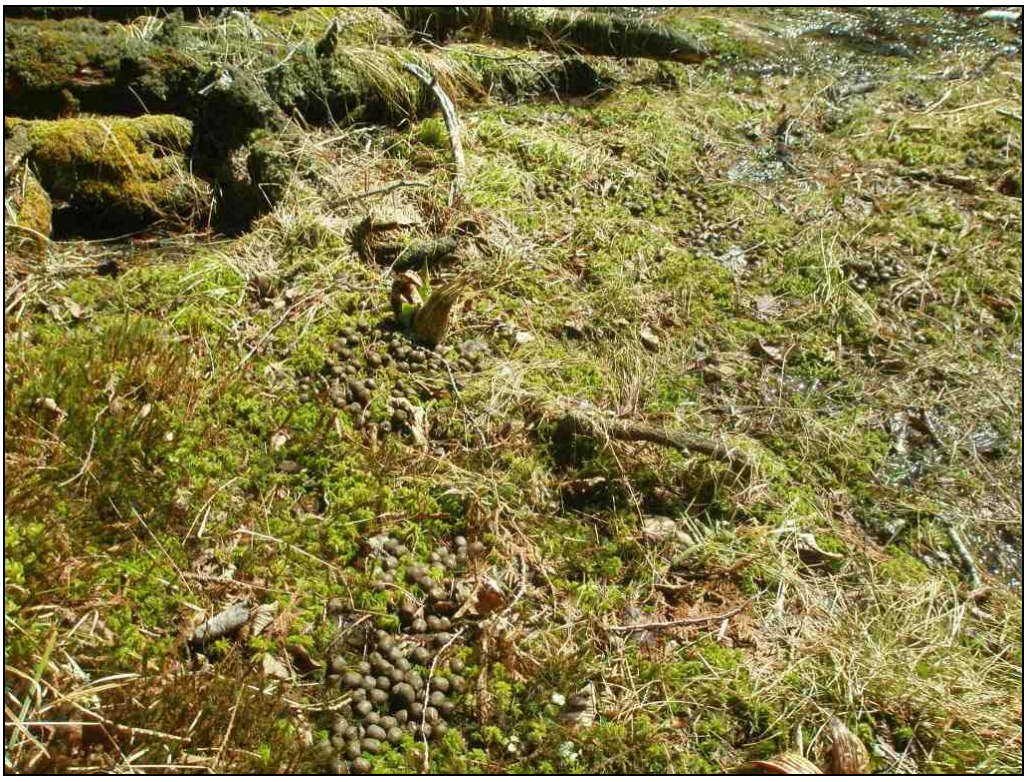
ISLESBORO DEER POPULATION ESTIMATE REPORT

MAY 2011



PREPARED FOR:
Tick-borne Disease Prevention Committee
Town of Islesboro
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Islesboro, ME 04848

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1.0 INTRODUCTION

Stantec Consulting (Stantec) was contracted by the Town of Islesboro's Tick-borne Disease Prevention Committee to conduct a white-tailed deer (*Odocoileus virginianus*) population estimate on Islesboro and 700 Acre Islands in the town of Islesboro, Maine. This work was completed to better understand the deer population on Islesboro so that more effective means of controlling deer ticks (*Ixodes scapularis*) and associated Lyme disease might ultimately be implemented on the island. This project is a collaborative effort between Stantec, the Town of Islesboro, and the Islesboro Tick-borne Disease Prevention Committee. This report summarizes the 2011 deer population estimate surveys completed on Islesboro and the subsequent data compilation and population estimate calculations. In addition, we offer observations and brief general comments regarding existing and predicted forest health conditions in relation to the locally high deer population.

A previous deer population estimate study was completed in 2010 as a collaborative effort between Stantec, the Islesboro Health Center, and the ninth grade biology class at Islesboro Central School, who used the study as their annual science project. For the 2010 work, students and local volunteers completed a portion of the transects and did the initial data entry and population estimate calculations. Both the 2010 and 2011 studies were completed in accordance with the 2010 Islesboro Deer Population Estimate Study Plan (Appendix A), which had been previously reviewed and approved by biologists from the Maine Department of Inland Fisheries and Wildlife.

2.0 SURVEY METHODS AND DATA REVIEW

Fifty-five randomly placed survey transects were located east to west across the Islesboro and 700 Acre Islands in order to sample the available habitats of both islands in accordance with the prescribed methods. The objective of the transect coverage was to create 3,154 survey plots located along 39 miles of transects on Islesboro and 625 plots located along 7 miles of transects on 700 Acre Island. The Tick-borne Disease Prevention Committee was responsible for contacting local landowners to gain access their properties for the study. Each transect was walked by Stantec biologists, and deer pellet groups were recorded on data forms for each sample plot. Copies of the original completed field data forms are available upon request.

Upon completion of the field surveys, Stantec biologists compiled the transect data into Excel spreadsheets and performed the population estimate calculations in accordance with approved study protocols. Stantec's data compilation effort focused on entering correct number of pellet groups for each plot and confirming that those plots that included snow cover, roads, driveways, houses, open water, salt marsh and beaches were omitted from the data set.

3.0 SURVEY RESULTS

Field work was completed on April 11-14, 2011. Surveys were completed before leaf-out and after the snowmelt in the majority of the study area. The winter of 2010/2011 did have above average snowfall, and a few remnant patches of snow were observed at the time of the survey. A total of 42 transects were completed as part of the deer population study on Islesboro, and an additional 13 transects were completed on 700 Acre Island (Figure 1). Landowner permission was granted on approximately 94 percent of the proposed transects. The properties without landowner permissions were not surveyed.

Following review of the plot data, it was determined that 2,651 plots were suitable to use for population calculations on Islesboro and 523 were suitable for use on 700 Acre Island. Stantec used this revised data set in accordance with the prescribed methods to calculate the number of deer per square mile and adjusted this number based on the quantity of deer taken during the 2010 hunting season (i.e., 9/11/10 to 12/11/10). Using a 95 percent confidence interval, Stantec determined the population density to be 48 (+/- 4) deer per square mile on Islesboro and 53 (+/- 4) deer per square mile on 700 Acre Island. Based on the size of Islesboro and 700 Acre Island, this calculates to a total deer population of approximately 744 deer and 62 deer, respectively. A summary of the data and calculation used as part of these estimates is contained in Appendix B.

4.0 DISCUSSION AND GENERAL FIELD OBSERVATIONS

The 2011 deer population estimate for Islesboro of 48 (+/-4) deer per square mile is down from the 2010 estimate of 62 (+/- 6) deer per square mile. The deer densities on Islesboro and 700 Acre Island, however, remain significantly elevated over the current literature recommendation of 10 deer per square mile needed to break the deer tick life cycle (Kirby 2007). While the 2011 surveys were limited to Islesboro and 700 Acre Island, it can also be inferred that nearby Spruce Island, Warren Island, and Job Island have similar deer densities, as these islands contain habitats similar to that found on Islesboro, and deer can easily swim between these adjacent islands. As such, the risk of Lyme disease on Islesboro and the surrounding islands is likely to continue to be high until appropriate efforts are made to lower existing deer densities.

In 2011, most deer signs (e.g., pellet groups, trails, scrapes) were observed near forest stands that offered deer wintering cover, primarily along the edges of the cedar wetlands and streams in upland stands. The forest canopy in these areas offered deer shelter from the deep snow of the winter of 2010/2011. This contrasts from general observations in 2010 where deer signs appeared to be more uniformly distributed across a range of habitat types because the deer were less restricted by snow depth during that milder winter.

While completing the deer transects, Stantec observed four deer carcasses on Islesboro and one on 700 Acre Island (Appendix C, Photo 1). No obvious signs of mortality were observed. It is interesting to note the lack of predators and scavengers on the islands as is evident by the relatively intact deer carcasses and skeletons (Appendix C, Photo 2). On the mainland, a deer skeleton would be in pieces and scattered over a much larger area.

In addition to the human health concerns associated with the Lyme disease, the high deer density on Islesboro also has significant ecological implications. Most of Islesboro's forested habitat is currently composed of mature softwood stands dominated by red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), and northern white cedar (*Thuja occidentalis*) with scattered eastern hemlock (*Tsuga canadensis*), larch (*Larix laricina*), and white pine (*Pinus strobus*) also present. Some mixed hardwood and softwood stands and hardwood stands are also found on the island. Dominant mature hardwood species include quaking aspen (*Populus tremuloides*), red maple (*Acer rubrum*), red oak (*Quercus rubra*), paper birch (*Betula papyrifera*), and yellow birch (*B. alleghaniensis*). Forested wetlands are also common on the island and dominated primarily by eastern white cedar, red maple, and balsam fir. Deer browse lines are readily evident on many tree species, creating open "park like" understory conditions throughout the island (Appendix C; Photo 3).

Field observations by Stantec indicate the current deer density exceeds the carrying capacity of the islands forest communities and is not sustainable over the long term. Present high deer population levels are significantly impacting the general ecological and silvicultural health of the island forests, and in particular, current forest regeneration. These observed impacts include loss of potential future regeneration and shifts in existing and future forest structures, an overall decrease in diversity of woody and non-woody vegetative species, and the continued establishment and spread of invasive plant species that are resistant to deer browsing, i.e., Japanese barberry (*Berberis thunbergii*) and bush honeysuckle (*Lonicera morrowi*) (Appendix C; Photos 4 and 5). Little or no regeneration of northern white cedar, oak, and northern hardwood tree species[1] is presently occurring due to the continued, high browsing pressure of the deer. Balsam fir regeneration is being strongly impacted (Appendix C, Photo 6), and impacts on red spruce growth, which is not a preferred browse species, are also occurring (Appendix C, Photos 7 through 9). These impacts are already resulting in a shift from the more recent, diverse, forest structure to one that will be largely dominated by red spruce (Appendix C, Photo 10). This shift is being expedited

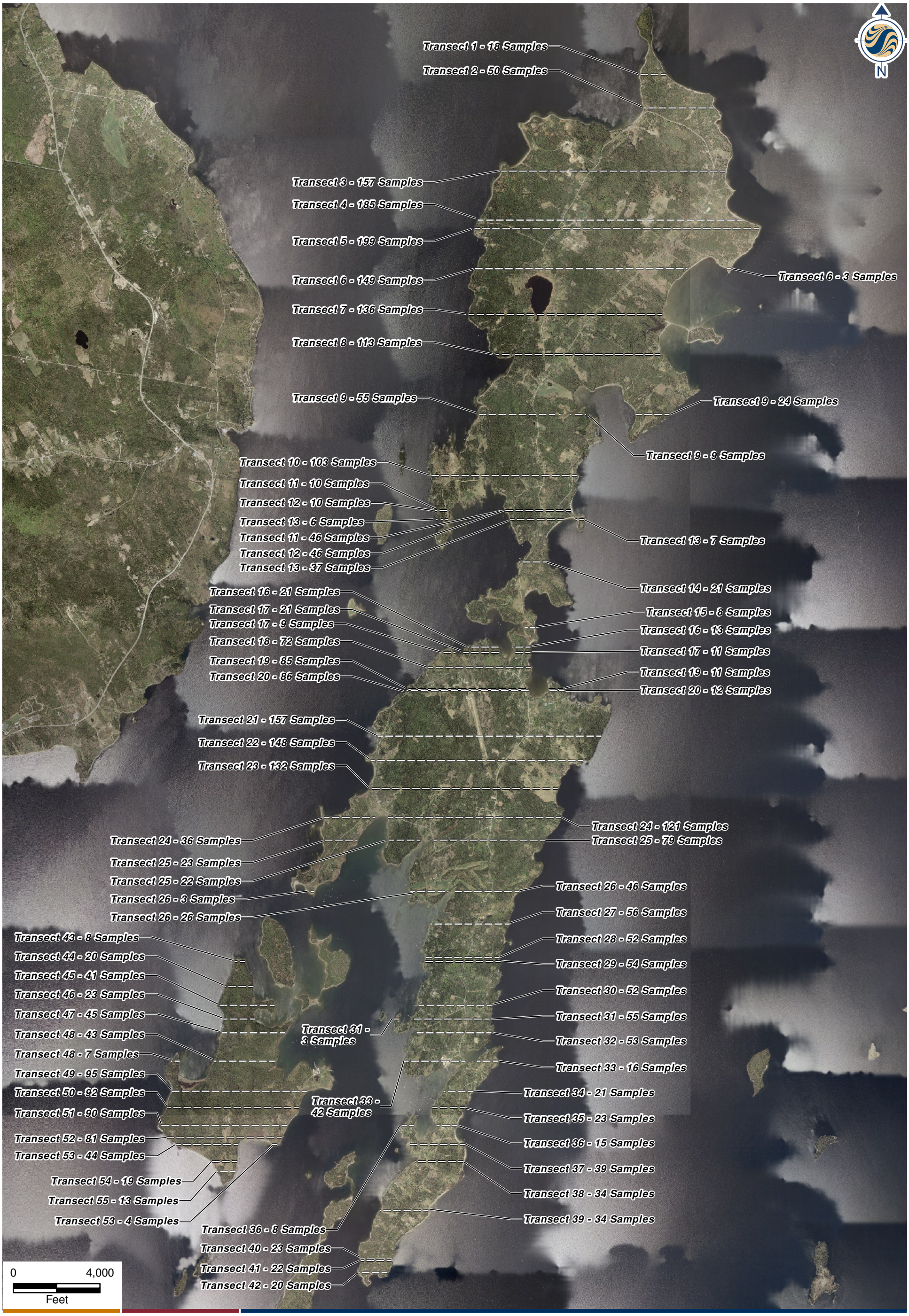
[1] The field survey occurred before leaf-out, which made it more difficult to observe hardwood regeneration. However, it appeared to be very limited based on our observations at the time. These observations of over browsing are however further supported by previous, direct observations by Stantec that occurred on Islesboro while conducting unrelated site assessment surveys during the 2007 summer and fall growing season conditions.

by blowdowns that were commonly observed on many areas of Islesboro and 700 Acre Island (Appendix C; Photos 11 and 12). The majority of Islesboro's forests have matured since the turn of the 20th century when the island was more widely used for agricultural purposes. These mature forest stands are now particularly susceptible to blowdowns due to the combination of shallow and/or wet soil conditions in many areas and the frequent exposure to high winds off the water. Deer browse is especially impacting regeneration of forest and establishment of invasive plant species in these blowdown areas.

5.0 REFERENCES

Dr. Kirby C. Stafford III, Vice Director, Chief Entomologist, Connecticut Agricultural Experiment Station, *Tick Management Handbook*, *An Integrated Guide for Homeowners, Pest Control Operators, and Public Health Officials for the Prevention of Tick-Associated Disease,* 2007.

FIGURE



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Legend

=== Sampling Transect

Client/Project
Islesboro Deer Survey
Isleseboro, Maine

Figure No.
1

Title
2011 Deer Survey Workplan
1/13/2011

00571-F01-Workplan2011.mxd

Appendix A

Work Plan

Islesboro Deer Population Estimate Study Plan

Introduction

Stantec Consulting (Stantec) has been contracted by the Islesboro Health Center to conduct a deer population estimate on the island of Islesboro, Maine. This work is being completed to better understand the deer population on Islesboro so the population can be more effectively managed in order to control deer ticks and associated Lyme disease. The following work plan covers surveys to be conducted in 2010 and can used as a template for future work. To best manage the deer population on Islesboro, Stantec recommends completing these surveys annually. This project is a collaborative effort between Stantec, the Town of Islesboro, the Health Center Advisory Board, local volunteers, and students. The ninth grade biology class at Islesboro Central School will use this work as an annual science project.

This work plan has been developed in general accordance with the Maine Department of Inland Fisheries and Wildlife (MDIFW) pellet group survey methods (MDIFW 1988) and additional consultation with Lee Kantar (State deer biologist) at MDIFW.

Establishing Transects

The layout of Islesboro creates technical challenges for conducting standard MDIFW pellet group survey transects. The standard methodology is typically conducted in large forest blocks and utilizes 0.5-mile transects run in courses at right angles to each other. Because of the shape of Islesboro, it is not possible to complete transects in this manner. Therefore, this work plan revises the standard methodology. A preliminary goal of 3000 plots was established based on MDIFW methodology, recommendations from Lee Kantar, and the layout and acreage of Islesboro. This goal of 3000 plots is based on 0.39 plot per acre and results in approximately 37.5 miles of transects.

For surveys conducted in 2010, transect locations were randomly established (Figure 1). For each transect, pellet group search plots were laid out at 1-chain (66-foot) intervals. Each plot is 25 feet long and 4 feet wide (i.e., 100 square feet), and the long axis of the plot extends along the transect line. There are no permanent plots or transect locations. A new set of random transects will be generated each year.

To establish the 2010 transects, transects running east to west were created in ArcInfo.[1] Transects are spaced north to south across the island and are eight feet apart so that there is no overlap in sampling. The attributes of each transect from ArcInfo have been exported into a transect attribute table in Excel, which contains the transect Feature ID and the length of the transect.[2] A simple script in Excel was used to generate a random number, and this number was used to select a transect. The script keeps track of the total length of all the transects as they are selected until the 37.5 miles target is reached or exceeded. The script copies each transect selected into a results worksheet. The results worksheet and the original transect shapefile are joined to select the transects to be used. From the selected transects, points that are 66 feet apart are used to identify the start point of each plot.

Field Methods

Surveys will be completed in the spring as soon as snowmelt is complete and before leaf-out begins. It is estimated that the field surveys will be conducted in early March. The Health Center and volunteers will contact landowners along each transect. Transect locations and/or numbers may need to be adjusted based on landowner permission.

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[1] ArcInfo is a geographic information system (GIS) software for performing advanced spatial analysis, managing, creating, and analyzing geographic data, and visualizing results on professional-quality maps.

[2] The Excel spreadsheet containing this script and the associated transect shapefiles will be provided to Islesboro. Transects for future years can be selected by using this script in association with the number of plots (number of transect miles) desired.

Although the overall goal of the project is to complete 3000 plots, it may not be possible to complete all plots in the time allowed. Each transect will be surveyed based on a randomly chosen order, and as many transects will be completed as time allows. The majority of the field work will be completed over a one week period in early March. During this week, two Stantec biologists will work with students and volunteers to complete as many transects as possible. Remaining transects will be surveyed by volunteers and students the following week.

A 25-foot measuring tape or rope will be used to lay out the plot during the field surveys. A four-foot measuring stick will be used by field crews to measure the width of the plot. Transect and plot locations will be uploaded to a handheld Global Positioning System (GPS) receiver for field surveys. The GPS will contain the beginning of each plot. No plots will be completed if they fall within natural obstacles (e.g., ponds or the shoreline) or developed areas (e.g., private homes, roads, gravel pits, cemeteries).

Within the search plot, all fresh deer pellet groups that fell entirely or partially within the plot will be recorded. Individual groups should number $\geq$ 30 pellets. Groups with less pellets should not be counted. Use the size, shape and color differences of pellets to differentiate individual groups in high density locations. Fresh (i.e., since leaf fall) groups will be dark and shiny and will lie atop most forest litter. Old groups will be partially covered by litter. Old groups will also be crumbly, lighter colored and often partially broken apart by weathering. Do not record deer pellet groups that were deposited prior to last fall's leaf-fall.

On the project data form (attached), record the transect number, plot number, and the number of deer pellet groups at each 100-square foot search plot. When no deer groups are found in a search plot, record a zero. Record moose pellet groups, evidence of deer yards, and dead deer in the notes section. Also record the habitat type for each plot location (see data form).

Data Analysis and Reporting

The Islesboro biology students will compile the transect data into Excel spreadsheets and complete the population estimate calculations. Data quality assurance/quality control will be maintained by their teacher, Heather Sinclair, and the lead Stantec biologist. Students will prepare a brief narrative report describing the survey methods, results, and analyses of the results. The report will include map(s) as appropriate of the surveyed transect locations and local deer abundance. Recommended discussion topics for the report include sources of error associated with this survey method and uncertainty associated with the data. Stantec can provide an outline for this report if needed.

Deer density is estimated from deer pellet group plot data. The general formula is as follows:

> Deer/mi^2 = (Estimated # of deer pellet groups per mi^2 $\div$ Deer defecation rate) $\div$ Deposition period in days.

The accepted value for defecation rate for deer on fall and winter diets is 13 pellet groups per day. The deposition period will be the number of days since days from leaf-fall to the date of the spring pellet survey. November 1 is the date when leaf-fall is complete in most parts of Maine.

The statistical entity will be the total number of deer pellet groups per plot. From this, the mean number of pellet groups per mi^2 $\pm$ with a chosen confidence level can be calculated. Pellet group data can be adjusted for deer removed by legal hunting in November.

Equipment List
Data Forms-waterproof paper
4-foot measuring stick
25-foot tape or rope
Field maps
Handheld GPS
Rain gear
Hiking boots/Rubber boots

Attachments
Figure 1 Transect Locations
Data Form

Reference
Maine Department of Inland Fisheries and Wildlife (MDIFW). 1988. Pellet Group Surveys. Wildlife Resource Assessment Section, Bangor.

Isleboro Pellet Group Data Form

General Information

Date:_____ Time:_____ Surveyors:_____

Transect Number:_____

Weather Observations

Sun/Clear:_____ Overcast/Rain:_____ Wind Direction:_____ Ambient Temp.:_____(°C / °F)

Plots

Plot Number	Pellet Groups	Habitat Type *	Notes
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Habitat Types:

Softwood forest (S)- Plot dominated by coniferous trees (>75%)

Mixed Fored (M)- Plot contains a mixture of coniferous and decidous trees

Harwood Forest (H)- Plot is dominated by decideous trees (>75%)

Field (F)

Lawn (L)

Other (O)- Note habitat

Appendix B

Summary of Calculations

Isleboro Summary of Data and Calculations

Data	Number	Summary
Initial Estimate		
Number of proposed plots	3154	Number of proposed plots as part of the original work plan.
Number of usable plots	2651	Number of plots used as part of the deer population estimate. Plots containing snow cover, roads, driveways, houses, open water and beaches were omitted from the data set. Proposed plots on land lacking landowner permission were also omitted.
Average number of pellet groups per plot	0.374198	Average of all pellet group counts from all usable plots.
Number of 100 square foot plots per square mile	278784	
Deer defecation rate	13	Number of pellet groups per day per deer
Deposition period in days	163	Number of days from leaf off (Nov. 1) to the date of the surveys.
Pellet groups per square mile	104320.5	Calculated by multiplying the average number of pellet groups times the number of 100 square foot plots in a square mile.
Deer density	49.23102	Deer/mi^2 = (Estimated # of deer pellet groups per mi^2 ¸ Deer defecation rate)¸ Deposition period in days.
Confidence Interval		
Standard deviation	0.818373	Standard deviation of the pellet group data
Confidence Interval	0.031153	Calculated by using a 95% confidence interval and the standard deviation
Confidence value	4.09856	Number of deer per square mile based of the confidence interval.
Deer estimate with confidence interval	49 +/- 4	
Incorporation of Deer Hunt		
Number of deer taken during 2010 season	146	
Number of days of hunt	91	
Number of days of hunt during leaf off	41	
Number of pellet groups contributed by hunted deer	17269.2	For the purposes of this calculation, it was assumed that deer were harvested at a consistent level throughout the hunting season. Therefore, by the Nov. 1 leaf off date, 64 hunted deer were remaining. The number of deer contributing pellet groups decreased each day for the remainder of the hunt down to 0 on the last day. Each day a total pellet groups were calculated for these deer and added to get the total pellet group number.
Pellets per square mile contributed by hunted deer	1569.927	Total pellet groups divided by the area of Islesboro in square miles.
Final estimate	48.49014	Recalculation of deer density having subtracted the number of pellet groups per square mile contributed by hunted deer.

700 Acre Island Summary of Data and Calculations

Data	Number	Summary
Initial Estimate		
Number of proposed plots	625	Number of proposed plots as part of the original work plan.
Number of usable plots	523	Number of plots used as part of the deer population estimate. Plots containing snow cover, roads, driveways, houses, open water and beaches were omitted from the data set. Proposed plots on land lacking landowner permission were also omitted.
Average number of pellet groups per plot	0.407266	Average of all pellet group counts from all usable plots.
Number of 100 square foot plots per square mile	278784	
Deer defecation rate	13	Number of pellet groups per day per deer
Deposition period in days	164	Number of days from leaf off (Nov. 1) to the date of the surveys.
Pellet groups per square mile	113539.2	Calculated by multiplying the average number of pellet groups times the number of 100 square foot plots in a square mile.
Deer density	53.25478	Deer/mi^2 = (Estimated # of deer pellet groups per mi^2 ¸ Deer defecation rate) ¸ Deposition period in days.
Confidence Interval		
Standard deviation	0.871266	Standard deviation of the pellet group data
Confidence Interval	0.033166	Calculated by using a 95% confidence interval and the standard deviation
Confidence value	4.336852	Number of deer per square mile based of the confidence interval.
Deer estimate with confidence interval	53 +/- 4	
Incorporation of Deer Hunt		
Number of deer taken during 2010 season	3	
Number of days of hunt	91	
Number of days of hunt during leaf off	41	
Number of pellet groups contributed by hunted deer	31.81818	For the purposes of this calculation it was assumed that deer were harvested at a consistent level throughout the hunting season. Therefore by the Nov. 1 leaf off date 1 hunted deer were remaining. The number of deer contributing pellet groups decreased each day for the remainder of the hunt down to 0 on the last day. Each day a total pellet groups were calculated for these deer and added to get the total pellet group number.
Pellets per square mile contributed by hunted deer	1569.927	Total pellet groups divided by the area of Islesboro in square miles.
Final estimate	**53.23985**	Recalculation of deer density having subtracted the number of pellet groups per square mile contributed by hunted deer.

Appendix C

Photographs

Photo 1. Dead deer observed on 700 Acre Island
Stantec Consulting, April 2011.

Photo 2. Intact deer skeleton on Islesboro as evidence of lack of predators/scavengers.
Stantec Consulting, April 2011.

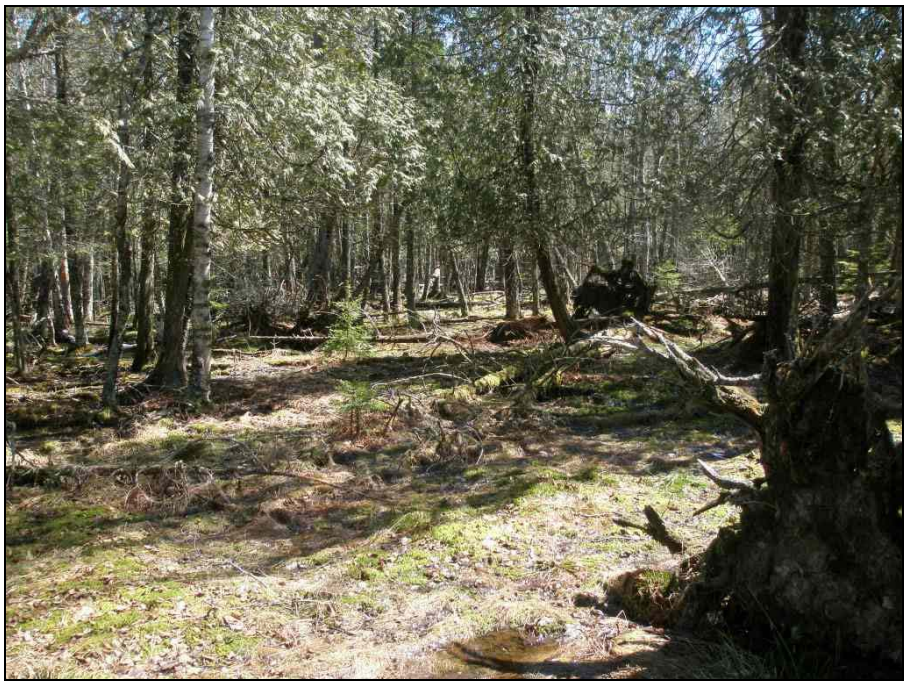

Photo 3. Cedar browse lines.
Stantec Consulting, April 2011.

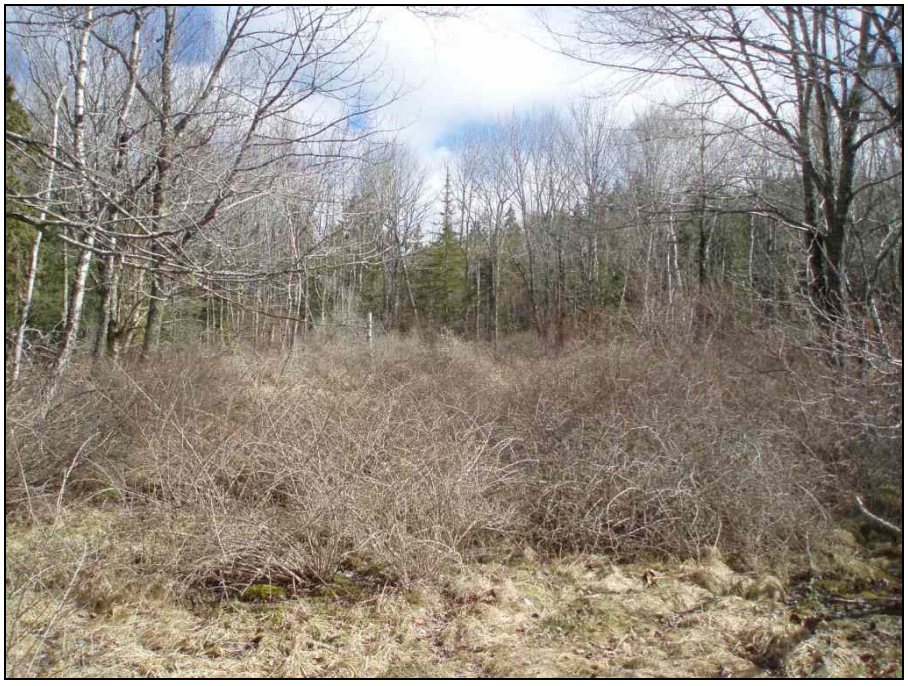

Photo 4. Invasive Japanese barberry.
Stantec Consulting, April 2011.

Photo 5. Invasive Japanese barberry in a blowdown on 700 Acre Island. Stantec Consulting, April 2011.

Photo 6. Heavily browsed balsam fir regeneration. Stantec Consulting, April 2011.

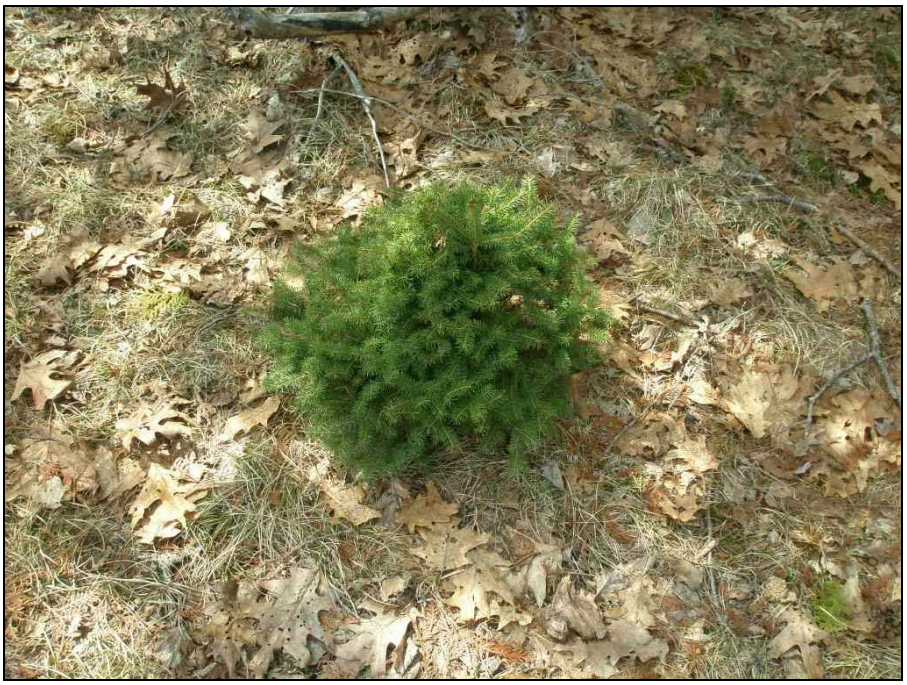

Photo 7. Stunted abnormal growth of red spruce.
Stantec Consulting, April 2011.

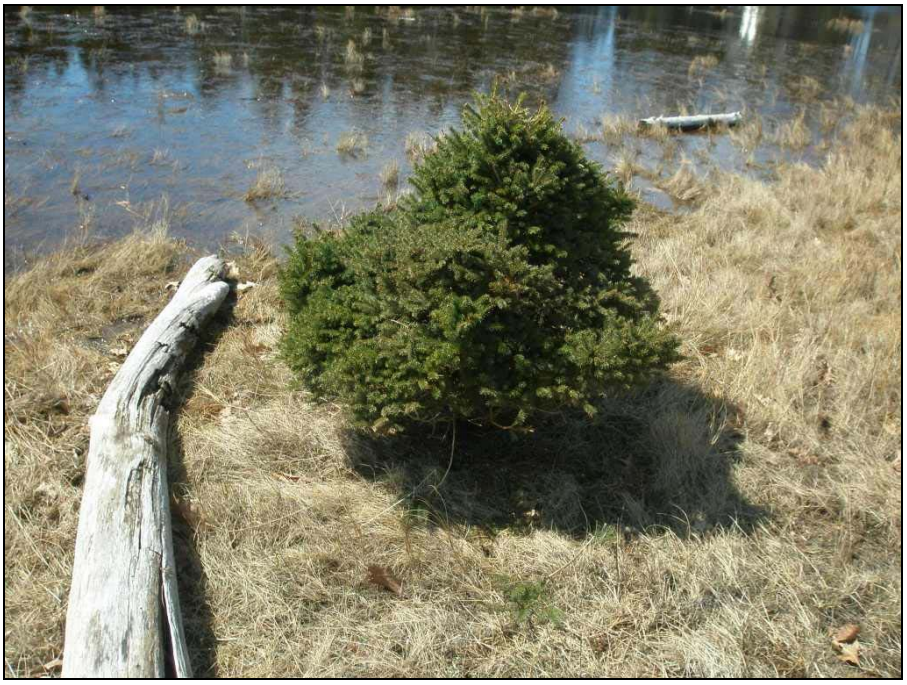

Photo 8. Stunted abnormal growth of red spruce.
Stantec Consulting, April 2011.

Photo 9. Stunted abnormal growth of red spruce.
Stantec Consulting, April 2011.

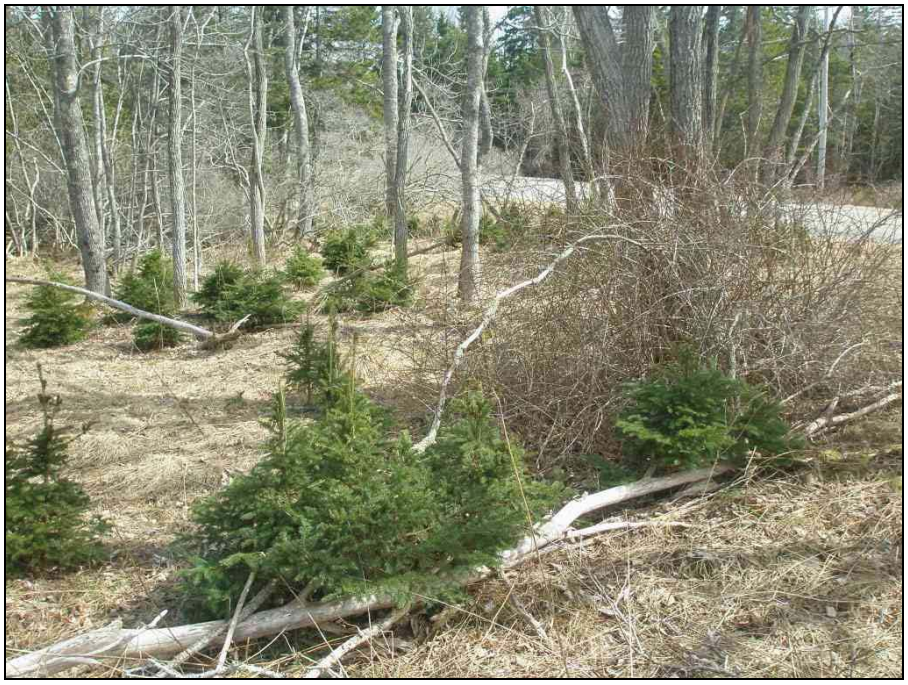

Photo 10. Hardwood stand transitioning to red spruce and Japanese barberry pressure from browsing deer. Stantec Consulting, April 2011.

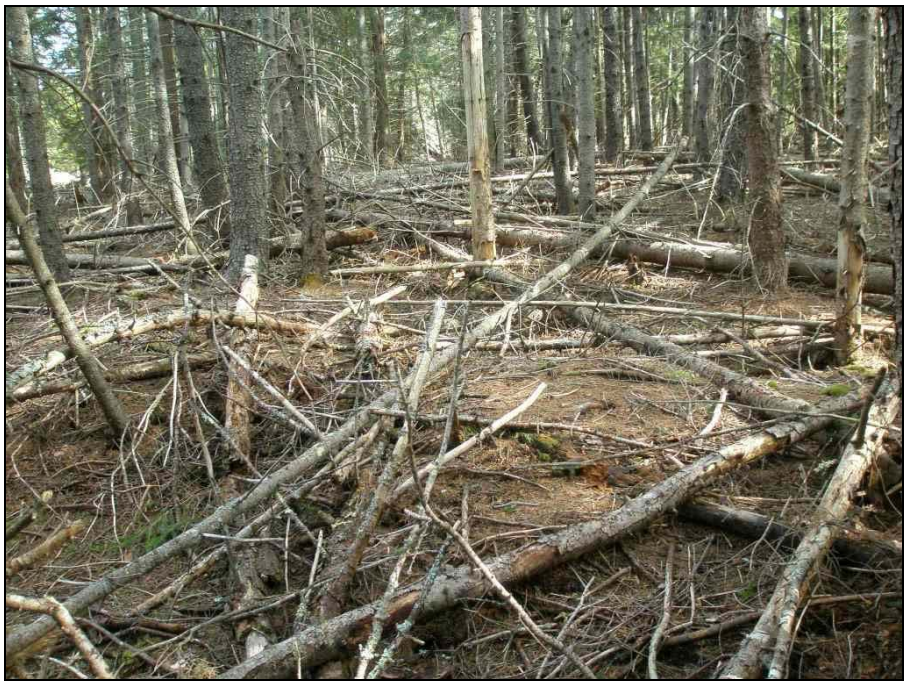

Photo 11. Blowdowns in a mixed softwood and hardwood stand.
Stantec Consulting, April 2011.

Photo 12. Blowdowns in a softwood stand.
Stantec Consulting, April 2011.