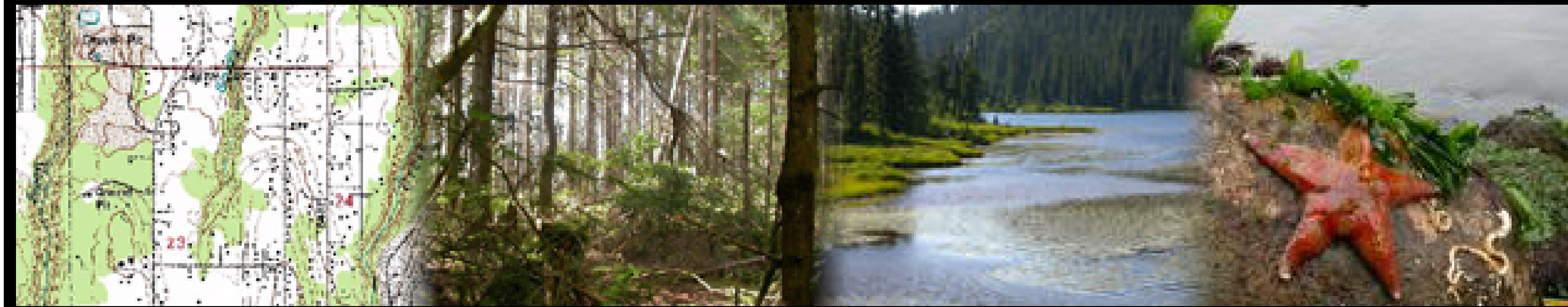

Photo Point Monitoring Protocols: Complete Protocol

(All information, unless otherwise noted, has been summarized from Hall 2002)

INTRODUCTION

Digital imaging, GPS, and GIS technologies are revolutionizing the way that scientists are collecting, analyzing, and displaying spatial data. This project provides students and faculty with an exciting opportunity to utilize these technologies to collect and analyze data on the spatial patterns of biodiversity in the Puget Sound region. A major goal of this work is to make this process as user-friendly as possible. Therefore, we have mapped out protocols for surveying in the field using GPS-linked digital photographs or video. Your field data can then be easily uploaded into MediaMapper®, creating an interactive map of your study site. The scientific information presented on this website will be useful to ecologists, government agencies, community groups, and environmental organizations when they make important decisions on restoration and development issues.

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BENEFITS

Benefits associated with using a Photo Point Monitoring protocol

- “Quick and effective documentation of change”
- Monitor the effectiveness of a proposed treatment/ restoration projects

- Compare the effectiveness of several treatments (manual removal, herbicide, etc.)
- Observe changes resulting from management decisions
- Measure biodiversity indices
- Monitor invasive species
- Images can be easily replicated over time by different individuals

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PHOTO POINT PROTOCOLS

General Information

Documentation is key. You must always assume that the next person that will be photographing the area will not be the same as the first person to do so. Therefore you must record specific information along the way.

- Obtain or create detailed maps of the area you are photographing. This can be done by documenting the perimeter of your study site using GPS and creating a map in MediaMapper (see **GPS Data Collection** and **Creating a MediaMapper Map**).
- Provide specific instructions for getting to the photo site. If permits or special permission are required, be sure to include phone numbers of contacts.
- Create a field book associated with your photo site. This should include the maps and instructions, as well as the original photograph and any others that have been taken since. This is the book in which to document all data and descriptions.
- In order to take identical, successional photos, the distance from camera to photo point *must* remain the same. Therefore, camera location and photo point require permanent markers. Collect point data with your GPS unit at both the camera location and photo point (see **GPS Data Collection**). For ease in the field and exact location for future photographs, permanent markers should be placed at these two locations. Cheap fence posts or steel stakes hammered into the ground work well. If it is impossible to mark your location with permanent markers, be sure to thoroughly document the coordinates and direction faced (i.e. N, SW) of *both* photo point and camera location with your GPS unit.
- Established dates and times of day for photographing may be useful. Consistent reference points can:
  1) evaluate seasonal differences
  2) compare change over several years
  3) establish a consistent time interval

  Always record the time of day the photograph was taken as well as the weather conditions.
- Always put a scale bar in your photograph, including a photo identification tag that includes site name and photograph number. Because the photograph will be linked to the GPS unit, you will automatically have the date, time, and coordinates of your photograph. White paper usually shows up badly in photographs; therefore, it is recommended that you use blue paper for your ID tag.

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1. Effectiveness of Restoration Efforts
Sample Project: Identifying Suitable Eelgrass Restoration Sites in Commencement Bay

Description:

- Uses repeat photography to document change
- Can monitor trends or changes in natural resources (inexpensively)
- Can use for education – biology labs
- Can use for citizen based monitoring projects – Seattle Aquarium, Puget Creek Restoration Society, Pierce Conservation District
- Can use as a component of a larger monitoring report

- Photographs of the release site are a valuable qualitative assessment tool. Photos taken annually from a designated photo point can provide a visual record of trends or changes in the vegetation at the site over time, though it does not necessarily show their causes. Thus, photographs are best used in conjunction with other monitoring techniques."[1]

This project requires a 'before' picture and many 'after' pictures to document the change after the invasive species is removed. The 'before' and 'after' pictures can be useful in documenting the effectiveness of a certain removal method, or a comparison of several removal methods, as one can document the percent cover of the invasive species before and after removal. The succession of 'after' photographs can document how effective the removal was by monitoring the status of both the invasive species and the native species.

Equipment needed:

- Field book
- Map of photo site
- Trimble GPS unit
- Digital camera that as been calibrated with GPS (see **Calibrating your Digital Camera with your Trimble GPS Unit**)
- Appropriate scale bar/meter board and ID tag
- Compass

What to photograph:

- Large-scale photographs of restoration site to document overall changes
- What you expect will be changing (i.e. stream erosion, livestock effects, canopy cover, etc)
- What will be demonstrated by monitoring area (i.e. effect of livestock on vegetation, increase in endemic species populations after removal of invasive species)

When to photograph:

- Set up a monitoring schedule before begin project
- "Before" photographs to document area prior to restoration
- A succession of "after" photographs

Procedure:

"Before" photograph:

1. Determine what needs to be photographed to accurately document your objectives
2. Calibrate your digital camera with your GPS unit
3. Put meter board in ground in middle of picture field

Note: For projects in which soil erosion, constant plant height documentation, etc, is required, meter board should be permanently implanted in order to accurately measure height changes of soil/shrubbery.

Note: For projects documenting changes in streams/riparian areas, one must be aware of stream bank erosion. The meter board should be placed at least a meter from the bank.

4. Document GPS coordinates of meter board - this will serve as your photo point
5. Document GPS coordinates and compass direction of camera location
6. Record time of day and weather conditions
7. Include photo ID tag with site name and photograph number in picture frame
8. Take photographs of site

Note: If two photographs are needed to cover a wide angle of scenery, always include the photo point (meter board) in both photographs for overlap.

9. Multiple angles of restoration site can be taken following these steps. Be sure to document GPS coordinates of all photo points and camera locations

“After” photographs:

1. Return to site on specified days to document change
2. Use GPS and compass coordinates to find meter board location and camera location
3. Record time of day and weather conditions
4. Examine previously taken photographs to ensure correct camera angle
5. Include photo ID tag with site name and photograph number.
6. Take photographs of site
7. Record in field book any obvious changes or details that are better captured in person than in a photograph

Before and after photographs showing the effects of logging (Hall 2002)

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2. Survey of Biodiversity

Sample Projects:

UPS Tree Tour; Lichen Biodiversity Survey on Trees around Tacoma, WA; Forest Habitat Survey

Description:

- Determine what is present at a specific location at a specific time, with tangible evidence
- If repeated over long period of time, may be able to detect changes in biodiversity, such as species loss.

Equipment needed:

- Field book
- Map of photo site
- Trimble GPS unit
- Digital camera that as been calibrated with GPS (see Calibrating your Digital Camera with your Trimble GPS Unit)
- Appropriate scale bar and ID tag
- Compass
- Appropriate flora and fauna identification books, if needed

If surveying along a transect,

- Tape measure/transect line
- Quadrat
- Random number generator (available online)

What to photograph:

- Large-scale photographs of overall site
- Close up shots (i.e. Photographs of a tree may include the entire tree, leaves, bark, and flowers/seeds)

When to photograph:

- May be useful to document biodiversity in spring/early summer when plants are in full bloom

Procedure:

1. Determine what needs to be photographed to accurately document your objectives
2. Calibrate your digital camera with your GPS unit
3. Determine how large an area you will survey (i.e. meter X meter square off transect)
4. Lay transect through area to be surveyed and document GPS coordinates and direction of transect
5. Generate random numbers
6. Lay quadrat at designated numbers along transect
7. Include scale bar in photograph. If using a quadrat, scale can be marked on its perimeter
8. Include photo ID tag with site name, photograph number, and transect number
9. Place GPS unit by quadrat, not by the camera, to document the quadrat coordinates and not the camera's
10. Photograph the quadrat from a designated height above (i.e. 1 meter above)

11. Continue this procedure for all randomly generated numbers along the transect and any other transects surveyed

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3. Invasive Species Monitoring

Sample Project: Forest Habitat Survey

Description:

- Can determine change in number/density/percent cover of invasive species (or special status/endangered species) in a specific area
- Can obtain a quantitative value for monitoring (i.e. Determine how percent cover of invasive and/or dominant species in quadrat changes with the season)

Part 1: Determining quadrats for random sampling

Equipment needed:

- Aerial photograph of site on computer, including coordinates (from GoogleEarth, etc)
- Numbered grid overlaid on photograph
- Random number generator (available online)
- Hard copy of aerial photograph or map of the area

Selecting random quadrats

1. Create a numbered grid and lay it over the aerial photograph of your site. If this is difficult to do on the computer, laying a transparent numbered grid on the computer screen works well.

2. Use the random number generator to determine where on grid you will be sampling.

3. Move the mouse arrow to that box on the screen so that you can record the coordinates associated with the four corners of the quadrat.

4. Mark the quadrat locations and numbers on a hardcopy of the map to take into the field.

Note: Just a general idea of the location, in combination with your GPS unit, will make it much easier to locate the predetermined quadrat locations. A problem encountered with this method was randomly selected areas being inaccessible due to overgrown vegetation. Attempt to reach as close to your predetermined site as possible, and be sure to record the exact coordinates of where you surveyed.

Part 2: Collecting the data

Equipment needed:

- Map of site with predetermined quadrat locations and GPS coordinates noted
- GPS unit
- Digital camera that as been calibrated with GPS (see Calibrating your Digital Camera with your Trimble GPS Unit)
- Large tripod
- Tape measure
- Brightly colored stakes to visually identify the corners of the quadrat – for photos and onsite determination of percent cover
- Field book
- Appropriate field guide to flora or fauna of area, if needed

What to photograph:

· Pre-determined quadrats

· Use meter X meter quadrats if you want to accurately measure species abundance or percent cover

- If larger quadrats are desired, to cover a larger area, you could take multiple photographs within the quadrat, which could later be put together for the large view.

When to photograph:

- Most useful to photograph with the desired species is in full bloom
- Midday: “photos taken near midday have less shadowing and may be easier to interpret”[2]

Procedure:

1. Using your GPS unit, find pre-determined quadrats at your site and mark their four corners using the tape measure and brightly colored stakes

2. Calibrate your digital camera with your GPS unit

3. Set up tripod such that is centers the camera above and at the middle of the quadrat for an aerial view

4. Be sure GPS unit is located by tripod to get coordinates of quadrat location

5. Include scale bar appropriate to the species you are monitoring and photo ID tag with site name, photograph number, quadrat number, and species name

6. If multiple photographs are taken to document a large quadrat, be sure to include some reference point (i.e. a stake) in each consecutive photograph for overlap and ease in putting pictures together to view larger scene

Determining abundance or percent cover of desired species:

- Can be done on computer or by hand
- On computer, once the photographs are downloaded, programs can calculate the exact area covered by the invasive species
- By hand, a transparent grid can be overlaid and the percent cover calculated

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4. Stream Sampling
Sample Projects: Assessing environmental health using macroinvertebrates in 3 Puget Sound creeks (Protocol was modified from M. Ball, Association for Biology Laboratory Education website); Kennedy Creek Salmon Trail

Description:

- Determine the presence of macroinvertebrates in streams and stream beds, using these organisms as bioindicators for the health of the stream
- Compare the quality of different streams
- Useful in analyzing stream restoration success

Equipment needed:

- Field book
- Map of riparian area to be monitored

- Trimble GPS unit
- Digital camera that as been calibrated with GPS (see Calibrating your Digital Camera with your Trimble GPS Unit)
- Surber Stream Bottom Sampler
- Plastic tub
- Rock scrubber
- Forceps
- Trowel
- Squirt bottle
- Plastic beaker
- Jar of ethanol
- Rubber boots

What to photograph:

- Stream sampling site(s)
- Surrounding riparian area

When to photograph:

- Depends on the parameters of your objective
- Could be before and after a riparian restoration project
- Could be during different seasons to monitor year-long changes
- Could be after a human impact (i.e. sewage leak, etc) to monitor effects

Procedure:

1. Select areas in the stream in which to sample

   Note: It is best to sample in riffle habitats – shallow, rocky areas with swift current. Select a riffle that is deeper than the frame of the Surber sampler.

2. Photograph site

3. Position the Surber sampler on the stream bottom with its mouth facing upstream (to catch any organisms flowing downstream in the net)

4. Photograph sampling spot at a predetermined height above the water

   Note: This is more to accurately determine your GPS position, but documentation of the stream is always useful

5. Remove all rocks from the sampler frame and place in the plastic tub filled with a small amount of water

6. Remove all material from the rocks using the scrubber and forceps, collecting all organisms removed in the water

7. Stir the substrate 4-6 inches deep in the Surber sampler frame for two minutes in order to catch any sediment-dwelling organisms in the net

8. Remove the sampler from the stream and carefully wash all organisms down to the collecting end of the net

9. Collect all organisms in ethanol container.

10. Back in lab, identify the macroinvertebrates for abundance and diversity.

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5. Intertidal Biodiversity Survey
Sample Project: Intertidal Biodiversity at Manchester State Park; Identifying Suitable Eelgrass Restoration Sites in Commencement Bay

Description:

- Determine what is present at a specific location at a specific time, with tangible evidence
- Can analyze different types of intertidal habitats (i.e. rocky vs soft-sediment, etc)
- Can analyze biodiversity differences at different tidal heights
- If repeated over long period of time, may be able to detect changes in biodiversity, such as species loss or what species is dominant at that location.

Equipment needed:

- Field book
- Map of photo site

- Trimble GPS unit

- Digital camera that as been calibrated with GPS

- Appropriate scale bar and ID tag
- Compass
- Intertidal organism identification books, if needed (i.e. *Seashore Life of the Northern Pacific Coast: An Illustrated Guide to Northern California, Oregon, Washington, and British Columbia* by Eugene N. Kozloff)
- Tape measure/transect line
- Quadrat (small: 0.25m^2 or large: 1m^2)

- Meter stick
- Random number generator (available online)
- Boots/shoes with good traction

What to photograph:

- Quadrats
- Close up shots (i.e.small organisms encrusted on rock, etc)

When to photograph:

Working at low tide will provide the largest area to survey

Procedure:

1. Calibrate your digital camera with your GPS unit.

2. Lay transect through area to be surveyed. Surveying along a transect that is parallel to the shoreline will give a general range of the biodiversity of the site. Surveying along a transect perpendicular to the shoreline will show the changes in species type and abundance with change in tidal height. Document GPS coordinates and direction of transect.

3. Generate random numbers.

4. Lay quadrat at designated numbers along transect.

5. Include scale bar in photograph. Scale can be marked on perimeter of the quadrat.

6. Include photo ID tag with site name, photograph number, and transect number.

7. Place GPS unit by quadrat, not by the camera, to document the quadrat coordinates and not the camera's.

8. Make sure area is well lit and light is not blocked, such that the photographs will clearly show the organisms present.

9. Photograph the quadrat from designated height above (i.e. 1 meter above).

Note: In habitats such as the rocky intertidal, there are usually just as many organisms living on the under side of rocks as on top that should be surveyed. If this is the case, document the top of the rock first (be sure to include TOP designation on your ID tag). Once the top has been fully documented (overall quadrat photograph and any close-ups needed), turn over the rock and quickly photograph the underside (including a BOTTOM designation on your ID tag) to capture any mobile organisms that will be quickly running away.

10. Continue this procedure for all randomly generated numbers along the transect and any other transects surveyed.

11. Once photographs have been downloaded onto the computer, it will be easy to identify and quantify the organisms present.

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6. Subtidal Surveys

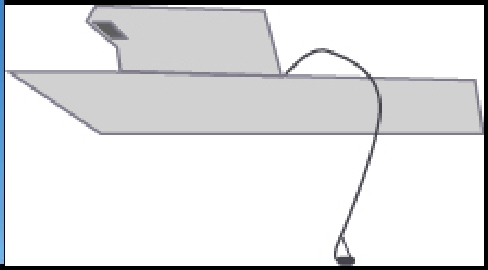
Sample Project: Eelgrass beds and bacterial mats in Commencement Bay; South Puget Sound Subtidal Biodiversity

Description:

- Can use underwater videography techniques and GIS to map subtidal areas of interest
- Can determine the distribution and abundance of target species in relation to water depth and sediment type
- Can identify areas best suited for restoration of target species

Equipment needed:

[Underwater camera system]



or

[Remote Operated Vehicle (ROV)]

- [VMS-300 hardware]

- Laptop computer for navigation and data storage
- Boat to deploy underwater video or ROV

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[1] http://www.invasive.org/weeds/loosestrife/ch3establish.html

[2] http://phytosphere.com/treeord/ordprt3c.htm

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