

Proposal & Field Protocol

**REGENERATION OF FOREST VEGETATION IN RESPONSE TO BROWSING BY
MOOSE AND DEER: AN EXPERIMENTAL APPROACH USING ENCLOSURES**

**Justin A. Compton, Department of Natural Resources Conservation, University of
Massachusetts, Amherst, MA 01003; 413-545-1562; compton@nrc.umass.edu**

**Stephen DeStefano, U. S. Geological Survey, Massachusetts Cooperative Fish and Wildlife
Research Unit, University of Massachusetts, Amherst, MA 01003; 413-545-4889;
sdestef@nrc.umass.edu**

**Cooperators: Massachusetts Division of Fisheries and Wildlife, Massachusetts Department
of Conservation and Recreation, Connecticut Department of Fish and Wildlife,
University of Massachusetts Amherst, Harvard University, U. S. Forest Service,
U. S. Geological Survey**

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INTRODUCTION

Over the past 200 years as Massachusetts has become increasingly populated, human distribution, land cover, and wildlife habitats have become more heterogeneous. Statewide, forest area peaked in the 1980s, and forests continue to mature with harvesting at moderate intensity (Berlik et al. 2002). Development, suburban fragmentation, and landscape degradation continue, particularly in eastern Massachusetts. Meanwhile social attitudes towards wildlife are shifting toward conservation and preservation, particularly through open-space acquisition and protection (Foster 2002). As a consequence of historical changes in land use, land cover, and human attitudes, there has been a remarkable change in the abundance and distribution of wildlife within the state including the re-appearance of moose (*Alces alces*), a species extirpated from the state in the early 1700s.

The increase in the Massachusetts moose population in recent decades has led to interest and concern about the interaction between forestry and moose. Moose can have landscape level effects on vegetation (Risenhoover and Maass 1987 and McInnes et al. 1992) and it is unclear what their impact will be on forest dynamics (i.e., composition, structure, and regeneration) and timber assets in Massachusetts. One of the main points of interests for sustainable forestry in the Commonwealth regarding moose is the potential for excessive browsing. Browsing by moose on young tree species may include twig browsing, stem breakage, and leaf and bark stripping. The damage, depending on severity, may reduce growth or lower stem and timber quality. In addition, preferential browsing by moose may alter species composition of forest stands over time. Dense and expansive stands of woody vegetation, such as regenerating cutovers, with high amounts of usable forage tend to attract concentrations of moose. High or repeated moose

browsing can significantly impact productivity and species composition of woody browse (Snyder and Janke 1976). Along with forest conservation, managing wildlife has become a critical component in the state's ability to conserve and preserve its unique flora and fauna. Moose are a species of particular interest because of their abilities to affect forest stand regeneration and composition, and their presence is indicative of successful forest regeneration and management.

RESEARCH NEEDS

There is a need to understand the ecology of moose as they recolonize southern New England. This need can be categorized into four major areas of interest: (1) ecological, including population dynamics and habitat relationships, (2) forest management and sustainability, (3) human interactions and dynamics and, (4) challenges to managing a large animal in a region with high human population densities and extensive development.

GOALS AND OBJECTIVES

Our primary objectives are to (1) quantify the composition, structure, and regeneration success of woody browse in harvested plots that are (a) protected from all browsing by moose and deer, (b) protected from moose browsing but subjected to deer browsing, and (c) subjected to all browsing from moose and deer; (2) document the amount of browsing on twigs and buds and estimate bud "survival" in all plot types, and (3) improve our understanding of moose browsing and its importance for the management of forest stands.

METHODS

With the aid of DCR personnel, we have established 3 sets of moose exclosures within the Quabbin (Prescott and Dana) and Ware River watersheds. Each set of exclosures is

comprised of 4 plots (full, partial, and paired controls) (Fig. 1). Exclosures were established in upland white pine, oak, and mixed hardwood stands that had been logged within 3-4 months before construction of exclosures. The purpose of this experiment is to determine the long-term influence of moose on the structure and species composition of the forest types in Quabbin and Ware River watersheds. Data collected from exclosures and paired controls will be compared in order to discriminate between the effects of moose browsing and forest community succession.

PLOT DESIGN

Treatment and control plots are 20 m x 20 m (66' x 66'). Within each plot, there is a 3 m buffer around the entire border; sampling does not occur in this buffer. A 5 x 5 matrix of subplots is laid out in the center of the plot (Fig. 2). Each circular subplot is 2.25 m in diameter and separated from adjacent subplots by 0.75 m (100 m² total sampling area per plot) (McInnes et al. 1992). The center of each subplot will be marked with a permanent stake, and will be identified with a single letter, starting with A at the northwest corner and lettered sequentially (A-Y) moving in a easterly direction to label all subsequent subplots (Fig. 2). In addition, the entire plot will be identified in a grid pattern (Fig. 2) starting with 1 at the northwest corner and numbered sequentially (1-36) moving in a easterly direction to label all subsequent plots (Appendix A).

CONSTRUCTION TECHNIQUES AND MATERIALS

After exclosure locations have been identified and all silvicultural treatments have been performed, the construction of exclosures can begin. The initial step is designating placement locations of exclosures and controls within the harvested area. Placement of all plots should be similar with respect to distances from edge of treatment area and should maintain a minimum

distance of 10 m (32') between plots. Following an estimated idea of plot location, the corners of each plot are staked-out and surveyed (i.e., measure lengths and angles of each side).

Subsequent to beginning construction and after the corners have been staked and sides surveyed the fence line should be cleared of all debris (e.g., woody material, vegetation, stumps, movable-rocks, leaf litter). The fence line is cleared for construction access for crews, equipment, material, and future maintenance.

Slash within the plot should be redistributed to be “even” among all future plots. Slash redistribution occurred in areas in which slash appeared in large piles or in areas where it was altogether absent. During redistribution, we removed slash from large piles and placed it in areas where slash was absent or in areas in which slash occurred below the average level of the plot. Initial redistribution was done on a coarse scale, meaning no volume calculations or other quantifiable measurements were done. Future redistribution of slash may occur if necessary after coarse woody debris calculations have been made.

After fence lines have been cleared and slash redistributed, post locations should be measured and marked. Post locations are marked at each corner and every 4 m (13 ft) along the surveyed plot sides. Postholes were constructed using a tractor mounted 3-point auger, 22 cm diameter x 91 cm length, (9” diameter x 3’ length) and manual posthole digger when necessary. Postholes were constructed to a depth of 0.6 m (2 ft). Once sufficient posthole depth was achieved, wooden posts, 3 m x 10 cm x 10 cm, (10’ x 4” x 4”) were placed inside, leveled, and holes were backfilled and compacted until posts were deemed sturdy. Once posts were set, angled wooden braces 1.5 m (5’) were cut and attached to the set post using SIMPSON Strong-ties[®] (model AC) and affixed with 5 cm (2”) galvanized nails. Braces were placed on the inside

of the exclosures to combat pressure being applied to the outside of the fence. Corner posts were affixed with two braces to aid in overall strength and stability of constructed exclosure.

After all posts had been set and adequately braced we installed TIGHTLOCK FENCING[®], a high-tensile woven wire 12.5 gauge, heavily galvanized steel, 2.4 m high (8'), with 20 horizontal line wires with 15.2 cm (6") between vertical stays. The tension curves in the fencing prevent the fence from losing tension when pushed by animals. Because of this property, the fence should not require stretching as tightly as do net wire and high-tensile smooth wire, which usually stretch upon impact. With less tension on the fence, it is less likely to break when hit, thereby reducing long-term maintenance costs. It also is less likely to injure an animal that runs into it. This type of fencing is very useful in heavy snowfall areas as well. The fencing is affixed to the posts using 5 cm (2") fence staples. When constructing the full exclosure the bottom of the fence is touching the ground, and when constructing the partial exclosure the bottom of the fence is stapled to the posts 0.6 m (2') above the ground. Fencing is placed on the side of the posts that will receive the most pressure from animals, to reduce strain against the staples attaching the fencing to the posts. In this case, the woven wire will be stapled to the exterior side of the exclosures.

CHARACTERIZATION OF PLOTS

Once plots are constructed, it is important to document the starting features and conditions of all treatment, control, and surrogate plots at the beginning of the experiment, and to continue to monitor those features over time.

(1) Digitizing Plots and Subplots

Using a handheld GPS unit (Garmin GPSMAP 60CS) each plot will be digitized. GPS

locations will be taken at all posts, and at all subplots in the 5 x 5 matrix. Locations will be recorded in UTM coordinates using North American Datum 1983 and transcribed on an associated data form (Fig. 3) (Appendix B).

(2) Landscape and Vegetative Features

For each established plot, we will map out and field digitize all landscape and vegetative features within the 20 m x 20 m (66' x 66') plots on a 400 square grid (Fig. 4). Features to be mapped and digitized will be all stumps, major rocks, large logs and other major woody debris, any residual trees or shrubs >0.5 m (19") in height. Other features will be mapped, digitized and recorded as deemed necessary (Appendix C).

Map and digitize all major landscape and vegetative features on 36 square grid form and record data on associated data form (Fig. 5):

- all stumps – record grid location, species, dbh, height, sprouting
- all large logs – record grid location, species, dbh, length
- large rocks and outcropping – record grid location, approximate area
- residual trees and shrubs – record grid location, species, dbh, height
- other features – identify, record grid location, pertinent information

(3) Slash and Coarse Woody Debris

We will conduct a woody detritus survey to measure coarse woody debris (CWD) that includes snags, logs, and stumps (>7.5 cm in diameter). To measure these components we will utilize a line intercept method (Van Wagner 1968 and Harmon and Sexton 1996).

In each 20 m x 20 m plot we will have 2 diagonal transects run from corner to corner and 2 transects that bisect the plot in a N-S direction and E-W direction (Fig. 6). All surveys will

start in the NW corner of the plot and transects will be completed in a clockwise rotation. To survey CWD we will measure the diameter of every piece of wood that intersects the line-transect (>7.5 cm in diameter) using a 50 cm caliper and we will note the grid location (20 m x 20 m) (Van Wagner 1968 and Harmon & Sexton 1996) (Fig. 7). In addition, we also will be recording species when possible and decay class as defined by Pyle and Brown (1998). We can calculate CWD volume per unit area by using the formula $V = 9.869 * \sum (d^2 / 8L)$, where L is transect length (m) and d is the piece diameter (m) (Van Wagner 1968 and Harmon and Sexton 1996). The goal will be to have similar types and amount of CWD in all plots. We will monitor the change in CWD in the plots over time (Appendix D).

(4) Digital Photographic Record

We will establish 2 camera points in each plot so we can take a digital photograph of the plot at least once during each season. The camera points will be fixed locations in 2 of the corners (SW and SE corners) and will be comprised of a 1.5 m post with a small platform marked by a directional arrow (Appendix E).

Camera posts inside SW and SE corners will be construction as follows:

- set post 1 m in from corner
- set post with small platform 1.5 m height above ground
- direct camera to opposite corner (to NE and NW) and check coverage
- mark permanent directional arrow on platform
- take digital photographs in May, August, November, and if possible, January

(5) Surrogate Plots

A minimum of 1 surrogate plot will be placed at each site. Surrogate plots will be placed

in adjacent and untreated (e.g., non-harvested) stands and will be a minimum of 10 m (33') away from the stand edge. Surrogate plots will be sampled in a similar fashion to other exclosure and control plots.

MEASUREMENT OF WOODY VEGETATION AND BROWSE

For each 2.25 m diameter subplot within the 5 x 5 matrix, we will record species, height and dbh of each individual woody plant (Fig. 8). This will give us 100 m² total sampling area within each plot. Woody plants will be classified as tree seedlings (< 30 cm high and < 2.5 cm dbh), saplings (> 30 cm tall and < 10 cm dbh), and pole timber (>10 cm dbh) (Fig. 9). In addition, within each 2.25 m diameter subplot we will record terminal twigs, and each twig will be counted as live and undamaged (terminal bud intact) or live, but clearly browsed. Buds that are not browsed but are either damaged or dead will not be counted. To be considered a twig rather than a bud, there must be at least 2.54 cm (1") of stem elongation prior to the bud. Browsed twigs should have the torn appearance of browsing and >1.27 cm (0.5") of dead stem before living tissue begins again. The idea is to derive a percent browsed figure, which specifically gives the amount of browsing that occurred since the last sampling period (or growing season) on material that was available to be browsed at the time. Height from ground and diameter of browsed and unbrowsed twigs also will be recorded in an attempt to differentiate between moose and deer browse. Where browse is heavy (e.g., in control plots) we will record browse data for up to 20 twigs, distributed among 4 quadrats in the circular plot (5 twigs per quadrat).

Sampling will begin at subplot A in all plots and will proceed in sequential order (A-Y). All subplots will be sampled as followed: Starting at the north point of each subplot a wooden

pole measuring 1.5 m in length (marked at 1 m and 1.125 m) will be placed on the ground so that one end is directly in the center of the subplot and the other end extends beyond the sampling area. Woody vegetation will be measured starting at the center of the subplot and out to the 1.125 m mark on the pole. The pole will be rotated in a clockwise fashion until the entire subplot has been sampled. Species, height, dbh will be recorded and terminal twig browse will be noted (Yes/No). Terminal twig height and diameter also will be recorded (Appendix F).

In addition, we will develop a vegetation guide to help in identification of plant species; the guide will contain materials that will aid in plant identification, such as written descriptions, line drawings, or photographs. We will also develop a pressed collection of plants as both an instructional aid and a collection of voucher specimens

MEASUREMENT OF PLOT TEMPERATURE

To measure temperature within the plots we will use ibuttons (Dallas Semiconductor Corporation – model DS1921G). Ibuttons are a rugged, self-sufficient system that measures temperature and records the results in a protected memory section. We will place 3 ibuttons throughout each plot. Ibuttons will be placed in mesh bags and stapled to a post at 1 m (3.3') above the ground. Temperature loggers will be programmed to record ambient temperature (°C) every 3 h and will be downloaded manually in May, August, November, and January (Cunningham et al. 2006) (Appendix G).

LEAF LITER

Five 25-m² litter traps with 2-mm wire mesh bottoms will be placed in each exclosure and control plot (McClagherty et al. 1985 and Pastor et al. 1993). Litter traps will be sampled as needed (determined by leaf litter accumulation) and after deciduous trees have dropped their

leaves. After collection, litter from each trap will be sorted by into deciduous, coniferous, and miscellaneous material. Litter will then be dried for 48 h at 60°C and weighed (to the nearest 0.01g) (Appendix H).

SOIL SAMPLING

Soil samples will be collected from exclosure and control plots. Soil sampling will be confined to the A1 or O2 horizons, where most of the soil organic matter and nitrogen is mineralized and is therefore the most likely horizon to be affected. Five soil samples will be collected during the summer with a brass core 5 cm in diameter (Pastor et al. 1993). Samples will be placed in polyethylene bags and air dried and moisture corrections will be made by drying samples at 100°C for 24 h (Pastor et al. 1988 and Pastor et al. 1993) (Appendix I).

TRAIL CAMERAS

Trail cameras (model: Reconyx RapidFire™ RM45 IR Game Camera) will be placed in partial exclosure and control plots to aid in the detection of site use by target species. Cameras will be configured to take 1 photos per trigger with a quiet period (time period after a trigger during which the camera will not respond to motion events) of 5 minutes. Cameras will be mounted to corner posts and will have approximately a 40-degree field of view with a 30 m trigger range. Cameras will be checked and photos downloaded monthly for first 3 months then continued as needed. Photos will be automatically labeled with date, time, temp (°C), and plot number (Appendix J).

PELLET SAMPLING

Pellet sampling will take place in all plots and will be both opportunistic and systematic. While conducting other work inside the plots pellets will be documented as they are found (date,

plot location, and species). A more systematic survey will be completed in May, August, November, and January (if possible). Plots will be surveyed by walking in a N-S direction (transect lines) covering entire plot length. Walking surveys will be spaced 2 m apart (10 total survey lines). When pellets are located we will record date, plot location, and species (fig. 10) (Appendix K).

HERBACEOUS PLANTS

Herbaceous cover will be estimated for all vascular plant species within each plot. Herbaceous surveys will be conducted during periods of peak vegetation cover (June-August). Within each plot, 10 subplots will be randomly selected to measure herbaceous cover. All subplots will be sampled as followed: Starting at the north point of each subplot a wooden pole measuring 1.5 m in length (marked at 1 m and 1.125 m) will be placed on the ground so that one end is directly in the center of the subplot and the other end extends beyond the sampling area. Herbaceous vegetation will be measured starting at the center of the subplot and out to the 1.125 m mark on the pole. The pole will be rotated in a clockwise fashion until the entire subplot has been sampled. Within each plot, species, percent cover, and height will be recorded (fig. 11) (Appendix L).

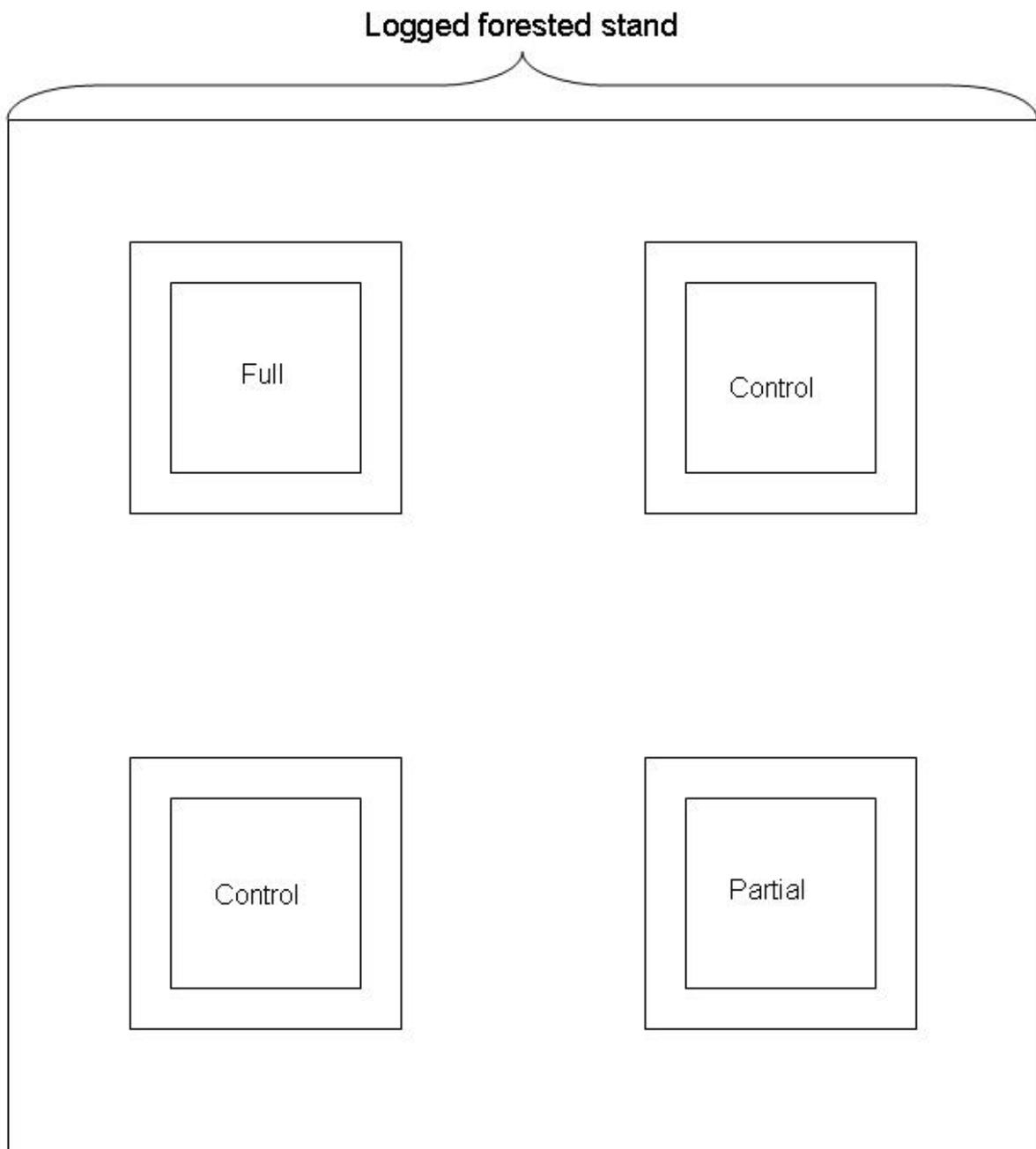


Figure 1. Representation of a single set of exclosure and control plots as displayed within a recently logged upland white pine, oak, and mixed hardwood stand.

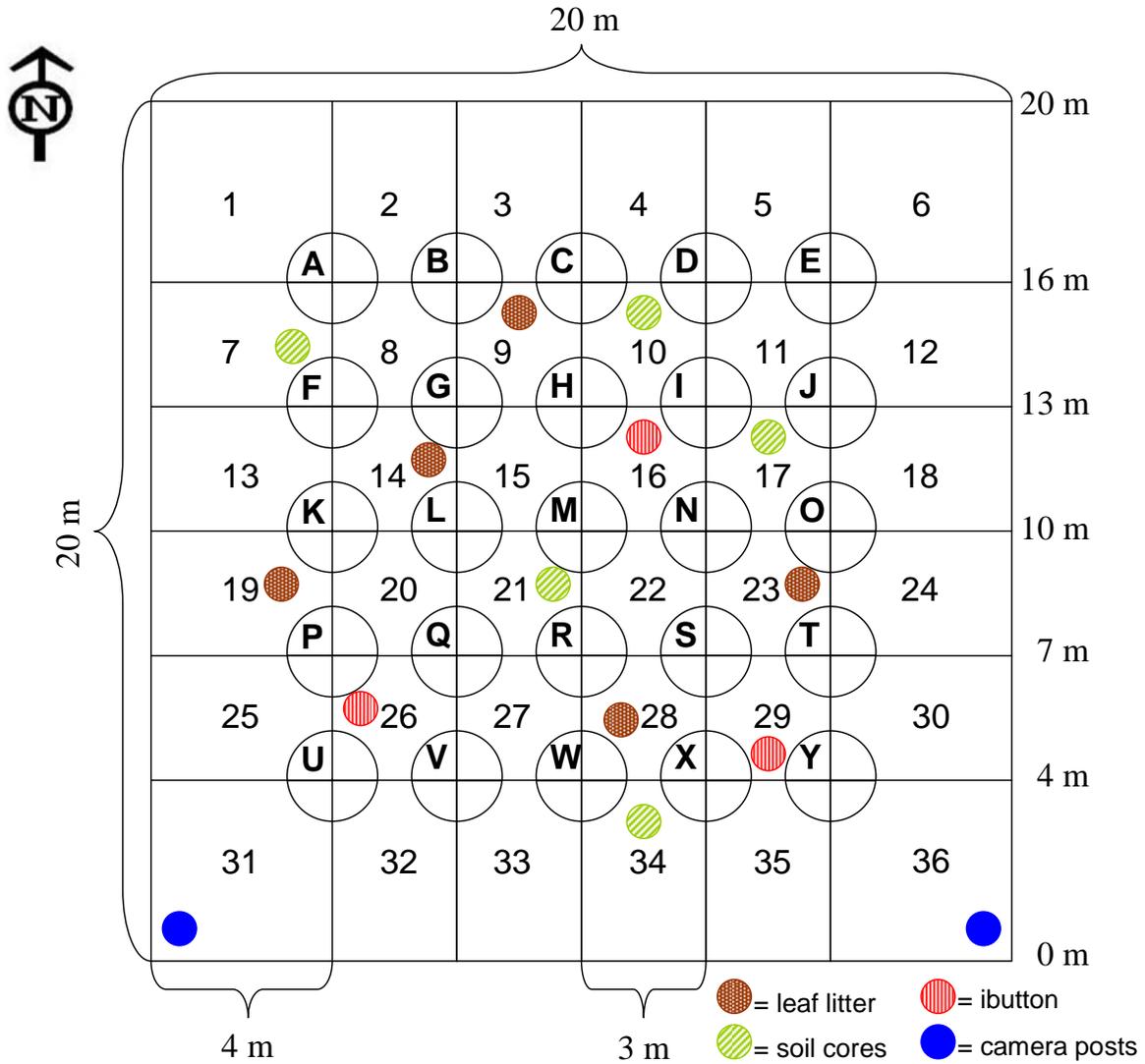


Figure 2. Sample plot showing a 5 x 5 matrix of subplots, 2.25 m in diameter, (4 m² sampling area; 100 m² total sampling area), camera posts, soil cores, leaf litter traps, and ibutton temperature probes. A 3 m buffer area will be established just inside the plot fence or line so that we are not sampling too close to the fence or edge of the plot.

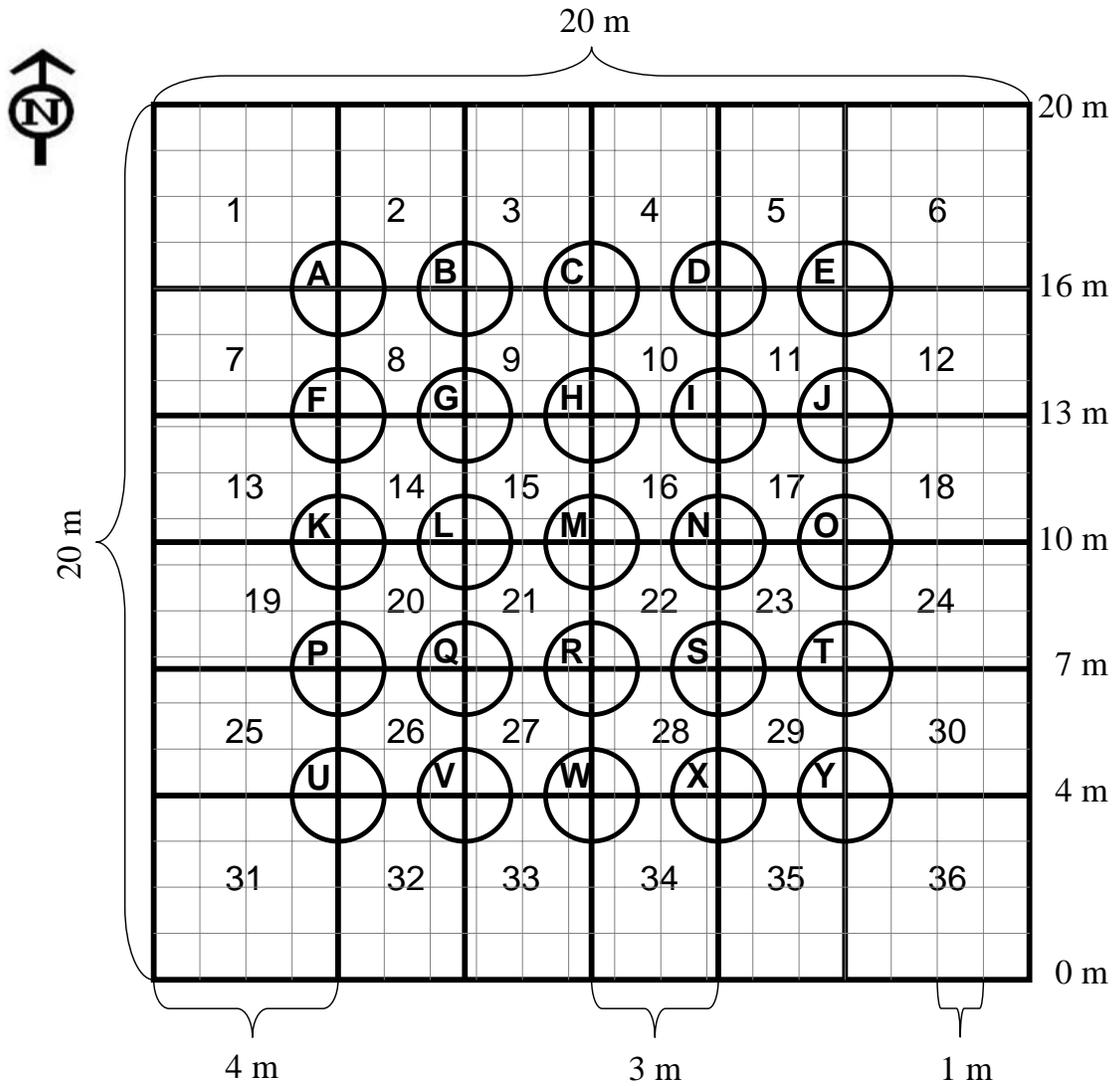
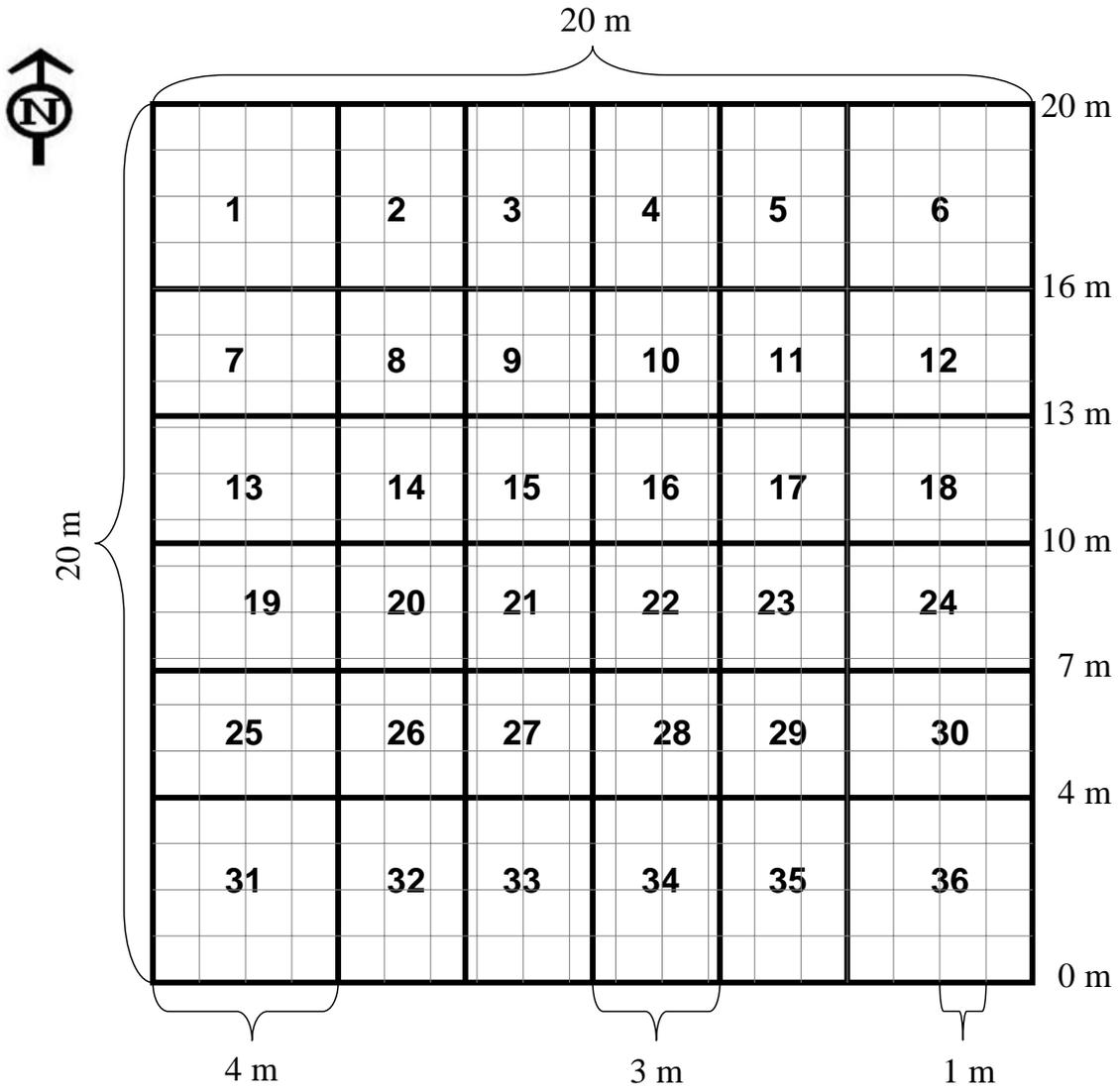


Figure 4. All landscape and vegetative features within the 20 m x 20 m plots will be mapped out and field digitized on a 400 square grid. Features to be mapped and digitized will be all stumps, major rocks, large logs and other major woody debris, any residual trees or shrubs >0.5 m in height. Other features will be mapped and recorded as deemed necessary.

Date: _____ Site: _____ Plot: _____



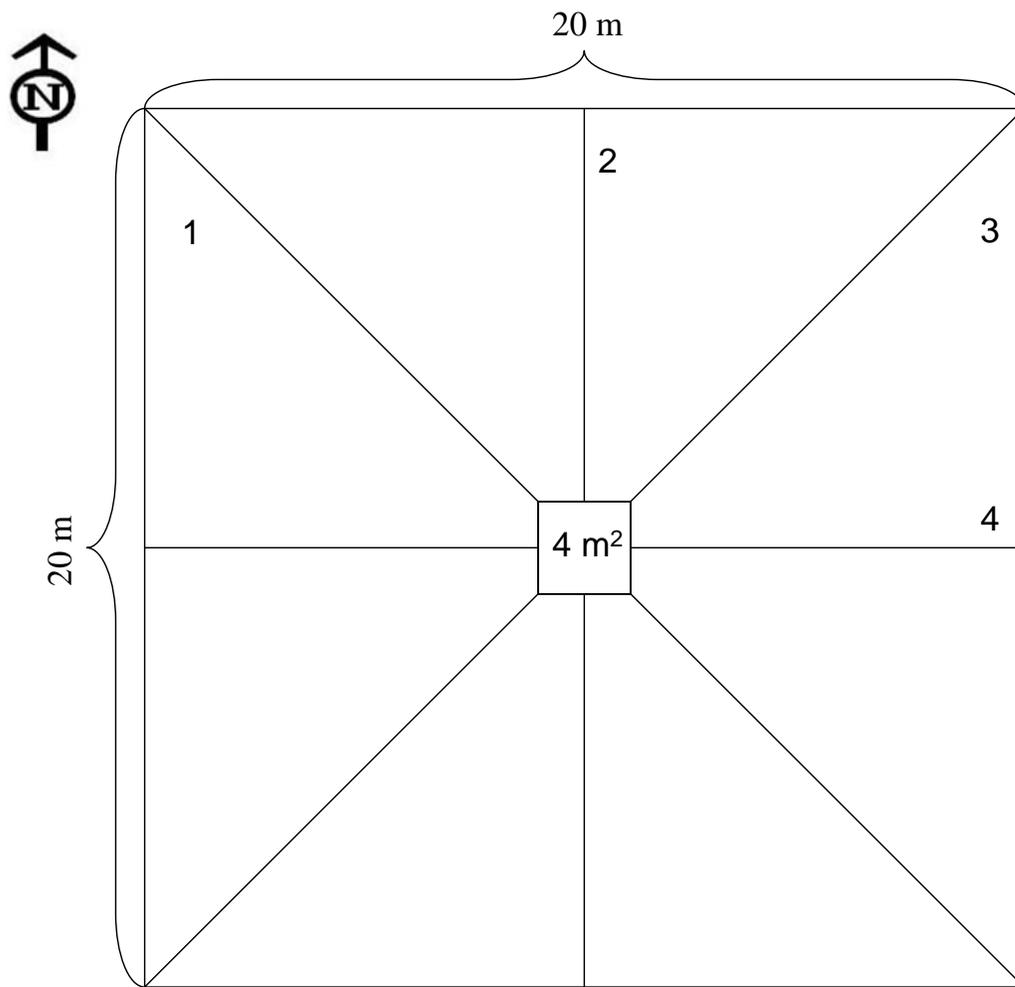


Figure 6. Slash and course woody debris transects in each 20 m x 20 m plot. We will have 2 diagonal transects run from corner to corner and 2 transects that bisect the plot in a N-S direction and E-W direction. All surveys will start in the NW corner (1) of the plot and transects will be completed in a clockwise rotation (1-4).

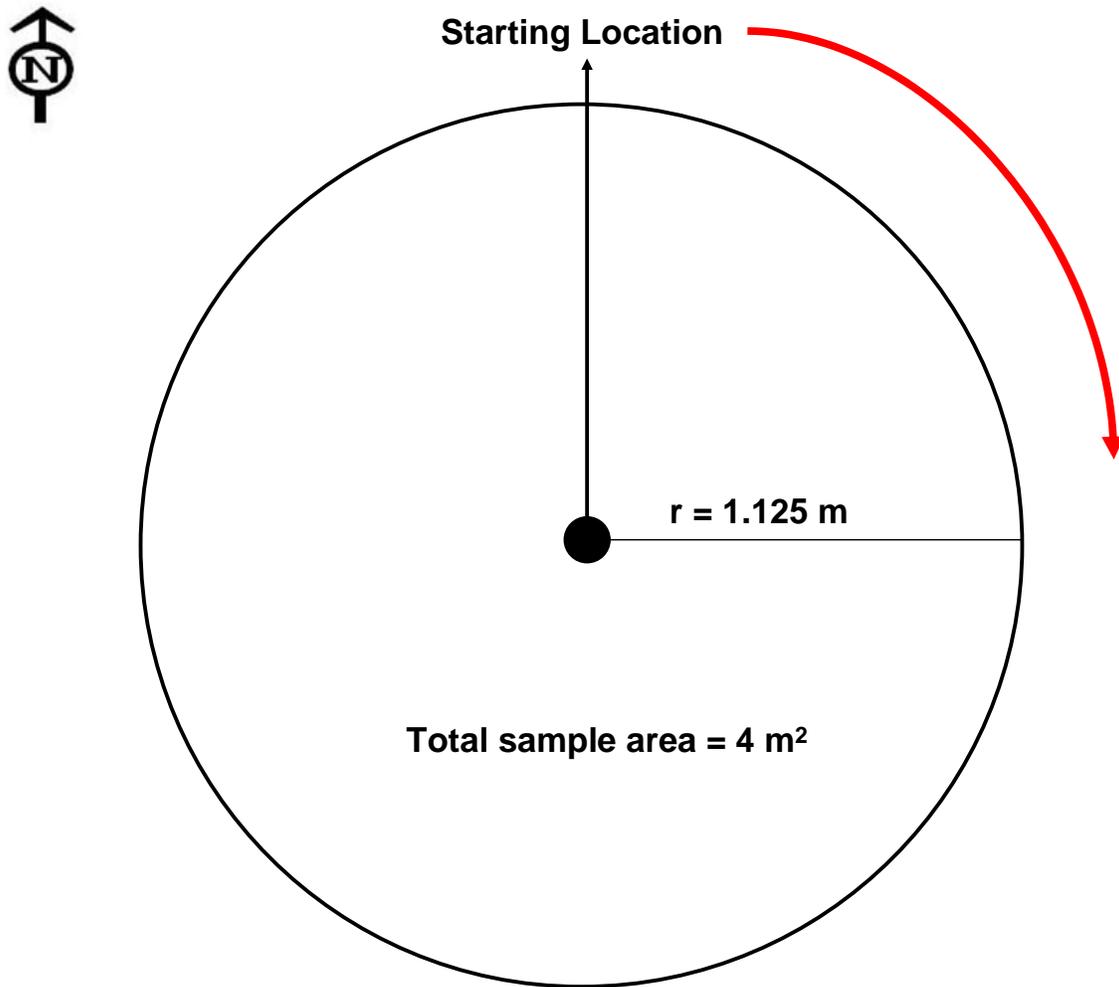


Figure 8. Individual 4 m² area subplot within the 5 x 5 matrix. Data collection will start at the northern most point and will follow a clockwise rotation around the sampling area.

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APPENDIX A: NECESSARY FIELD EQUIPMENT

1. GPS Unit
2. Pencils and markers
3. Data forms
4. Field notebook and clipboard w/extra paper
5. Digital camera and camera post
6. Digital calipers
7. Measuring tape
8. Diameter tape
9. Wooden pole 2 m in length
10. Permanent survey markers (wood or plastic) for 5 x 5 matrix and control plots
11. ibutton temperature sensors (sensors, 1.5-2 m stakes, mesh)
12. Trail cameras (batteries, CF cards, cords, cable locks)
13. Leaf litter baskets (basket, mesh)
14. Soil sampling auger & soil sample bags/ties
15. Tools (hammer, fence staples, nails, ax, handsaw, string)
16. Plastic bags
17. 50 cm caliper
18. Compass

APPENDIX B: FIELD PROTOCOL FOR DIGITIZING PLOTS AND SUBPLOTS

1. GPS all corner and side posts – record coordinates in UTM and set Datum to NAD 1983.
2. Measure out 5 x 5 matrix using 50 m tape and set stakes.
3. Stretch 50 m tape along northern plot edge and set the first stake at 4 m.
4. Measure 3 m from first stake and set stake 2.
5. The next 3 stakes will be spaced 3 m apart.
6. Starting at the first stake placed on the northern edge, run a tape perpendicular to the base line to the other side of the plot.
7. Using the tape place a stake at the 4 m mark.
8. Measure 3 m from the last stake and set another stake.
9. The next 3 stakes will be spaced 3 m apart.
10. You have just completed the first row of 5 subplots.
11. Repeat steps 7-9 for each stake set at the northern plot edge.
12. 5 x 5 matrix is now complete.
13. Take GPS location of each stake within the 5 x 5 matrix.

APPENDIX C: FIELD PROTOCOL FOR DIGITIZING AND MAPPING LANDSCAPE AND VEGETATIVE FEATURES

1. Locate all stumps within the plot – on data form record grid location and dbh (cm).
2. Next GPS the stump location (UTM – Datum NAD 1983).
3. Locate all large logs (> 15 cm dbh and 1 m in length) within the plot – on data form record grid location, species, dbh (cm) and length (m).
4. Take GPS locations of large logs at both end points.
5. Locate all large rocks within the plot – on data form record grid location and approximate area (use tape to measure “base” cm).
6. Take GPS location of rock.
7. Locate all residual trees and shrubs within the plot – on data form record grid location, species, dbh, and height.
8. Take GPS location of tree/shrub.
9. If other unique features are located within the plot – on data form record object, grid location, and other pertinent information.
10. Take GPS location of unique features.

APPENDIX D: FIELD PROTOCOL FOR MEASURING SLASH AND COARSE WOODY DEBRIS

1. Locate the center of the plot (subplot M).
2. Using string and stakes, measure and mark off a 2 m x 2 m (4 m² area) around the center of the plot (subplot M).
3. No sampling will occur in the 4 m² area.
4. Starting at the NW corner of the plot, place a diagonal transect line to the SE corner of the plot.
5. Walk the transect and record any piece of wood (>7.5 cm in diameter) that intersects the line.
6. Record the grid location that the intersection occurs in.
7. Record the dbh of the wood using calipers, species if possible and decay class (use associated data form).
8. Once the transect is complete move in a clockwise direction to the center of the side of the exclosure.
9. Starting on the N side run a transect directly across (bisecting the plot in N-S direction).
10. Repeat steps 5-7.
11. Starting at the NE corner of the plot, place a diagonal transect line to the SW corner of the plot.
12. Repeat steps 5-7.
13. Once the transect is complete move in a clockwise rotation to the center of the side of the exclosure.
14. Starting on the E side run a transect directly across (bisecting the plot in E-W direction).
15. Repeat steps 5-7.

APPENDIX E: FIELD PROTOCOL FOR DIGITAL PHOTOGRAPHIC RECORD

1. Set post 1 m in from corner SW corner.
2. Set post with small platform 1.5 m height above ground.
3. Direct camera to opposite corner (NE) and check coverage.
4. Mark permanent directional arrow on platform.
5. Take digital photographs in May, August, November, and January (if possible)
6. Duplicate steps 1-5 for SE corner of plot.

APPENDIX F: FIELD PROTOCOL MEASUREMENT OF WOODY VEGETATION AND BROWSE

1. Start at subplot A within all plots.
2. Start at the north point of each subplot.
3. Place wooden pole measuring 1.5 m in length (marked at 1 m and 1.125 m) on ground with one end directly at the center of the plot and the other end extending beyond sampling area.
4. Woody vegetation will be measured starting at the center of the subplot and out to the 1.125 m mark on the pole.
5. The pole will be rotated in a clockwise fashion until the entire subplot has been sampled.
6. For all woody vegetation found within the subplot record species, height (cm), dbh (cm) (using digital calipers), and note if terminal twig has been browsed (Yes/No).
7. Also record terminal twig height (cm) and diameter (cm).

APPENDIX G: FIELD PROTOCOL FOR MEASUREMENT OF PLOT TEMPERATURE

1. All ibuttons will be pre-programmed before placement in the field.
2. Ibuttons will record ambient temperature (°C) every 3 h and will be downloaded manually in May, August, November, and January (if possible).
3. Place ibuttons **near** subplots U, N, and G (do not place inside 3 m buffer area or inside subplots).
4. At identified locations drive a 1.5 m stake into the ground 0.5 m.
5. Place ibutton into mesh and fold (create pouch) and staple together.
6. Affix pouch (containing ibutton) onto side of stake (with staples) at a height of 1 m.

APPENDIX H: FIELD PROTOCOL FOR LEAF LITTER

1. Leaf litter baskets will be lined with 2-mm wire mesh (sides and bottom).
2. 5 Baskets will placed within each plot (not inside the buffer zone).
3. A stake will be place through each basket to secure its position within the plot.
4. When leaf litter is collected, it will be placed into a paper bag.
5. Paper bags will be labeled with date, time, basket #, grid location, and plot.

APPENDIX I: FIELD PROTOCOL FOR SOIL SAMPLING

1. Five soil samples will be taken within each plot (not in buffer area).
2. Using a brass core 5 cm in diameter take extract soil sample (confined to A1 and O2 horizons).
3. Place soil sample into polyethylene bags and seal with tie.
4. Bags will be labeled with date, time, basket #, grid location, and plot.

APPENDIX J: FIELD PROTOCOL FOR TRAIL CAMERAS

1. Trail cameras will be configured prior to field deployment.
2. Camera will be placed on a corner post at 1.5 m high and affixed to post.
3. Sample photos will be taken and viewed to assure proper placement and coverage.
4. Camera will be armed.
5. Camera will be checked once a month and photos will be downloaded and batteries replaced if necessary.

APPENDIX K: FIELD PROTOCOL FOR PELLETT SAMPLING

1. When pellets are observed during work inside the plot (opportunistic search) record date, plot location, and species
2. Systematic searching will be conducted in May, August, November, and January.
3. Place a 50 m tape along the southern edge of the plot (beginning of tape at SW corner)
4. Starting at the 2 m mark, walk toward the northern end of the plot and search for pellets (systematic search).
5. If pellets are located, record date, plot location, and species.
6. Repeat steps 4-5 every 2 m.

APPENDIX L: FIELD PROTOCOL FOR HERBACEOUS SAMPLING

1. 10 subplots will be randomly selected to be sampled for herbaceous vegetation.
2. Start at subplot with letter nearest A and proceed in alphabetical order for remainder of subplot sampling.
3. Place wooden pole measuring 1.5 m in length (marked at 1 m and 1.125 m) on ground with one end directly at the center of the plot and the other end extending beyond sampling area.
4. Herbaceous vegetation will be measured starting at the center of the subplot and out to the 1.125 m mark on the pole.
5. The pole will be rotated in a clockwise fashion until the entire subplot has been sampled.
6. For all herbaceous vegetation found within the subplot record species, percent cover and height (cm).