 4-Poster devices (Figure 8).

During 2008 and 2009 we have observed roughly 60-65% of our marked deer population using 4-Poster devices. High deer use detected using trail cameras each month suggest a large proportion of the total deer population on Shelter Island use 4-Poster devices. High deer use is a positive indicator of effective treatment and tick management efforts but also a positive indicator of increased interactions among deer and potential for rapid spread of disease throughout the deer population.

Approximately 60% of trail camera photos detect 1 deer feeding while 40% of photos detect 2 or more deer feeding simultaneously. The design of the 4-Poster system helps to reduce the number of direct contacts between deer; each device has 1 small feeding port on each side, allowing only 1 deer to feed per port. Additional sources of deer feeding currently occur within both Shelter Island and North Haven through NYS nuisance deer hunting permits that allow the use of baiting to maximize the effectiveness of deer management efforts. Open bait site (bait piles on the ground) associated with nuisance hunting do not limit the number of deer that can feed at one time and thus often result in more direct contact between larger numbers of deer.

We have begun collected trail camera data for the final study year and ultimately will use 2008-2010 data to provide direct and indirect contact indices between deer at 4-Poster devices. Additionally, GPS collared deer movement data and overlap between animals at devices will be used to further evaluate interactions at devices and the potential for disease transmission.

Monitoring Deer Populations: Population Estimates, Mortality, and Productivity

Deer population status is being monitored on Shelter Island and North Haven through 2010 to evaluate the impact of the supplemental feed available at 4-Poster devices on the deer population. Providing deer with supplemental food may contribute to enhanced reproductive success and increased total population numbers. Natural mortality within the deer population can help to control deer numbers but in suburban areas, factors contributing to natural mortalities are often limited to hunter harvest and deer-vehicle collisions and occasionally, starvation. Starvation mortalities that result from high deer densities and limited natural food resources due to browsing pressure are often

suppressed when supplemental food is available, further contributing to increased population numbers (McCullough 1997, Schmitz 1990, McShea et al 1997).

Shelter Island and North Haven deer populations continue to be monitored to evaluate the impact of supplemental food at 4-Posters. We have completed our first trail camera survey of the 2010 study year and these data are currently being entered into our database. Upon completion of data entry, we will derive population estimates using capture-resight methods (Bowden's Model Estimation, NoRemark; White et al., 1982) and branch-antlered buck identification techniques (Jacobson et al. 1997). Doe to fawn ratios are obtained from fall camera survey to inform reproductive rates and mortality rates within our marked deer population continue to be monitored. Additionally, we have obtained dressed deer weight data from Mashomack Nature Preserve to evaluate any changes potentially resulting from supplemental feeding at 4-Poster devices. These data will be used to begin making conclusions regarding the changes in the deer population while 4-Posters have been used and the implications related to human-wildlife conflicts in areas with high deer densities. A complete review of this information will be available upon study completion.

Objective II. Investigation of Permethrin Residues

2008 and 2009 Study Season Sampling Results

Neck muscle, liver, and coat swabs were collected from 16 deer during 2008 and hindquarter and neck muscles, liver, and coat swabs were collected from 13 deer during 2009 on Shelter Island. Permethrin was detected on 26 of the 29 coat swabs collected from deer during 2008 and 2009 sampling. The coat swab results did not differ significantly between 2008 and 2009 ($p=0.714$); swabs averaged 535 mcg of permethrin per swab and ranged from 0.02 to 5,110.30 mcg/swab during 2008 while swabs averaged 739 mcg/swab and ranged from 7.52 to 5,296.49 mcg/swab during 2009 (Table 3). Three coat swabs were analyzed by the NYSDEC Division of Solid and Hazardous Materials Laboratory using a higher minimum detection level (MDL) than Cornell AHDC (3.0 mcg/swab and 0.001 mcg/swab, respectively). Analysis results from the NYSDEC lab reported non-detections at 3 mcg/swab or higher on the coat swabs of those 3 deer (Table 3).

During 2008 and 2009, liver samples collected from deer on Shelter Island were all non-detections for permethrin. The 2008 sampling procedures resulted in 3 of 16 neck muscle samples testing positive for permethrin with residues ranging from 11.2 to 270.3 ppb (Table 3). Hindquarter muscles were added to the sampling regime in 2009 in conjunction with a revision to the sampling protocol to further minimize residue transfer from the hide to the muscle; no residues were detected in the neck or hindquarter muscle samples obtained during 2009 (Table 3).

The sampling conducted on North Haven during 2008 and 2009 was structured the same as sampling on Shelter Island. Data collected on North Haven are used to evaluate potential permethrin accumulation on or within deer from environmental exposure (i.e. broadcast lawn spraying) and enhance our understanding of potential human exposures

related to handling and consuming deer prior to 4-Poster device use. Similar to the 4-Poster tick management technology, permethrin is often used as the pesticide for broadcast landscape applications. The broadcast applications are widely used throughout Long Island to control ticks on localized levels. On average, 77 lbs of permethrin has been applied to the landscape each year via broadcast lawn applications on Shelter Island (NYS Pesticide Sales and Use Reporting Records, 2003-2005). The reported records such as those provided for Shelter Island, provide only lawful commercial pesticide application by certified commercial applicators and technicians and do not reflect pesticide use by homeowners and illegal commercial applications. Suffolk County Landscape Gardener's Association suggests the reported pesticide usage represents roughly one-half of the total amount used throughout New York State each year (V. Palmer, NYSDEC personal communication). Comparatively, the 4-Poster technology being evaluated on Shelter Island has resulted in an average use of 31 lbs of permethrin each year through direct application to wildlife hosts. The reported amounts of permethrin applied to the landscape using broadcast methods may suggest deer could be exposed to permethrin residues through contact with and consumption of vegetation found within area where broadcast application occurs.

Neck muscle, liver, and coat swabs were collected from 4 deer during 2008 and hindquarter and neck muscles, liver, and coat swabs were collected from 6 deer during 2009 on North Haven. Low-levels of permethrin were detected on 8 of the 10 coat swabs collected. Coat swab results did not differ between 2008 and 2009 ($p=0.104$); swab residues averaged 0.03 mcg/swab during 2008 and ranged from 0 to 0.05 mcg/swab while residues averaged 0.11 mcg/swab and ranged from 0 to 0.24 mcg/swab during 2009 (Table 4). During 2008 and 2009, liver, neck muscle, and hindquarter muscle samples were all non-detections for permethrin residues on North Haven (Table 4). Low-level permethrin detections on coat swabs collected from North Haven deer suggest environmental exposure is occurring and contact with vegetation in areas where broadcast landscape applications occur is a likely avenue of exposure for deer. However, the levels are considerably lower than swab residues from deer visiting 4-Poster devices on Shelter Island due to the method of application (direct landscape versus direct deer). Although broadcast methods are a concern related to some non-target insects (i.e. toxicity to honeybees) and aquatic organisms (i.e. spray drift near and into waterways), it presents negligible concern related to hunter exposure through direct contact or consumption (Center for Environmental Health, NYSDOH 2009).

During the review of permethrin residue data, Cornell and the NYSDOH examine trail camera photos documenting device use by each sampled deer, harvest photos of each deer, information regarding device use by each deer, and tickicide application history for each device used by sampled deer. Upon careful data review, the NYSDOH indicated very low health risks associated with handling and consuming venison or liver from deer using 4-Poster devices on Shelter Island during 2008 and 2009 (Center for Environmental Health, NYSDOH 2009). Revisions to the sampling protocol following permethrin detections within neck muscle samples collected from Shelter Island during 2008, resulted in no further permethrin detections within neck or hindquarter muscles. These results suggest the residues detected were consequences of residue transfer from the neck

hide to the neck meat while sampling during 2008. The differences between the 2008 and 2009 sampling protocols served to identify the relative ease of residue transfer and the importance of proper deer handling and processing techniques. Permethrin residue analysis results have also provided insight into the low to negligible residue detections that hunters are likely to be exposed to when following the suggested safe handling procedures (available at <http://wildlifecontrol.info/TickStudy/Pages/PermethrinResidueInvestigations.aspx>). Sampling will continue during 2010 and thorough review of human exposure and health risks associated with 4-Poster technology will be conducted by the NYSDOH.

Implications for Safe Deer Handling & Community Education and Outreach

The permethrin detections on coat swabs from 26 of 29 Shelter Island deer and 8 of 10 North Haven deer stress the importance of wearing protective gloves when handling deer to avoid potential exposure to permethrin or other contaminants that may be present on the animal's coat. Protective gloves are also recommended as standard practice for hunters to reduce exposure to pathogens and other contaminants. Based on the first year of permethrin residue investigations, Cornell has issued a fact sheet regarding deer harvest and safe handling for hunters (Appendix 1). Hunters are encouraged to follow these guidelines when handling and processing each deer harvested from 4-Poster treatment areas. These recommendations include, wearing protective gloves when handling, field dressing, and processing deer, using new (clean) gloves and knives during each handling and processing step, skinning each deer from tail to head, and avoiding contact between the hide and the meat you intend to consume. These recommendations are also helpful for processing any harvested deer, regardless of the harvest location.

The 2008 and 2009 estimates of 4-Poster device use obtained using trail cameras and a marked (ear tagged and/or collared) deer population offer insight into the proportion of the total deer population visiting 4-Poster devices and being treated with permethrin on a regular basis. On average, visitation to 4-Poster devices by up to 65% of our marked deer population has been observed while monitoring 24 devices for 3-days each month. Understanding the movement of deer from 4-Poster treatment areas to non-treatment areas may also better enable communities to effectively educate the surrounding towns and villages. Low emigration rates (3% of the marked population, $n=3$) suggest minimal movements of deer off Shelter Island to the surrounding communities. However, the majority of these movements occur by males and detection rates for tagged males are considerably lower due poor visibility of the small ear tags used to identify individuals. The high deer use of devices within 4-Poster treatment areas stresses the importance of identifying avenues for sportsmen awareness and public education related to 4-Poster device use and human health and safety where 4-Poster technology is used effectively with high deer densities (i.e. 9 month device deployment, 5 devices/mi², ≥ 40 -60 deer/mi²). Although low rates of emigration from the 4-Poster treatment area to non-treatment areas suggests limited concerns for hunters within surrounding communities, Shelter Island is an island surrounded by deep waterways with swift tidal currents restricting some deer movements. Large movements by tagged bucks and does within Shelter Island suggest communities within a 6-10 miles radius of treatment areas may consider more extensive education and outreach to inform hunters and members of surrounding communities of the potential for permethrin exposure while handling deer.

The impact of 4-Poster technology on hunter effort may also be considered in order to evaluate the implications of device use in suburban areas where deer densities are high, deer mortality is limited aside from hunter harvest and deer-vehicle collisions, and deer population control through effective deer management programs is necessary.

Objective III: Efficacy of 4-Poster System

4-Poster Devices

All 4-Poster devices were deactivated in 2009 by ending servicing in early December and allowing corn bait to draw down by mid-December. Last servicing in December, 2009 was 12/2 (Robert Moses State Park), 12/10 (Fire Island National Seashore/FINS), 12/9 (Shelter Island except Mashomack) and 12/10 (Mashomack). Posts and rollers were removed from Shelter Island units from 12/16 – 12/18 and devices themselves were withdrawn from the field by 12/18 (40 units outside Mashomack) and by mid-January (20 units in Mashomack), cleaned and stored. On Fire Island, the eight devices were withdrawn from the field by late December to mid-January, as weather and cooperating staff time allowed. In 2010, forty devices on Shelter Island (except Mashomack) were returned to the field on 3/22; the remaining twenty units (Mashomack) were placed on 3/25. On Fire Island, three units in FINS were placed on 4/1 and one on 4/8 (Christensen); at Robert Moses State Park the four units were moved to the field on 4/8. As in 2008, Shelter Island (except Mashomack) units will be serviced twice a week; Mashomack devices will be serviced weekly due to available resources. At Fire Island sites, all units will be serviced weekly as before. The list of professional applicators is shown in Appendix 2.

Corn consumption at 4-Posters doubled on Fire Island and on Shelter Island in 2009 compared with figures for 2008. Devices on Shelter Island were active for a total of 15,640 device-days (average of 261 days/device), using 309,175 lbs corn (5,153 lbs/device) based on amount added (or 296,060 based on amount consumed according to the less accurate interior volume gauge, usually around 5 – 10% lower than actual amount). According to applicator records, 62.3 gallons (1.04 gal./device) of Tickicide were used during the season at Shelter Island across all 60 devices. On Fire Island, FINS sites (4 locations) used a total of 34,120 lbs (8,530 lbs/device) of corn in 2009 (33,165 lbs by interior volume gauge records) and 6.08 gallons (1.52 gal./device) of Tickicide; at Robert Moses State Park (RMSP) 27,118 lbs (26,178 lbs by interior gauge) of corn were used in 2009 or 6,779.5 lbs/location (four sites; a second unit was added to the RM1 Golf Course unit in mid-August) and 5.1 gallons (1.27 gallons/location) of Tickicide was applied during the season. Totals for both Fire Island locations (FINS and RSMP) were 61,238 lbs of corn added (59,343 lbs by interior volume gauge) and 11.18 gallons (1.40 gal./device) of Tickicide. Robert Moses units were active for a total of 1189 device-days (single units were active 267 days on average) and FINS units were active 1047 device-days (an average of 262 days deployed per device).

Post springs have continued to be an issue, though replacement types are holding up much better. A stock extension spring (Home Depot/Everbilt brand model 169 551,

13/16" x 4" x 0.120" rated 61.70 lbs safe working load, \$3.67/pair) is now being tested and fits the factory-supplied posts with only slight modification (the lower end loop compressed slightly to fit the base). The spring is under slight tension but barely extended when fit, which appears to avoid the problem of 'kinking' at the joint when there are large gaps in more extended coils or when posts are overstressed. A 1" dia. x 0.120" wire extension spring also works well with replacement posts that lack the internal reducing tube, though we have had some trouble finding short springs at reasonable cost. Rubber 'sleeves' noted in the October 2009 report help stiffen posts that have failing springs but ultimately deteriorate and the larger springs appear to be a better solution. Andy Szulinski, Vice-President of CR Daniels/Dandux, the 4-Poster manufacturer, is visiting the project in May, 2010 and has been notified of these and other issues with device performance. Costs for basic maintenance include corn (\$8.50 - \$10.50/50 lbs), Tickicide (\$248.75/gallon), parts (rollers \$35/dozen, replaced approximately seven times per device or 28 rollers per season), warning signs (\$35/dozen), replacement metal gates (\$25/pair), applicator gun (\$110), and supplies for repairs and maintenance (gloves, plastic treatment bags, flashing and caulking for repairing holes chewed in the device, broken posts, chewed fastener straps, repellent, etc.).

Tick Sampling

Tick counts from 2008 and 2009 have been previously reported (October 2009 report). Tick sampling for 2010 is scheduled to start around early to mid-June as in previous years. Sampling will be done in the same locations and in same way as before, targeting nymphal stages of lone star and blacklegged ticks; data will then be compared with counts from prior years.

Tick sampling for 2010 will be conducted in June to July, as noted above, and data provided in the following and final report.

REFERENCES

Carroll, J.F., Allen, P.C., Hill, D.E., Pound, J., Miller, J., George, J. 2002. Control of *Ixodes scapularis* and *Amblyomma americanum* using the '4-poster' treatment device on deer in Maryland. *Experimental and Applied Acarology*. 28:289-296.

Center for Environmental Health, New York State Department of Health. 2009. Shelter Island and Fire Island 4-Poster Deer and Tick Study: Human Exposure Risks Associated with 4-Poster Technology. Press Release. New York State Department of Health, Troy, New York.

Curtis, P. D., B. Boldgiv, P. M. Mattison, and J. R. Boulanger. 2009. Estimating deer abundance in suburban areas with infrared-triggered cameras. *Human-Wildlife Conflicts* 3(1):116-128.

Doenier, P. N., G. D. DelGuidice, and M. R. Riggs. 1997. Effects of winter supplemental feeding on browse consumption by white-tailed deer. *Wildlife Society Bulletin* 25:235-243.

- Jacobson, H.A., J.C. Kroll, R.W. Browning, B.H. Koerth, M.H. Conway. 1997. Infrared-triggered cameras for censusing white-tailed deer. *Wildlife Society Bulletin* 25: 547-556.
- Mathiason, C. K., J.G. Powers, S.J. Dahmes, D.A. Osborn, K.V. Miller, R.J. Warren, G.L. Mason, S.A. Hays, J. Hayes-Klug, D.M. Seelig, M.A. Wild, L.L. Wolfe, T.R. Spraker, M.W. Miller, C.J. Sigurdson, G.C. Telling, and E.A. Hoover. 2006. Infectious prions in the saliva and blood of deer with chronic wasting disease. *Science* 314:133-136.
- McCullough, D. R. 1997. Irruptive behavior in ungulates. Pages 69–98 in W. J. McShea, H. B. Underwood, and J. H. Rappole, editors. *The science of overabundance: deer ecology and population management*. Smithsonian Institution, Washington, D.C., USA.
- McShea, W.J., H. B. Underwood, and J. H. Rappole, editors. 1997. *The science of overabundance: deer ecology and population management*. Smithsonian Institution, Washington, D.C., USA.
- Miller, M.W., E.S. Williams, N.T. Hobbs, and L.L. Wolfe. 2004. Environmental sources of prion transmission in mule deer. *Emerging Infectious Diseases* 10(6).
- Pound, J. M., J. A. Miller, and C. A. Lemeilleur. 2000a. The ‘4-Poster’ passive topical treatment device to apply acaricide for controlling ticks (Acari: Ixodidae) feeding on white-tailed deer. *Journal of Medical Entomology* 37: 588-594.
- Pound, J. M., J. A. Miller, and J. E. George. 2000b. Efficacy of Amitraz applied to white-tailed deer by the ‘4-Poster’ topical treatment device in controlling free-living lone star ticks (Acari: Ixodidae). *Journal of Medical Entomology* 37: 878-884.
- Schmitz, O. J. 1990. Management implications of foraging theory: evaluating deer supplemental feeding. *Journal of Wildlife Management* 54:522–532.
- Solberg, V. B., J. A. Miller, T. Hadfield, R. Burge, J. M. Schech, and J. M. Pound. 2003. Control of *Ixodes scapularis* (Acari: Ixodidae) with topical self-application of permethrin by white-tailed deer inhabiting NASA, Beltsville, Maryland. *Journal of Vector Ecology* 28: 117-134.
- White, G. C., D. R. Anderson, K. P. Burnham, and D. L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. LA-8787-NERP, Los Alamos National Lab, Los Alamos, NM.

Table 1a. A summary of different plants that were observed heavily or severely, moderately, and lightly or not browsed by deer while conducting the 2009 and 2010 surveys for deer browse damage within forest sites on Shelter Island and North Haven.

1b. A summary of different amenity plants that were observed heavily or severely, moderately, and lightly or not browsed by deer while conducting the 2009 and 2010 surveys for deer browse damage at homes on Shelter Island and North Haven.

a.

Heavy-Severe Deer Damage	Moderate Deer Damage	Light or No Deer Damage
Arborvitea Beech Autumn Olive Common Greenbrier Juniper Oak Sassafras	Black Locust	American Holly Autumn Olive Barberry Bayberry Black Cherry Blueberry Common Greenbrier Grape Hickory Japanese Honeysuckle Multiflora Rose Norway Maple Oriental Bittersweet Privet Rubus spp. Sassafras Tartarian Honeysuckle Viburnum Zalcova Beech Shadblow Birch Spruce Summer Sweet

Table 1. Continued.

b.

Heavy-Severe Deer Damage	Moderate Deer Damage	Light or No Deer Damage
Atlas Cedar Autumn Olive Azalea Blackgum tree Cherry Laurel Climbing Hydrangea Douglas Fir Eastern Red Cedar Flowering Quince Gold Thread Cypress Grape Holly Hydrangea spp. Hynoke Chamaecyparis Japanese Holly Juniper spp. Kousa Dogwood Leyland Cypress Manhattan Euonymus Mountain Laurel Nelly Stevens Holly Oakleaf Hydrangea Oriental Bittersweet Pegee Hydrangea PJM Rhododendron Privet Rhododendron spp. Spruce spp. Torulosa Juniper Willow Winged Euonymus Wysteria Yew	Common Lilac Crepe Myrtle Currant Forsythia Hairy Lauders Walking Stick Ink Berry Holly Japanese Maple Juniper spp. Pfitzer Juniper	Amelanchier American Beech American Holly Andromeda Apple var. Aronia Ash Atlas Cedar Autumn Olive Barberry Bayberry Beech Black Locust Blue Atlas Cedar Blue Holly Blueberry Boxwood Bridal Wreath Spirea Camellia Chamaecyparis spp. Cherry spp. Climbing Rose Colorado Blue Spruce Common Lilac Crepe Myrtle Cryptomeria Deciduous Mountain Holly Dwarf Alberta Spruce Eastern Red Cedar English Holly European Birch Fastigate Oak Flowering Cherry Flowering Dogwood Forsythia Grafted willow Hairy Lauders Walking Stick Hawthorne Holly spp. Honeysuckle Hydrangea spp. Inkberry Holly Japanese Black Pine Japanese Maple Juniper spp. Korean Boxwood Kousa Dogwood Lace Cap Hydrangea Leucothoe Lindnt Maple spp. Montgomery Blue Spruce Multiflora Rose Norway Spruce Ornamental Honeysuckle Osmanthus Pegee Hydrangea Pfitzer Juniper Privet Prostrate Juniper Purple Leaf Plum Red Cedar Red Maple Red Oak Red Spruce Red Twig Dogwood Rigosa Rose River Birch Rose Shadblow Skimmia Skimmia japonica Snowball Hydrangea Spirea Spruce spp. Stewardia Styrax Sycamore Tamarisk Verigated Holly Viburnum Vitex Weeping Birch Weeping European Beech Weeping Norway Spruce White Pine Wigelia Willow Winterberry Wysteria

Table 2. A total of 78 (29 males, 49 females) marked deer on Shelter Island and 36 marked deer on North Haven (9 males, 27 females) remain active during the 2010 study year. During the final study year, 13 GPS and 13 VHF collared on Shelter Island and 8 GPS and 7 VHF collared deer on North Haven will be monitored during the final study year.

Capture Date	Capture Site	Ear Tag ID	Approximate Age	Sex	Transmitter Frequency	Collar Type	Capture Method
4/30/2008	NH	001	Adult	F	150.210	GPS	Darting
5/6/2008	NH	002	2	F	150.170	GPS	Darting
5/13/2008	NH	003	2	F	150.190	GPS	Darting
5/16/2008	NH	051	1	M			Darting
1/15/2009	NH	006	1.9	F	151.910	VHF	Darting
1/29/2009	NH	007	2.9	F			Clover
1/29/2009	NH	008	0.9	F			Clover
1/29/2009	NH	009	1.9	F	151.060	GPS	Clover
1/30/2009	NH	010	2.9	F	150.830	VHF	Clover
1/30/2009	NH	011	1.9	F			Clover
2/2/2009	NH	012	0.1	F			Clover
2/4/2009	NH	013	0.1	F			Clover
2/5/2009	NH	014	0.1	F			Clover
2/6/2009	NH	015	6.1	F	151.030	VHF	Clover
2/17/2009	NH	016	2.1	F	151.970	GPS	Drop
2/17/2009	NH	017	1.1	F	150.990	VHF	Drop
2/17/2009	NH	018	0.1	F			Drop
2/21/2009	NH	019	3.1	F	151.810	VHF	Drop
2/21/2009	NH	020	1.1	F			Drop
3/2/2009	NH	021	4.11	F	151.210	GPS	Clover
3/6/2009	NH	022	0.11	F			Clover
3/6/2009	NH	023	7.11	F	151.110	VHF	Clover
3/31/2009	NH	024	0.11	F			Clover
3/31/2009	NH	025	0.11	F			Clover
4/1/2009	NH	026	4.12	F	151.460	GPS	Darting
4/7/2009	NH	027	1.12	F	150.790	VHF	Darting
8/19/2009	NH	030	2.2	F	150.190	GPS	Darting
9/1/2009	NH	031	1.4	F	150.710	GPS	Darting
1/23/2009	NH	052	0.9	M			Clover
1/27/2009	NH	053	0.9	M			Clover
1/29/2009	NH	054	0.9	M			Clover
1/27/2009	NH	055	1.9	M			Clover
1/30/2009	NH	056	0.9	M			Clover
2/4/2009	NH	057	1.1	M			Clover
2/5/2009	NH	058	0.1	M			Clover
2/7/2009	NH	060	2.1	M			Clover
2/21/2009	NH	061	0.1	M			Drop
2/17/2009	NH	062	0.1	M			Drop
2/21/2009	NH	063	0.1	M			Drop
4/23/2009	NH	028	2	F			Darting

Table 2. Continued

Capture Date	Capture Site	Ear Tag ID	Approximate Age	Sex	Transmitter Frequency	Collar Type	Capture Method
2/29/2008	SI	A01	2.1	F	150.010	VHF	Drop
3/6/2008	SI	A02	2.1	F	150.870	VHF	Drop
3/13/2008	SI	A03	2.1	F	150.590	VHF	Drop
3/13/2008	SI	A04	2.1	F			Drop
3/21/2008	SI	A05	0.1	F			Clover
3/29/2008	SI	A07	0.1	F			Drop
3/29/2008	SI	A08	Adult	F	150.035	GPS	Drop
3/31/2008	SI	A09	0.1	F			Rocket
8/5/2008	SI	A11	1.3	F	150.610	GPS	Darting
8/7/2008	SI	A12	Adult	F	150.850	GPS	Darting
8/10/2008	SI	A13	2.3	F	150.510	GPS	Darting
2/25/2008	SI	A52	2.1	M			Drop
2/29/2008	SI	A53	0.1	M			Drop
3/28/2008	SI	A58	0.1	M			Drop
3/29/2008	SI	A59	0.1	M			Drop
4/9/2008	SI	A63	1.1	M			Clover
4/17/2008	SI	A65	1.11	M			Clover
2/29/2008	SI	B01	0.1	F			Clover
3/2/2008	SI	B02	Adult	F	150.390	VHF	Drop
3/2/2008	SI	B04	1.1	F			Drop
3/25/2008	SI	B05	3.1	F	150.330	VHF	Clover
4/10/2008	SI	B09	0.1	F			Drop
8/4/2008	SI	B10	Adult	F	150.410	GPS	Darting
8/13/2008	SI	B13	Adult	F	150.750	GPS	Darting
4/9/2008	SI	B53	0.1	M			Clover
4/16/2008	SI	B54	0.1	M			Clover
4/24/2008	SI	B55	2.1	M			Clover
1/8/2009	SI	A14	0.9	F			Clover
1/9/2009	SI	A16	2.9	F	150.910	GPS	Clover
1/9/2009	SI	A17	0.9	F			Clover
1/10/2009	SI	A19	2.9	F	151.310	GPS	Clover
1/11/2009	SI	A21	0.9	F			Clover
1/13/2009	SI	A22	2.9	F	151.510	GPS	Clover
1/14/2009	SI	A23	1.9	F	150.070	VHF	Drop
1/14/2009	SI	A24	1.9	F			Drop
1/14/2009	SI	A25	0.9	F			Drop
1/16/2009	SI	A26	0.9	F			Clover
1/15/2009	SI	A27	1.9	F	151.990	VHF	Clover
1/15/2009	SI	A28	0.9	F			Clover
1/16/2009	SI	A29	1.9	F	151.950	GPS	Clover
1/17/2009	SI	A30	3	F	151.560	VHF	Clover
1/20/2009	SI	A31	1.9	F			Clover
1/21/2009	SI	A32	0.9	F			Clover
1/23/2009	SI	A33	5.9	F	151.770	VHF	Clover
1/10/2009	SI	A68	0.9	M			Clover
1/19/2009	SI	A68	0.9	M			Clover
1/10/2009	SI	A69	0.9	M			Clover
1/11/2009	SI	A70	0.9	M			Clover
1/14/2009	SI	A71	1.9	M			Clover
1/15/2009	SI	A72	0.9	M			Clover
1/15/2009	SI	A73	0.9	M			Clover
1/17/2009	SI	A74	0.9	M			Clover
1/20/2009	SI	A76	1.9	M			Clover
1/22/2009	SI	A77	0.9	M			Clover
1/27/2009	SI	B14	1.1	F	151.650	VHF	Clover
1/29/2009	SI	B15	1.1	F	151.530	GPS	Clover
2/6/2009	SI	B16	0.1	F			Clover
2/24/2009	SI	B18	2.1	F	151.850	VHF	Drop
2/24/2009	SI	B19	0.1	F			Drop
2/24/2009	SI	B20	0.1	F			Clover
3/2/2009	SI	B23	6.11	F	150.550	GPS	Clover
3/4/2009	SI	B25	1.11	F	151.730	VHF	Drop
3/5/2009	SI	B26	5.11	F	150.970	VHF	Clover
3/6/2009	SI	B27	0.11	F			Clover
3/6/2009	SI	B28	2.11	F			Clover
3/12/2009	SI	B29	6.11	F			Clover
9/23/2009	SI	B31	1.5	F	150.150	GPS	Darting
2/11/2009	SI	B58	0.1	M			Clover
2/13/2009	SI	B59	1.1	M			Clover
2/25/2009	SI	B63	0.1	M			Drop
2/25/2009	SI	B64	0.1	M			Drop
3/4/2009	SI	B65	0.11	M			Drop
3/4/2009	SI	B66	0.11	M			Clover
3/4/2009	SI	B67	0.11	M			Clover
3/5/2009	SI	B69	2.11	M			Clover
3/5/2009	SI	B70	0.11	M			Clover
2/16/2010	SI	B71	1.7	M			Darting
5/15/2008	SI	004	3+	F	150.110	GPS	Darting

Table 3. Permethrin residues detected in coat swabs (micrograms (mcg) per swab), muscle (ppb), and liver (ppb) samples taken from deer on Shelter Island, New York during 2008 and 2009. Permethrin residue analysis was conducted by Cornell Animal Health Diagnostic Center (AHDC) using a minimum detection level (MDL) of 0.001 mcg/coat swab and 10 ppb for muscle and liver analysis. Residues results falling below MDLs are reported as no detection (ND). Hindquarter muscle samples were not collected during 2008 sampling and reflect a modification to the 2009 sampling protocol.

Deer ID	Neck Muscle	Hindquarter Muscle	Liver	Coat Swab	Harvest and Sample Collection Date	Hunting Method	Sex	Approx. Age	Approx. Weight	Observations of 4-Poster Use
SI1	ND	—	ND	ND *	9/13/2008	Not Applicable	F	2.5	110	—
SI2	ND	—	ND	ND *	9/17/2008	Shotgun	F	8.5	130	—
SI3	ND	—	ND	ND *	9/17/2008	Shotgun	M	4 months	40	—
SI5	11.2	—	ND	16.28	10/3/2008	Regular Bow	M	5 months	60	Corn present in rumen
SI6	ND	—	ND	0.06	10/6/2008	Regular Bow	F	5 months	45	
SI7	ND	—	ND	0.02	10/6/2008	Not Applicable	F	5 months	40	Corn present in rumen
SI8	ND	—	ND	0.02	10/10/2008	Not Applicable	F	5 months	45	—
SI9	ND	—	ND	0.02	10/10/2008	Regular Bow	F	3.5	120	—
SI11	ND	—	ND	2.60	10/10/2008	Regular Bow	M	1.5	120	Verified 4-Poster use
SI14	ND	—	ND	68.40	10/17/2008	Nuisance Shotgun	M	1.5	125	Verified 4-Poster use
SI15	55.9	—	ND	704.00	10/18/2008	Regular Bow	M	2.5	150	Verified 4-Poster use
SI20	ND	—	ND	71.30	11/3/2008	Regular Bow	F	2.5	120	Tagged (B12) Verified 4-Poster use
SI21	270.3	—	ND	5110.30	11/6/2008	Regular Bow	M	1.7	125	Verified 4-Poster use
SI22	ND	—	ND	107.20	11/8/2008	Regular Bow	M	2.7	140	Tagged (B052) Verified 4-Poster use
SI23	ND	—	ND	610.70	11/11/2008	Regular Bow	M	2.7	135	Tagged (A55) Corn in rumen. Verified 4-Poster use
SI24	ND	—	ND	258.80	11/11/2008	Nuisance Shotgun	M	1.7	125	Tagged (A57) Verified 4-Poster use
M1	ND	ND	ND	7.52	7/28/2009	Shotgun	M	1.2	120	Verified 4-Poster use
M2	ND	ND	ND	108.10	7/30/2009	Shotgun	M	2.2	155	Verified 4-Poster use
L3	ND	ND	ND	24.93	8/4/2009	Shotgun	M	Unknown Adult	90	Verified 4-Poster use
SI7-09	ND	ND	ND	131.74	10/2/2009	Nuisance	M	1.5	125	Corn present in rumen. Verified 4-Poster use.
SI-A20	ND	ND	ND	173.71	12/7/2009	Not Applicable	F	1.7	130	Corn present in rumen. Verified 4-Poster use.
SI13-09	ND	ND	ND	1089.55	10/15/2009	Nuisance Shotgun	M	1.5	130	Corn present in rumen. Verified 4-Poster use.
SI-B03	ND	ND	ND	297.26	10/11/2009	Not Applicable	F	2+	140	Corn present in rumen. Verified 4-Poster use.
SI17-09	ND	ND	ND	1030.89	11/19/2009	Nuisance Shotgun	M	1.5	140	Corn present in rumen. Verified 4-Poster use.
SI18-09	ND	ND	ND	34.98	11/23/2009	Regular Bow	M	3.5	165	Verified 4-Poster use
SI21-09	ND	ND	ND	435.43	12/1/2009	Nuisance Shotgun	M	1.5	125	Corn present in rumen. Verified 4-Poster use.
SI6-09	ND	ND	ND	5296.49	10/2/2009	Regular Bow	M	1.5	115	Tagged (A75) Corn in rumen. Verified 4-Poster use
SI24-09	ND	ND	ND	578.25	12/8/2009	Nuisance Shotgun	M	1.5	130	Corn present in rumen. Verified 4-Poster use.
SI25-09	ND	ND	ND	402.06	12/13/2009	Nuisance Shotgun	M	1.5	130	Verified 4-Poster use

* Denotes lab analysis procedures for coat swabs conducted by the NYSDEC Division of Solid and Hazardous Materials Laboratory using a MDL of 3.0 mcg while all others were conducted by Cornell AHDC using a MDL of 0.001 mcg/swab.
ND = No Detect

Table 4. Permethrin residues detected in coat swabs (micrograms (mcg) per swab), muscle (ppb), and liver (ppb) samples taken from deer on North Haven, New York during 2008 and 2009. Permethrin residue analysis was conducted by Cornell Animal Health Diagnostic Center (AHDC) using a MDL of 0.001 mcg/coat swab and 10 ppb for muscle and liver analysis. Residues results falling below MDLs are reported as no detection (ND). Hindquarter muscle samples were not collected during 2008 sampling and reflect a modification to the 2009 sampling protocol.

Deer ID	Muscle	Hindquarter Muscle	Liver	Coat Swab	Harvest and Sample Collection Date	Hunting Method	Sex	Approximate Age	Approximate Weight	Observations of 4-Poster Use
NH1	ND	—	ND	0.02	10/4/2008	Nuisance	F	4.5	115	Not Applicable
NH2	ND	—	ND	0.04	10/4/2008	Nuisance	F	5 months	50	Not Applicable
NH3	ND	—	ND	0.05	10/4/2008	Nuisance	M	5 months	50	Not Applicable
NH4	ND	—	ND	ND	10/27/2008	Nuisance	M	1.5	125	Not Applicable
NH1-09	ND	ND	ND	0.24	10/14/2009	Nuisance	M	6 months	50	Not Applicable
NH2-09	ND	ND	ND	0.23	10/27/2009	Nuisance	M	2.5	145	Not Applicable
NH3-09	ND	ND	ND	0.06	11/12/2009	Not Applicable	F	4.5	130	Not Applicable
NH4-09	ND	ND	ND	0.07	12/1/2009	Nuisance	M	1.6	135	Not Applicable
NH5-09	ND	ND	ND	0.06	12/9/2009	Nuisance	M	1.6	120	Not Applicable
NH6-09	ND	ND	ND	ND	12/9/2009	Not Applicable	F	6 months	50	Not Applicable

Figure 1. The spatial distribution of deer-vehicle collisions (DVC) on Shelter Island and North Haven during 2009 (white) and 2005 (red) in relation to 2009 4-Poster device locations (yellow). These data are being used to identify areas where DVCs are significantly clustered (hotspots) or are more likely to occur.

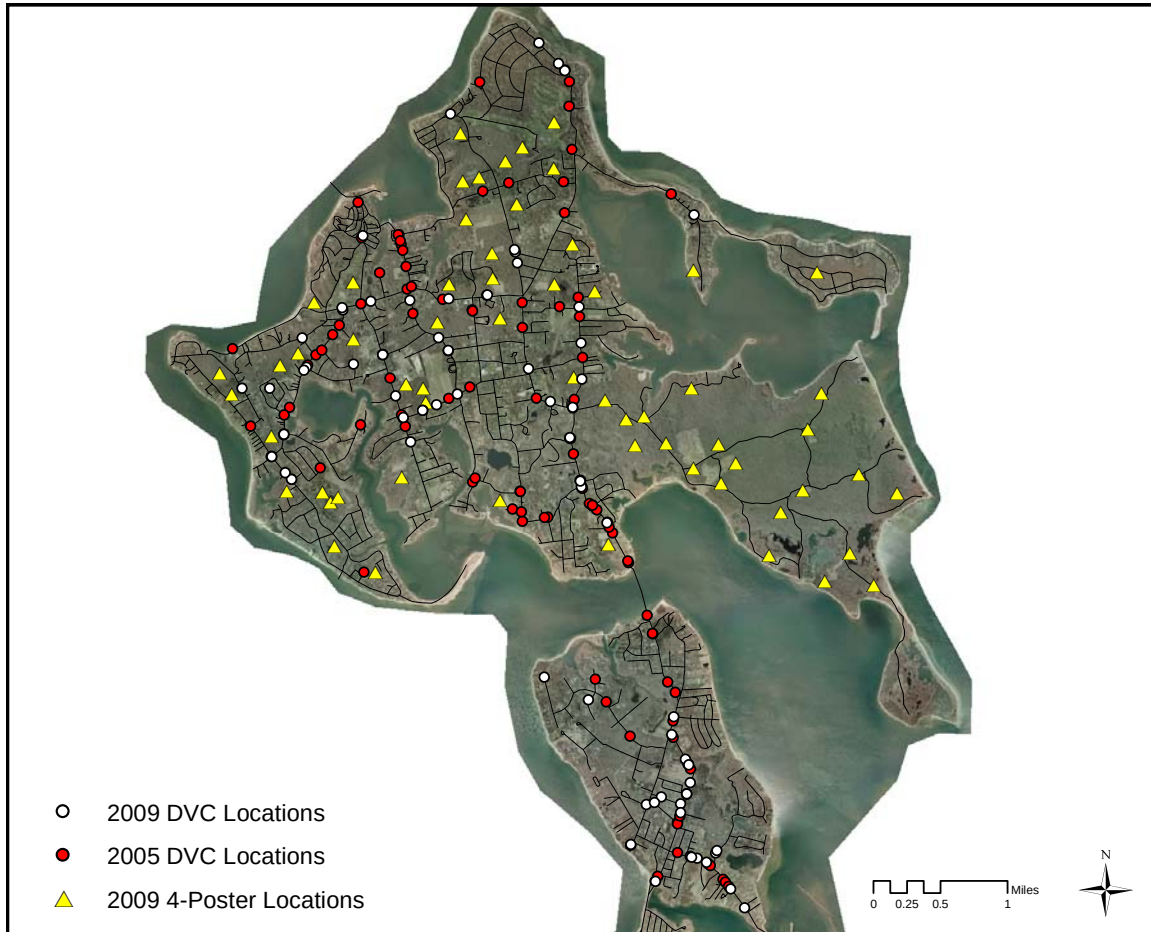


Figure 2. Different colored polygons represent the unique areas of habitat or home ranges 24 GPS collared does reside within on Shelter Island (treatment area) and North Haven (control area). 4-Poster devices locations are identified by yellow markers, Study Area B is delineated by the white boundary, and Study Area A is delineated by the black boundary.

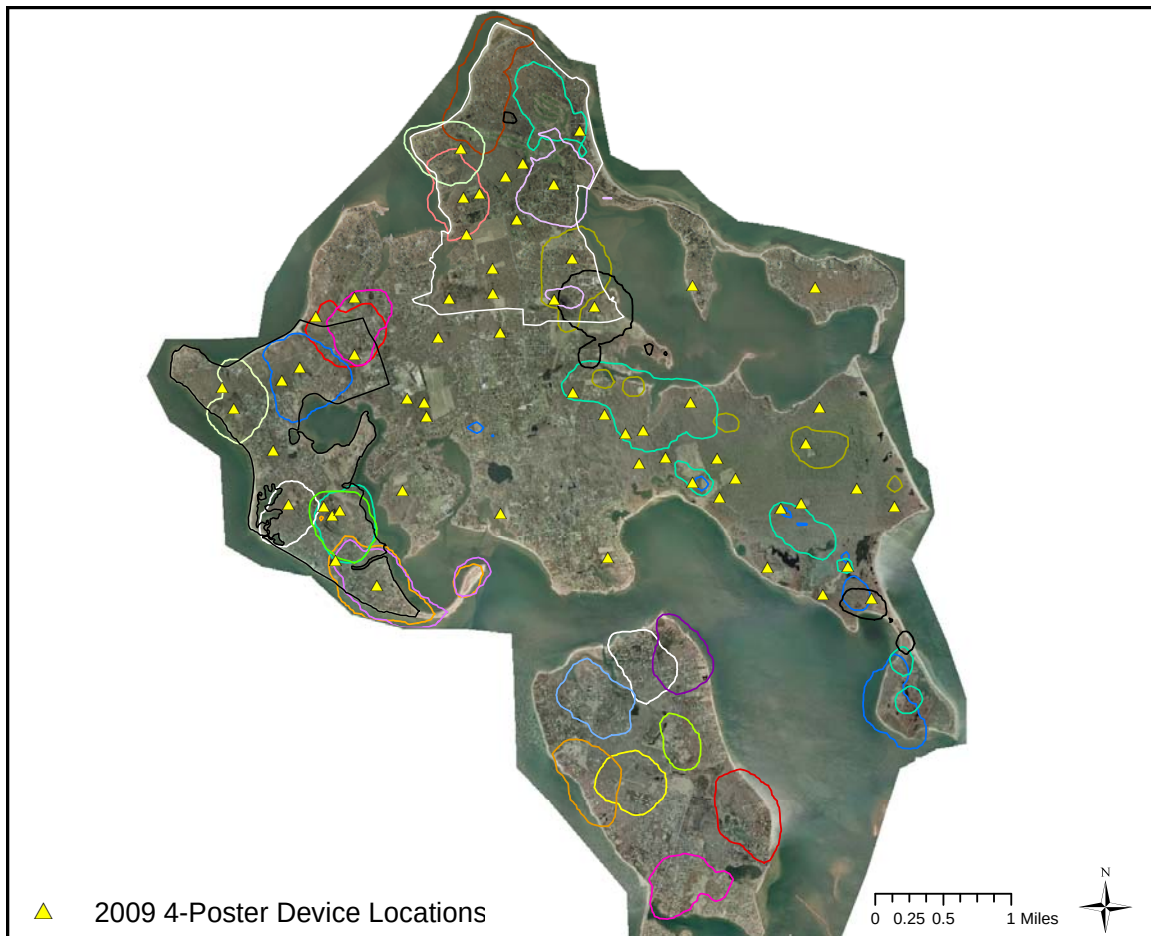


Figure 3. Site fidelity of deer home ranges and core areas each year is being evaluated to examine the influence 4-Poster bait stations may have on deer behavior on Shelter Island, New York. The home ranges A08 (Shelter Island, treatment area) occupied during 2008 and 2009 overlapped by more than 86% and similar results were observed for 002 (North Haven, control area).

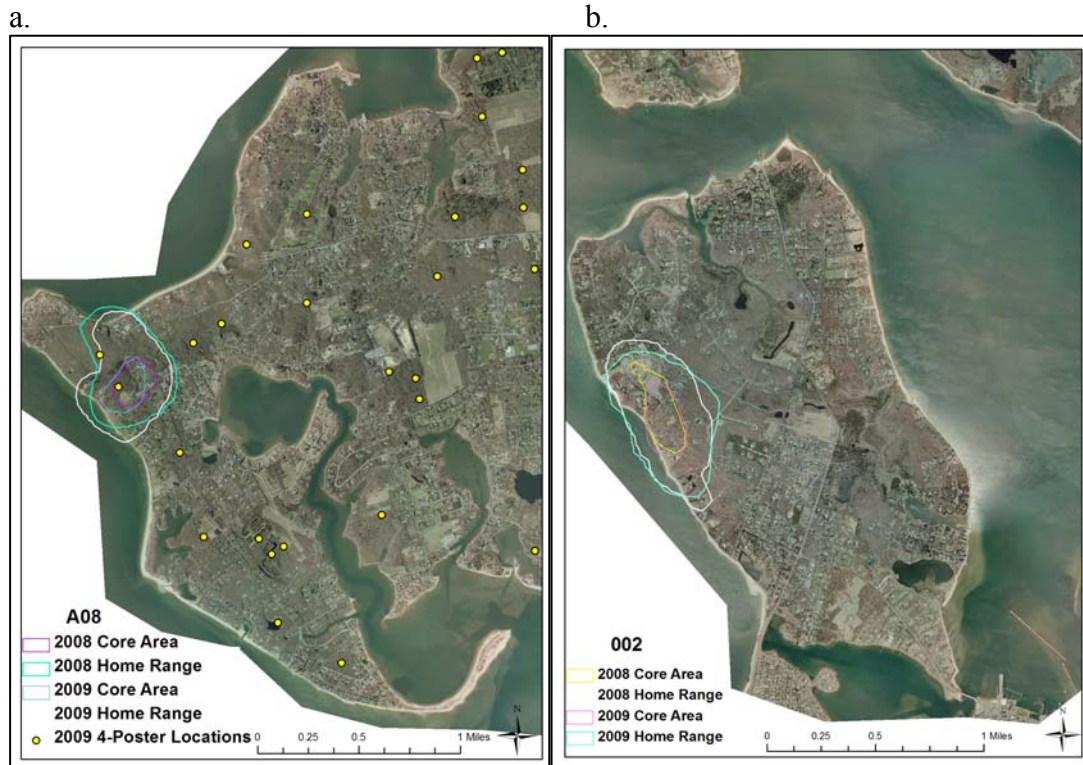


Figure 4. The movements of 2 GPS collared does, B15 and B23, serve as examples of deer incorporating larger areas of habitat into their home ranges on Shelter Island, New York.

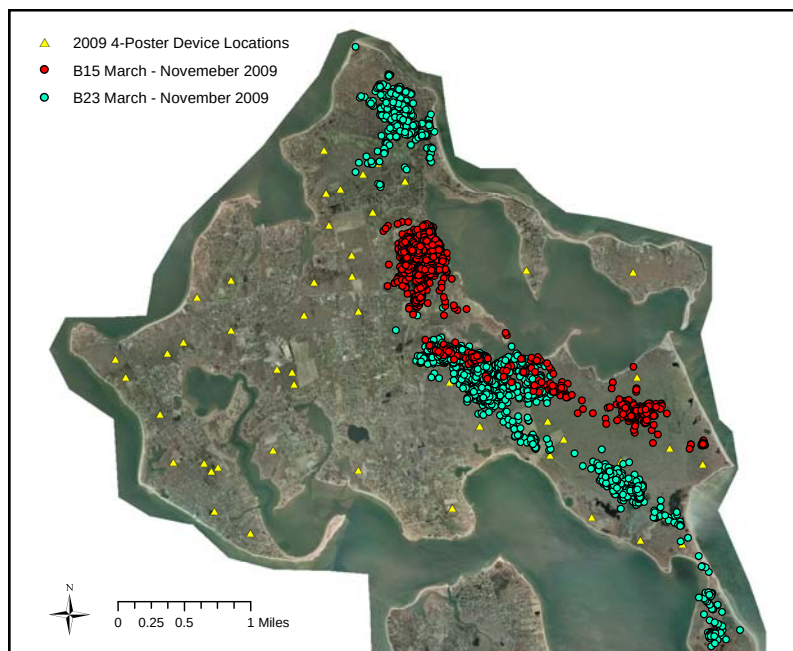


Figure 5. Corn consumption estimates of the average number of deer using each device per month during the 2008 4-Poster deployment season on Shelter Island, New York. The graduated symbols provide a spatial representation of the differences in the number of deer/device/month during the 2008 study year. Study Area B is delineated by the white boundary and Study Area A is delineated by the black boundary.



Figure 6. Corn consumption estimates of the average number of deer using each device per month during the 2009 4-Poster deployment season on Shelter Island, New York. The graduated symbols provide a spatial representation of the differences in the number of deer/device/month during the 2009 study year. Study Area B is delineated by the white boundary and Study Area A is delineated by the black boundary.



Figure 7a. Using trail camera photos collected during 2008, the relative activity index (total number of visits [photos] divided by the total sampling effort [number of camera days]) of each animal at devices was estimated throughout the 4-Poster deployment season (March-November).

7b. Using trail camera photos collected during 2009, the relative activity index (total number of visits [photos] divided by the total sampling effort [number of camera days]) of each animal at devices was estimated throughout the 4-Poster deployment season (March-November).

a.

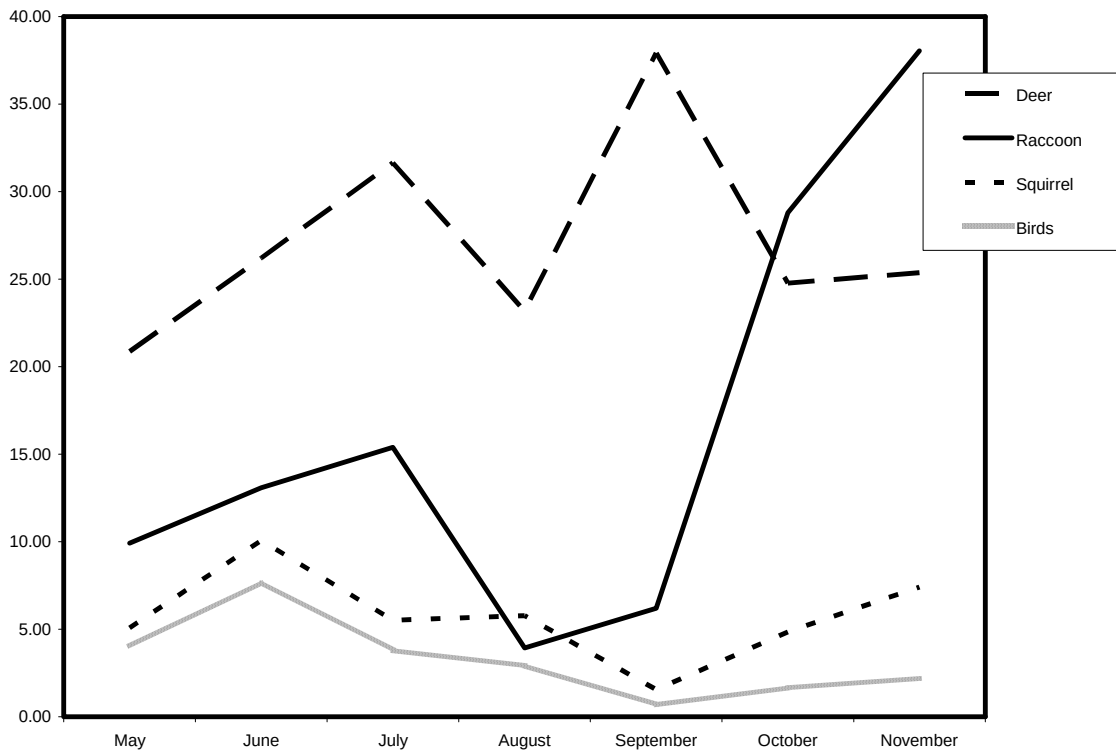


Figure 7. Continued

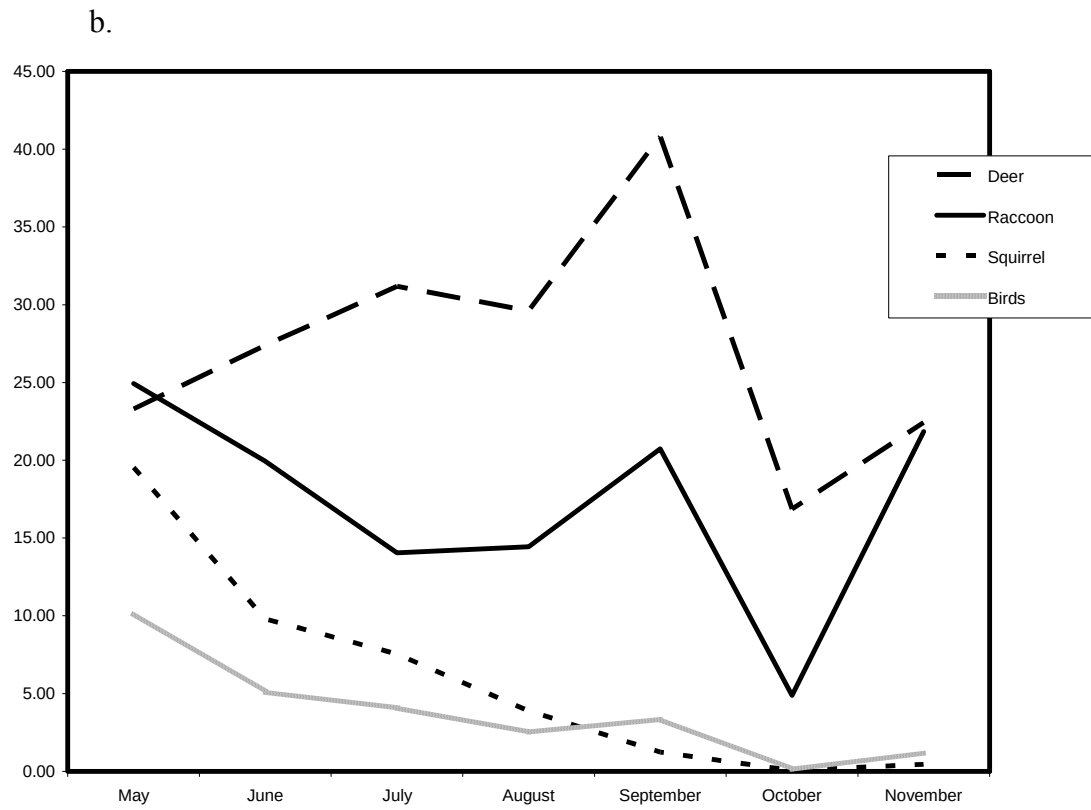


Figure 8. A photo capturing contact between deer feeding at a 4-Poster device on Shelter Island, New York.



Appendix 1. Safe handling recommendations for hunters in areas where 4-Poster technology is used.



Cornell University

White-tailed Deer: Harvest & Safe Handling

Susan M. Walker

Cornell University Department of Natural Resources, 4-Poster Deer & Tick Control Project

White-tailed deer on Shelter Island may have contacted permethrin present on 4-Poster devices that are being used by Cornell as a method for tick control. Any permethrin present will likely be on the deer hide, specifically on the head and neck. Based on permethrin residue sampling from hunter harvested deer during 2008, Cornell is providing the following recommendations for handling and processing deer harvested from Shelter Island. As an informed sportsman, you will find that many of these handling suggestions are standard protective measures recommended each time you handle and process a deer. Please visit the NYSDEC's deer and bear hunting webpage to review more information regarding deer harvest throughout NYS as well as information from the NYSDOH about lead in venison (<http://www.dec.ny.gov/outdoor/7857.html>).

*** ALWAYS WEAR PROTECTIVE RUBBER OR PLASTIC GLOVES WHEN HANDLING, FIELD DRESSING, AND PROCESSING YOUR DEER. CHANGE GLOVES BETWEEN EACH OF THESE STEPS.**

*** SKIN YOUR DEER STARTING FROM THE TAIL END AND MOVING TOWARD THE HEAD TO MINIMIZE CONTACT WITH THE FUR ON THE NECK.**

*** AVOID CONTACT BETWEEN THE HIDE AND THE MEAT YOU INTEND TO PROCESS FOR CONSUMPTION.**

*** DURING THE SKINNING PROCESS, REPLACE OR CLEAN YOUR KNIFE BETWEEN INITIAL INCISIONS THROUGH THE SKIN AND WHEN YOU USE THE KNIFE TO ASSIST PULLING THE SKIN DOWN.**

*** WASH YOUR HANDS THOROUGHLY AFTER FIELD DRESSING AND PROCESSING YOUR DEER.**

AS ALWAYS:

- Field dress your deer ASAP to speed the loss of body heat, especially in warm weather. This will slow bacterial growth and improve the quality of the meat.
- Clean out the body cavity with a damp cloth or paper towel to remove dirt, feces, hair, and bloodshot areas.
- Prop the body cavity open with sticks to allow for adequate air circulation.
- Minimize meat contact with the brain, spinal cord, spleen, and lymph nodes.
- You may be able to age your deer in a temperature-controlled room, set between 35 and 40°F, for up to a week.
- Wrap your venison tightly with heavily waxed paper, freezer wrap, heavy-duty aluminum foil, or plastic freezer bags before freezing or refrigerating. Take care to remove all excess air from the package. Deer venison will keep 9-12 months in a freezer when properly wrapped.
- Thoroughly clean and sanitize equipment and work areas with a 10% bleach solution (one part bleach in nine parts water) after processing.

For more information and/or interest in providing samples, please contact Cornell (631-749-0896). Also, visit our website

<http://wildlifecontrol.info/TickStudy/Pages/default.aspx>.

Appendix 2. Commercial pesticide applicators.

Shelter Island – except Mashomack (2008 – 2009)

John Bennett NY Commercial Pesticide Applicator ID# C1800309
Premier Pest Control, NY Business/Agency Registration # 10723
1736 County Rd 39, Southampton NY 11968
Phone 631-287-5551

Shelter Island –Mashomack (2008 – 2009)

Ilia Rochlin NY Commercial Pesticide Applicator ID# C1831788
Gerald Franklin NY Commercial Pesticide Applicator ID# C1831068
Chris Kampfer NY Commercial Pesticide Applicator ID# C1831171
Brian Viggiano NY Commercial Pesticide Applicator ID# C1831075
Danny Lopez NY Commercial Pesticide Applicator ID# C1800278
Glenn Springman NY Commercial Pesticide Applicator ID# C1659413
Steven Impellizzeri NY Commercial Pesticide Applicator ID# C1671627
Mike Masterson, NY Commercial Pesticide Applicator ID# 1831797

Suffolk County Dept. of Public Works – Division of Vector Control
NY Business/Agency Registration # 02189
335 Yaphank Ave., Yaphank, NY 11980
Phone 631-852-4010

Fire Island (2008-2009)

Lynn Frank NY Commercial Pesticide Applicator ID# C1269607
Kenny Munch NY Commercial Pesticide Applicator ID# C1806759
Suburban Pest Management LLC, NY Business/Agency Registration #14395
879 Jericho Turnpike Smithtown NY 11787
Phone 631-864-6900

Joe Brodtman NY Commercial Pesticide Applicator ID# C1839248 (2008)
Chris Thompson NY Commercial Pesticide Applicator ID# C1831746 (2008 – 2009)
John Cabral NY Commercial Pesticide Applicator ID# C1869557 (2008 – 2009)
Joseph Leissle, NY Commercial Pesticide Technician ID# T1874860
Robert Moses State Park, NY Business/Agency Registration #06505
PO Box 247, Babylon, NY 11702
Phone 631-669-0449