

Development of a Comprehensive State Monitoring and Assessment Program for Wetlands in Massachusetts

Appendix A

Standard Operating Procedures: Assessment of Forest Communities

Phase 1: 2007

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Standard Operating Procedures: Assessment of Forest Communities

1.0 Scope and Application

Plants, birds, lichens, and earthworms are an important part of the biota of forests. This SOP establishes a standard set of procedures for identifying and quantifying vascular plants (excluding mosses), birds, epiphytic macrolichens, and terrestrial earthworms of upland deciduous forests. This SOP is part of a project to validate the Conservation Assessment and Prioritization System (CAPS) as a mechanism for landscape level analysis (Level 1) of ecological integrity.

Described below are general procedures identifying and quantifying vascular plants, birds, lichens, and earthworms at randomly selected sites throughout the watershed.

2.0 Summary

UMass and MassDEP have developed upland forest assessment protocols for undeveloped areas that constitute much of the watershed area for wetlands and other water bodies. The data collected will be used as part of an assessment of current forest condition and to validate predictive models of ecological integrity for the CAPS project for inland freshwater wetlands and forested uplands.

All vascular plant, lichen, and bird identifications will be made in the field. Collection of plants and lichens may be required for species that cannot be positively identified in the field. Earthworms will be sampled and collected for identification in the lab.

3.0 Safety Considerations

1. Fieldwork will not be conducted during heavy rain events or unsafe conditions such as electrical storms or high wind events. Practice “safety first”.
2. Private property will be respected using the following guidelines.
 - a. If property is posted or in close proximity to buildings or other heavily used areas, landowner permission will be sought
 - b. Posted property will not be accessed without permission of the landowner
3. Preservation, storage and identification of earthworms will be conducted using safe handling procedures recommended on Materials Safety Data Sheets for 70% isopropyl alcohol and formalin, including adequate ventilation and protective clothing and eye protection. Alcohol will be kept away from sources of ignition. Leak-proof containers will be used for both transfer and permanent storage of specimens.

4.0 Sample Collection, Preservation, and Handling

Vascular plant and lichen collections will be limited to species that cannot be identified in the field. For species that cannot be positively identified in the field samples will be collected for lab

identification and photographed for digital preservation. Taxonomic identification will be achieved in the laboratory through the use of field guides, technical keys, and reference to regional herbaria. Samples will be labeled in the field with the plant ID (e.g. “unknown sedge #1”) site location, date, and person who collected the sample, and assigned a code in the laboratory for use in digital preservation.

Earthworms will be collected into 70% isopropyl alcohol and kept cool until transfer to lab for permanent preservation. Samples will be labeled in the field with the plot ID, subplot ID, date, and person who collected the sample:

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Reference the appropriate field data collection sheet on each sample.

See also Section 9 Quality Control, below, for further detail.

5.0 Equipment/Apparatus

Before leaving for the field the Field Manager will confirm the following equipment is available:

Location maps
Compasses
GPS (Global Positioning System)
Digital camera
Timepiece
50 meter distance tapes
Diameter tapes
Chaining stakes
Hand lens
15-factor prism
Flagging
Data sheets
Rite-in-rain paper and pen
Clipboard
Plastic collecting bags (vascular plants) with labels for plot ID and date
Paper herbarium packets (lichens) with labels for plot ID and date
3-1 gallon containers of liquid mustard solution per plot
Earthworm sampling tray
Forceps
50ml polypropylene centrifuge vials filled with isopropyl alcohol, with lids
Earthworm sampling frame
SOP

6. Reagents

Earthworms:

- 70% Isopropyl Alcohol – to be used for transfer of samples from field to lab.
- 10% Buffered Formalin solution (traditional fixative, buffered to a neutral pH) – to be used in the lab as a fixative preceding permanent storage of all field samples. See Section 8.4 below for more detail

No other reagents are required.

7. Calibration & Training

The field crew will have extensive experience in plant, lichen, and bird identification and in field sampling procedures. The Field Manager and Field Scientists will receive training from the QA Manager on appropriate QA/QC procedures.

Experts in terrestrial earthworm identification are presently limited. Earthworm sampling will follow these and previously established protocols. Identification of 10% of earthworm samples will be made available for verification to an outside expert.

Any revisions to this protocol will require that all personnel who apply this procedure be re-trained. The field crew manager will provide additional instruction to the field scientist and will be responsible for monitoring the performance of the assistant throughout the field season. The quality assurance manager will periodically conduct internal audits and coordinate external audits of field and lab procedures.

8. Procedures

Sampling of upland deciduous forests will occur between July 1 and September 30. Sample locations will be randomly stratified across four elevation gradients and 10 gradients of ecological integrity from the CAPS assessment of 2005 (McGarigal et al 2005). Forest plots will be selected by stratifying across quartiles of elevation and deciles of IEI to create 40 elevation x IEI bins. A large number of uniform random points will be selected within the watershed. Only points that fall within deciduous forest (as depicted in NLCD) will be retained. Points will be randomly ordered and points that fall within 500 m of a lower-ordered point will be thrown out. Each point will be assigned to the appropriate elevation x IEI bin and given a within-bin index from 1 to n. The goal is to visit the first three plots per bin this season. If a plot needs to be dropped the next-higher plot number will be used.

Field plots will maintain a minimum separation of 500m. We will use GPS navigation to each sampling location. GPS precision must be 10m or less and the navigator will stop and establish the plot once the distance to plot center is 0m. In the case of GPS interference from tree-canopy or atmospheric effects two procedures may be followed. The first is to wait 10 minutes for satellite reception to improve. If a dense forest canopy appears to be the problem use

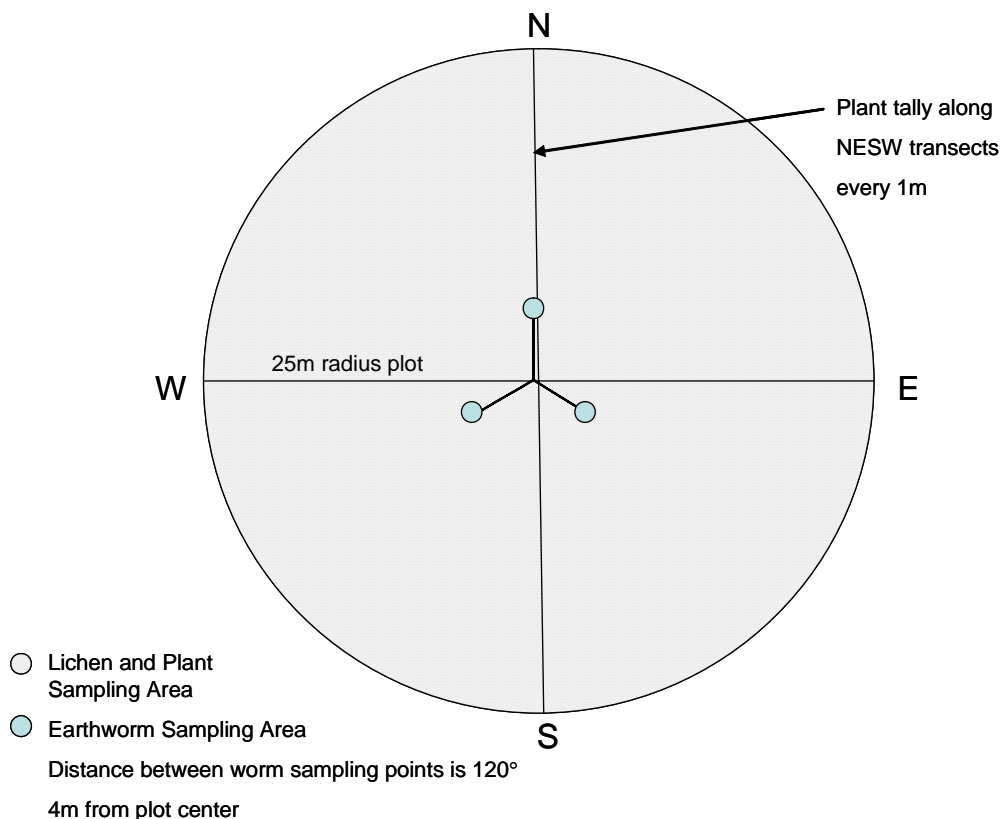
triangulation to locate the plot. We will approach the plot from three different locations where the canopy is mainly deciduous. Using compass and distance measurements provided by the GPS (precision must be 10m or less), the plot will be located.

It will not be necessary to hit the plot exactly (since it's randomly selected) it just needs to be selected without bias. However, a reasonably precise GPS point is needed of where the plot actually ends up. The strategy is (1) do the best you can when locating the plot and (2) take a precise location (precision ≤ 10 m RMS) once the plot has been established. Field workers will be on the plot for 2-3 hours and will be able to keep trying until they get good GPS coverage.

The forest canopy must be greater than 75% deciduous to qualify as deciduous forest. Plots will be sampled even if removal of all basal area has occurred. Minimum mapping unit will be 30m².

1. Plot center will be marked temporarily with flagging. This plot is the locus for measurement of all indicators in this assessment.
2. Lay out distance tapes in four cardinal directions, 25m in each direction, and mark endpoints with flagging to delineate plot boundary (Appendix B).
3. Record location using GPS and record plot ID and precision on Form 1 Site Characterization datasheet (Appendix B).
4. Fill out Form 1 Site Characterization datasheet (Appendix B). All data recording is on paper.

Figure 8.1 Upland Forests Plot Sampling Scheme



The Form 1 Site Characterization is a general assessment of the area within the 25m radius plot. Check all boxes that apply. Use the comments section for any additional information inside the plot area or the stand in which the plot is located.

8.1 Estimating percent cover of vascular plants (excluding mosses)

Vascular plant data will be collected as an indicator of community composition and species diversity (proportion of native to invasive), will contribute to the understanding of the status of species of conservation concern (rare, endangered, or invasive), and provide useful information on potential threats to natural systems. Invasive plants named as such in this assessment are those currently regulated by the Commonwealth of Massachusetts (Somers et al 2006). Data collection will occur throughout the field season, July – September.

Species abundance of all vascular plants in a 25m radius plot (see Appendix B) will be estimated using a line intercept method. Percent cover is calculated as the proportion of the line directly intercepted by each species by vertical projection on 4-25m transects placed in the four cardinal directions (NESW). Each plant species is tallied that touches the transect line or is intercepted by a vertical projection every 1m along the transect from forest floor to canopy. Tallies are made every 5m simply as a way to keep accurate count. Following transect sampling a 20-minute walk-around the entire plot will occur to list species not encountered on transects. These additional species will receive a percent cover class of <1%.

1. Beginning with the north transect walk to first meter mark. List each plant species on the Form 2 Vegetation & Bird Sampling datasheet that intercepts the line, from soil to top of canopy. On the datasheet a tally will be kept for each species every 5 meters, so not every species has to be listed at every meter mark. If no plants are present list litter, bare soil, rock, or coarse woody debris (>4" diameter). Follow this procedure for each subsequent transect.
2. Follow transect sampling with a 20-minute walk-around of the entire plot. List only plant species not found on the transects.
3. Assign a forested landcover class according to MassWildlife Landcover Mapping Decision Rules (March 1996) and a natural community type according to the Massachusetts Natural Heritage & Endangered Species Program (Swain & Kearsley 1999).
4. Collect unknown species for lab identification under dissecting scope. Place each species in a separate collecting bag with labeled with plant ID (e.g. "Unknown #1, etc.), plot ID and date. Take digital photographs on site as needed. List PhotoID # next to unknown plant ID on Form 2.
5. Refer to regional flora if necessary (Gleason & Cronquist 1991, Magee & Ahles 1999). Assistance from the herbaria and staff at the UMass herbarium will be requested as needed.

8.2 Birds

To evaluate whether avian incidence can assess forest integrity we will conduct bird counts during a set sampling window. All birds heard within a variable radius plot are sampled for 50

minutes. The approximate distance from plot center at which birds will be recorded is 75m. Bird species are listed in a separate column on the Form 2 Vegetation & Bird Sampling datasheet (Appendix B).

1. Record time of sample.
2. List birds using alpha codes on Form 2 according to American Ornithological Union taxonomy (<http://www.pwrc.usgs.gov/bbl/manual/bandsize.htm>). This is a random sample to be taken during the first part of the vegetation sampling. A minimum of two vegetation plots will be sampled per day, therefore the bird count could occur anytime during a sampling window from 7am until 6pm.

It is beyond the scope of this project to conduct a rigorous survey of breeding birds at each of the sampling sites. However, we believe that incidental observations of particular bird species (interior nesting forest birds, nest parasites, edge predators, and non-native species) may be useful for assessment of forest condition.

8.3 Epiphytic macrolichens

Epiphytic macrolichen data will be collected as an indicator of forest health, community composition, and species diversity. The goal of this assessment is to attempt to relate the response of the entire lichen community to landscape context and to determine relationships between vascular plant diversity and lichen diversity.

1. Stand at center of established 25m radius plot. Starting north, use 15-factor prism to select trees for lichen sampling. Macrolichens will be measured on all trees with a diameter at breast height (dbh) of four inches or greater.
2. Estimate percent cover on the trunk in the area between 0.5m and 2m from base of tree. On Form 3 Epiphytic Macrolichens (Appendix B), number and list each tree species, measure dbh, and list each macrolichen species on each tree. Cover classes are as follows: +=<1%, 1=1-5%, 2=6-25%, 3=26-50%, 4=50-75%, 5=<75%.
3. Collect samples as needed into paper herbarium packets labeled with plot ID, date, collector, and sample number. Mark any samples collected with a “V” for voucher on the data sheet next to its tentative name or as “Unknown #1, Unknown #2, “ etc. Nomenclature will follow (Esslinger 2007).

8.4 Terrestrial earthworms

Northern hardwoods are a significant component of western Massachusetts forests. Threats to northern hardwoods are presently of concern in part due to the removal of leaf litter from the forest floor by exotic earthworms (Hale et al 2005). Sugar maple dominated forests may have the current year’s litter removed each year by earthworms. Rapid forest floor removal can have cascading ecosystem effects including disruption of mycorrhizal fungi associations, decline of food supply for forest floor dwelling organisms, and alterations in nutrient cycling.

Earthworm data will be collected as an indicator of anthropogenic disturbance, and provide baseline data on earthworm species distribution in different deciduous forest types. Worms and worm middens will be counted in the field and worms extracted for collection and lab

identification using established collecting and liquid extraction techniques (Lawrence and Bowers 2002, Hale et al 2005).

Three methods of earthworm sampling may be employed on each plot: liquid extraction, midden counts (*Lumbricus terrestris*), and “flip and strip.” The first two methods provide data on relative abundance of different species and density of worms on an area basis. All plots will be sampled for earthworms using the liquid extraction and midden count procedures (Lawrence and Bowers 2002, Hale et al 2005). The flip and strip method will be used as time and necessity permit, that is, when no worms can be found using the other two methods. Flip and strip method can add additional species to a plot but cannot generate abundance or density estimates.

Liquid Extraction and Midden Count Method:

1. Establish three earthworm sub-sampling plots within the greater 25m radius plot, each four meters from plot center at 0° (Subplot A), 120° (Subplot B), and 240° (Subplot C).
2. Place sampling frame (11' diameter or 613 cm²) on top of leaf litter and carefully remove litter from within frame. Record time of sampling on Form 4 Terrestrial Earthworm Assessment (Appendix B).
3. Collect any earthworms found in leaf litter and place in small plastic sampling tray with lid.
4. Count number of juveniles, adults, and middens within the subplot and record on data sheet.
5. Characterize litter layer on Form 4 Terrestrial Earthworm Assessment as follows: Litter present or absent; duff layer present or absent. Litter is defined as the loose plant material found on top of the forest floor where little decomposition has occurred and duff is the layer just below the litter; it is composed of decomposing leaves, fine roots, and other organic material.
6. Push sampling frame into soil. Pour ½ gallon liquid mustard into sample area and begin collecting worms as they surface. Wait three minutes before pouring remaining ½ gallon into soil. Liquid extraction sampling time for each subplot is a maximum of 10 minutes.
7. All worms should be killed in 70% isopropyl alcohol. Place worms into alcohol-filled vial labeled with plot ID, subplot ID, and date, and collector's name. Earthworms should be kept cool until transfer into 10% formalin solution for permanent preservation at the end of the field day.
8. Transfer of worms into formalin should occur in a fume hood using safety glasses and gloves. Worms should remain in formalin for at least 24 hours before being permanently stored in 70% isopropyl alcohol.
9. Tentative species IDs and counts may be made in the field. Official counts and IDs will be made in the lab using a dissecting microscope. Earthworm species identifications will follow Schwert (1990) and Reynolds (1977).

“Flip and Strip” Method

1. Explore earthworm microhabitats for 15 minutes within the entire 25m radius plot. Look through and under leaf litter, bark, and rock for additional species.
2. Collect earthworms found into a separate alcohol-filled vial labeled as “flip search” with plot ID, and date. This sample must be kept separate from the area-based sub-samples.

Download GPS data and digital camera data onto computer hard drive at the end of each day.

Lab processing of earthworm samples:

All earthworm samples will be identified using a dissecting scope. Protective gloves should be worn when handling formalin-preserved earthworms.

Each sub-plot sample will be processed and recorded separately. IDs and counts should be recorded on Form 4 Terrestrial Earthworm Assessment.

All earthworms will be archived in UMass-Amherst Natural History Collection.

9. Quality Control

Compliance with procedures in this SOP will be maintained through monthly internal reviews. Personnel will conduct periodic self-checks by comparing their results with similarly trained personnel working on the project.

| In addition to adhering to the specific requirements of this SOP the minimum QA/QC requirements are:

- a. Verification: The field crew manager will conduct periodic reviews of field personnel and procedures to ensure adherence to this SOP.
- b. QC samples: Ten percent of sites sampled for earthworms will receive an external check of species identifications from a known expert in the field. Specimens will be shipped via USPS Surface Mail in 10% formalin. 10% formalin is not listed as a hazardous substance in USPS Publication 52.
- c. Deviations: regular monitoring of procedures in this SOP will be maintained to avoid deviation from the methods. Deviation shall be documented to allow repetition of each method as performed.

See sections 2.5 and 2.6 of the QAPP for details about QA/QC measures.

10. Interferences

Inclement weather (heavy rain) may interfere with our ability to collect representative data on a variety of parameters. Severe weather may delay field data collection due to safety concerns. Heavy tree canopy cover and atmospheric effects may make it difficult to locate sampling plots using GIS. Access may be a challenging aspect of data collection in more developed areas of the study area. Posted property or sites that are too difficult to access or unsafe to sample will be replaced with alternative sites from the same stratified sampling bin. Extremely dry weather may result in an underestimate of earthworm populations.

11. Preventative Maintenance

Field equipment will be inspected by the UMass Field Manager each day before going out to collect field data. Equipment will be subject to regular maintenance as needed. GPS accuracy will be assessed once a month by a check of any units used in the field with a known location.

12. Corrective Actions

Data quality control ensures high quality data, however we are prepared to re-measure any plots which contain data anomalies. Any plots that contain anomalous data that cannot be resolved will be removed from the data set.

13. Waste Minimization and Pollution Prevention

Care will be taken to avoid transport of vegetation, soil, and earthworms to other sites. This will be done by thorough inspection of all equipment and clothing prior to departure from a site. Invasive plant samples will be disposed of in a way to avoid accidental release into the environment.

Formalin can be reused after initial preservation of earthworm samples so that only a minimal amount is required.

14. References

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