Intertidal Quadrat Study Techniques Manual

Straitkeepers
Georgia Strait Alliance 2002

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Introduction

Quadrat studies are a method of looking at what kinds of animals, seaweeds and plants live in the intertidal zone, and how abundant they are relative to each other and to different sites on the coast. Useful information on local shorelines can be gathered by motivated, non-professional volunteers.

Most importantly, the data can be monitored and analyzed over time to reveal changes in the biological makeup of our shorelines. Such information can prove invaluable to scientists, politicians, managers and concerned citizens , allowing them to make more informed decisions about policies that might affect the health of our favorite beaches and seashores.

This new version of the manual features streamlined techniques to make setup and location of the transects as quick and easy as possible. It also incorporates changes brought into effect in 2001, including a second quadrat at each tide level and a species presence/abundance column.

Look for "tips" on numerous topics, field tested techniques that will help make surveys faster and more accurate.

TIPS

- How long does a survey take? That varies considerably between groups, sites and days. However, a focused team of six can relocate a transect line and do all 12 primary and 6 secondary quadrats in under three hours. More people can make it even quicker – or more relaxing and sociable, depending on the mood of the group and benevolence of the weather gods.

- for a quick reference or reminder, refer to the specific directions for filling out each of the four different data sheets: Transect, Station, Primary & Secondary

Minimizing Impacts

Follow accepted beach etiquette guidelines.

Avoid walking over the area where quadrat frames will be placed. This is relatively easy to do as both rows of quadrats are on one side of a baseline. Remember to walk on the LEFT side of the transect line (when facing the shore).

Limit the number of people wandering around the study area BEFORE and AFTER the baseline is set up.

Site Selection

When first choosing a site for continued study, there are a number of important factors to consider.

- select a shoreline with bedrock, boulder and/or cobble substrate. A mix of substrates is fine, but this technique was not designed for beaches that are primarily pebble, sand, mud or shell. For our purposes:

Bedrock	solid rock
Boulder	greater than 256mm; dinner plate plus sized
Cobble	64-256mm; apple to dinner plate sized
Pebble	2-64mm; pea to apple sized
Sand	0.06-2mm; sugar granule sized
Mud	finer than sugar
Shell	mostly shell fragments

- for safety reasons, choose an area that isn't too steep; remember, people will be scrambling around at all tide levels. This usually means a slope of <30 degrees.

- conversely, if the slope is too shallow, the large distances between the upper and lower quadrats will make the study more difficult

- site should be away from local sources of fresh water, as this will affect which organisms can and cannot grow there

- site should not be subject to heavy human impacts (i.e. clam digging, major foot traffic).

- quadrat locations should not include tide pools, as they are distinct habitats and cannot be compared to rocky areas that dry

- site should be safe to work in, accessible, and have access to permanent shore landmarks.

Establishing A Transect Line

Transect lines are the lines along which the study will take place. The transect line is set up perpendicular to the water line, so that it covers the beach from the water through the intertidal zone toward the high tide mark.

When you first do the study, choose a location to set up your transect line. The location should be close to permanent landmarks, as you will measure the distance of the line relative to the landmarks. This way, transect lines can be relocated to exactly the same place for future studies. In the Strait of Georgia, actual quadrat frames are placed along the transect line at tidal heights of 1.0m, 1.5m, 2.0m, 2.5m, 3.0m, and 3.5m with respect to the 0.0m tide datum.

Locating the Quadrats

1) Calculate the height of the tide at the time of the survey. The easiest way to do this is to print up tide heights (in meters) at 5 minute intervals for an hour or two either side of low tide. Commercial software or the Wintide freeware program can be used, and results verified with the current CHS booklet. If you don't have the software, GSA can provide it (or the data) for you.

2) extend a line along the ground from the high tide level to the water's edge. The line should run perpendicular to the water's edge. This is your transect line. For new sites, it is best to line it up with a seaward landmark if possible, as it makes relocating it very quick and easy.

3) determine the difference in HEIGHT (in meters) between the calculated tide height and the height at which the closest quadrat frame (to water's edge) will be placed.

Example: if you have calculated the tide at 11:00 am to be at 0.4m, then the closest quadrat frame will be located at 1.0m. The difference is 0.6m. At 11:00 am, use the survey rods to measure 0.6m from the water.

4) two survey rods (1.5m high, with tape markings at every decimeter (1/10th of a meter) will be used to measure the difference calculated in c) above. Hold upright the first survey rod (we'll call this Rod A) at the water's edge. Move the second survey rod (called Rod B) up shore, towards the land, along the transect line. The distance you move up shore will depend on the height difference calculated in c), and the slope of the beach. To attain the calculated height difference at a beach with a steep slope, you will not need to travel up shore as far as at a beach with a gentle slope.

Once you have traveled up shore the approximate height difference, hold the second survey rod (Rod B) upright and count down from the top of the rod so that the number of decimeter lines equals the height difference calculated in c). In Example 1 (above) you would need to count down 6 taped lines, 0.6 m, which equals the difference calculated.

Now holding rod B vertically and with your eye next to the appropriate decimeter line, sight through the site level with the bubble on the horizontal line to rod A. IF the horizontal line in the level is at the top of rod A you're eye is at the same height as rod A and the bottom of rod Bis at the correct height difference above the bottom of the rod A.

IF on the other hand the horizontal line is below the top of Rod A; you are too low and need to travel higher up along the transect; Alternatively, if when you sight across and are above rod A, then you are too high and need to travel down the transect.

Mark the location where correct alignment is obtained by placing a small fish weight tied to an index card with the quadrat height and transect line letter on the ground. This will be the location of the first quadrat.

(Note: If the horizon is at least 2 kilometers away then the appropriate decimeter mark on the second survey rod can be lined up by eye with the top of the first survey rod (Rod A) and the horizon, rather than using the site level).

5) Establish the remaining quadrat locations at 1.5 m, 2.0 m, 2.5 m, 3.0 m and 3.5 m using both the survey rods and the site level.

To determine the location of the 1.5 m quadrat, hold Rod A upright at the 1.0m quadrat and move Rod B up shore a distance which represents an ELEVATION GAIN of 0.5 m. Count down 5 lines from the top marking on Rod B. (Remember the difference in elevation between the 1.0 and 1.5 m quadrat is 0.5 m. Therefore count down 5 lines = 0.5 m) View through the site level at the fifth line down, aligning the site level cross hair with the top of Rod A. If the bubble is aligned with the cross hair you are in the correct location. If not, move Rod B either up shore or down shore, until the bubble is aligned with the crosshair, which is aligned with the top of Rod A.

Repeat this procedure to establish the location of the remaining quadrats.

Again, place a small weight attached to a card with the relevant data including the quadrat location and transect line letter.

Locate the second set of frames by placing a quadrat on the edge of the first and carefully flipping it over at a right angle away from the line. As the quadrats are 50cm square, it will now be 50cm away. Flip it again so it is one meter away. Be especially careful not to step on this area, or the secondary quadrat rocks to be sampled to the left of here.

Note: As it is easy to make mistakes with the site level, these measurements should be checked by two people to ensure that the correct quadrat location is found.

Establishing Landmarks

It is important to locate two relatively permanent landmarks with respect to the 3.5 m quadrat so that it is easy to accurately re-establish the transect line in the future.

Choose two relatively permanent objects on the shoreline (i.e. a tree, large boulder, fence, sign etc.). Ideally, the right landmark will be 45 degrees to the right of the transect line when viewed from the 3.5 m quadrat and the left landmark will be 45 degrees to the left of the transect line when viewed from the 3.5 m quadrat. Location information will be recorded on the transect sheet.

1. One person, standing at the 3.5 m quadrat location, holds two tape measures at the zero mark. *NOTE: the zero mark on many measuring tapes is actually located ~30cm in from the end of the tape.

2. Two other people each take one of the two 100 m measuring tape reels and extend them to each landmark. Ensure tape is pulled taught. Record the distance to each landmark on the transect sheet, just above the appropriate diagonal line. The landmarks will be photographed so that you can relocate the place the measurement was made from. If possible, you can place a small dot of paint on the landmark at the point from which the distance is measured.

3. Repeat this procedure, this time measuring to the 1.5m quadrat. If the distance to the 1.5m quadrat is farther than 100m from one of the landmarks, then take both measurements to the furthest quadrat where the distance is less than 100m, and note that on the Transect Sheet. This should only be an issue on very gentle beaches

4. Measure the cumulative distance along the transect line starting from the 3.5 m fishweight to each of the lower quadrat locations. Fill in these increasing distances in the appropriate space on the Transect Sheet.

5. OPTIONAL From each landmark take a compass bearing (uncorrected for declination) to the 3.5m quadrat and the 1.5m quadrat (unless you land marked to a higher one). Note this below the appropriate diagonal line on the sheet.

6. OPTIONAL Take a compass bearing down the transect line towards the water.

TIP

- If it's windy and the distances are long, there can be a fair amount of pressure and bend on the tape – use extra people and hold it as low as possible to minimize this.

TRANSECT SHEET

An accurate transect sheet is your most helpful tool for relocating a transect line and it's quadrats. Proper orientation is critical – no matter what site you are at, the transect sheet is like a view looking straight down from above the survey area, with the ocean at the bottom and the land at the top.

AREA & SITE

Sites are divided up by community (e.g. Nanaimo, Pender, Cortes), and each site has a three letter code for simplicity of recording (e.g. **VWS** for Victoria Whiffin Spit). See Appendix 1 for the communities, sites and codes as of Jan 2002.

DATE
In Year/Month/Day format.

REPETITION
If the site is only done once per season, repetition is **1**. If you wish to repeat a site in the same calendar year, repetition would be **2** (most communities do not do this).

LEFT LANDMARK TRIANGLE
RIGHT LANDMARK TRIANGLE
Jot down what they are and any tips that might help locate it. A small sketch often helps.

12 SQUARES
These squares represent the locations of the primary quadrats, 2 at each of 6 potential tide levels. If you do not use all 12, cross out the ones you skip and note why.

6 OVALS
These represent the secondary surveys, approximating the area where you will choose rocks to turn over.

DIAGONAL LINES
There are four long diagonal lines on the diagram, connecting each landmark to the left center of the 3.5 and 1.5m quadrats. The distance in meters (usually to two decimal places ie. the nearest centimeter), of each of these lines is how you quickly relocate a transect line. The four distances should be clearly written above each respective line. Optional compass bearings (uncorrected) can be included below the line.

CUMULATIVE DISTANCES
These appear left of each primary quadrat on the line, in ___m ___cm form. Starting from the left center of the 3.5m quadrat, enter the distance to each of the five others.

NOTES

Circle the quadrat (usually the 3.5m) that the GPS reading is taken from. At the bottom of the page, note any landmarks that line up with the transect line – boulders, islands, distant mountains, whatever – these can be very helpful.

TIP

- Though right and left are obvious on the transect sheet, be careful when using terms like "walk down the right side of the line" during surveys, which depend on which way the speaker is facing and often cause confusion.

STATION SHEET

For each survey, complete a station sheet which includes the following information (GSA will provide updated station sheets or RTF files for you to print up on demand):

AREA & SITE

Sites are divided up by community (e.g. Nanaimo, Pender, Cortes), and each site has a three letter code for simplicity of recording (e.g. **VWS** for Victoria Whiffin Spit). See Appendix 1 for the communities, sites and codes as of Jan 2002.

REPETITION

If the site is only done once per season, repetition is **1**. If you wish to repeat a site in the same calendar year, repetition would be **2** (most communities do not do this).

DATE, TIME START and END

Date in Year/Month/Day format, plus the approximate start and stop times of the session, including setup.

TEAM MEMBERS

All the people who helped with the survey – it is very helpful to include phone numbers.

GPS READING

Taken from the highest (usually 3.5m) quadrat, which should be circled and noted on the Transect Sheet diagram. Ideally this is done with a portable GPS unit, taken to three decimal accuracy (e.g. **49º 07.274' North**). A less accurate fix can be taken from navigation software or a chart.

FRESHWATER INFLUENCE

Enter **none**, **slight** or **moderate**.

TIDAL CURRENTS

Enter **none** if the site is well protected from currents. Enter **slight** if some current (less than 2 knots) reaches the intertidal zone. Enter **strong** if currents of 2 knots or more cross your survey area (imagine it at high tide on a big exchange).

WAVE EXPOSURE

Enter **protected** if the site is a small, well protected bay. Enter **semiprotected** if the site is open to a fetch (open water) of up to 10km. Enter **semiexposed** if the site has a fetch of more than 10km (there will likely be signs like driftwood and wave influence well above the high tide mark).

WEATHER

Note if it was **sunny**, **partly cloudy**, **overcast** or **raining** and if the wind was **none**, **breeze** or **strong** (for our purposes, strong will be greater than about 12 knots, which would produce reasonably frequent whitecaps).

LINE ESTABLISHED?

Note how the line was established for this particular survey – if you used measurements from a previous year's Transect Sheet, note the year. If you used tidal data and the site measures, note the height of the tide, the time you used for reference and the decimeters to the lowest quadrat (usually 1.0m).

PHOTO CHECKLIST

Check off which photos were taken. How many is up to the discretion of each team, as the usefulness of photos varies considerably from site to site.

FINDING THE SITE

Describe (as clearly and concisely as possible) how to get from an easy to find roadside landmark/parking area to the left and right landmarks. The best descriptions will be compiled in a site database but will need to be periodically updated as roads, trails, beaches and landmarks change.

SITE DRAWING

Stand with back to waters edge and make a sketch of the beach layout denoting key landmarks.

TIP

- The best way to print up the Station Sheets are with the Transect Sheets on the back – that way all the data you need to find the line next year is on one sheet of paper.

Photographs

Photographs of landmarks, transect lines, and quadrats are taken to give a visual record of the site and to help in the re-establishment of future transect lines.

The following photos are especially important for relocating the line next year:

1. Clear shots of each landmark showing the exact spot where the tape should be held.

2. A side or top view of the entire transect line showing the line, as many quadrats as possible and any landmarks that will help to relocate it.

3. If the site allows, shots of any of the primary quadrats along the line that lie near permanent, recognizable features such as distinct boulders or bedrock outcroppings.

At least one of these photos should include a sign showing the site code and date. Other photos can be taken at the discretion of the team. There is a checklist on the station sheet to help with this process. It lists the following shots to consider:

1. _____ Left landmark showing exact point to hold tape
2. _____ Left landmark from 3.5m (or highest) quadrat
3. _____ Right landmark showing exact point to hold tape
4. _____ Right landmark from 3.5m (or highest) quadrat
5. _____ Down transect (showing quadrats)
6. _____ Up transect from water's edge
7. _____ Side view of transect (showing quadrats)
8. _____ 3.5m primary quadrat 1 (on line)
9. _____ 3.5m primary quadrat 2 (1m away)
10. _____ 3.0m primary quadrat 1 (on line)
11. _____ 3.0m primary quadrat 2 (1m away)
12. _____ 2.5m primary quadrat 1 (on line)
13. _____ 2.5m primary quadrat 2 (1m away)
14. _____ 2.0m primary quadrat 1 (on line)
15. _____ 2.0m primary quadrat 2 (1m away)

16. _____ 1.5m primary quadrat 1 (on line)
17. _____ 1.5m primary quadrat 2 (1m away)
18. _____ 1.0m primary quadrat 1 (on line)
19. _____ 1.0m primary quadrat 2 (1m away)

These are fairly self explanatory. For number seven, choose the vantage that best shows off the line and helpful landmarks.

To make each primary quadrat photo consistent, take the shot from the "lower" side (looking up the beach). To be self sufficient, each shot needs to include the following items:

1. a clear, close shot of the quadrat frame and any permanent features it includes (bedrock or boulders).

2. an index card that shows the three letter site code and the Year/Month of the survey

3. the weighted tidal height marker (eg. 3.0m)

4. the transect line if it is quadrat number 1 (the primary quadrat that lies right on the line)

If each of these things is included then even if different surveys are processed together or the photos are subsequently mixed up, the photos will still be sortable and useful.

All photos should be labeled and placed into a binder/album.

TIPS

- the wide angle of most cheap cameras allows full coverage; a 50mm lens on an SLR might be harder for shorter people to use effectively.

- Look at photos from previous years. Were any particularly helpful in relocating the line? Take those again.

- Pay close attention to the landmarks – it is best to have someone holding the tape in the photo to make clear where it is to be held and the angle at which it approaches.

- Prepare a site code/date card before the survey, preferably on a grayish paper that won't reflect too much in the photos. Get into the habit of placing it at the lower left of the photo and the tide height marker at the lower right – then you won't forget to include them.

- If you prefer you can make two site code/date cards; one with a 1 on it and one with a 2. That way you don't have to make sure the transect line is in the photos to differentiate the two quadrats at each tide level.

- If you've got a good set of photos and things haven't changed, it is not necessary to keep taking them every year, particularly in areas with no useful landmarks (sand and small cobble).

Relocating a Line and Its Quadrats

Once a survey site has an established transect line and quadrats, relocating it can be relatively quick and simple if good measurements were taken in previous years. Site levels and poles are not necessary (though you should bring them for backup in case things have changed).

1. Find each of the landmarks using a combination of experienced volunteers, the verbal descriptions and photographs. If the site or it's landmarks have changed significantly, note changes on the Station and Transect sheets and take new photographs.

2. Using the 100m measuring tapes and the Transect Sheet diagram, locate the middle left of the 3.5m transect. From each landmark, measure the distance recorded on the previous transect sheet and move the tapes so that the specified distances intersect. (With three people this can be done quite quickly). Drop a weighted 3.5m card there.

3. Using the same technique, locate the lower (usually 1.5m) quadrat. Drop the 1.5m weighted card there. If you have a landmark out to sea, this is even easier.

4. Spool out the transect line between the two locations, going past the lower one right to the water's edge.

5. Use one of the 100m tapes to measure the cumulative distances to each quadrat (left center) from the 3.5 down to the 1.0. That's it – you're done!

TIPS

- Remind people not to walk on the side of the line where the quadrats will be. It helps to put the quadrat frames down as soon as possible as a reminder.

- The accuracy of your measurements will be verified by how close the 1.5m quadrat lines up. If this seems significantly out, consider double checking and/or digging out the site levels for a new set of measurements.

- If your site has unmoving landmarks or bedrock, use photos from the previous years to help locate each quadrat.

Primary Quadrat Analysis

A primary quadrat analysis is a survey of what is living above the substrate level. It does not include unattached (washed up) plants or dead animals. It gives us information about what kinds of species are living on the beach, how many of them are present and how much of the beach they occupy.

As of 2001, there are two 50 x 50cm primary quadrats at each tide level, spaced one meter apart. Quadrats contents are analyzed using pvc frames intersected by lines.

Set Up

Place a frame on the right side (facing shore) of the transect line so that the left edge of the frame is even with the transect line itself and the flagging tape marker for that tide level is centered under the left side. To quickly locate the second frame, place it on the right edge of the first and then carefully overturn it twice to the right (since the frames themselves are 50cm, this will place it one meter away).

DIAGRAM

TIPS

- unless you have plenty of time and skilled people then once the line is established, start with the lowest level that the tide allows

- five or six frames are sufficient for all but the largest groups – it is best to place both primary quadrats at the 3 lower tide levels first and leave the upper levels marked with just the weights. With both in place a particular quadrat is less likely to get stepped on during the study.

Once the quadrats are in place, the data can be recorded. This is best done with three people – one to record data, one to wield the knitting needle and a third to consult field guides and help identify organisms. Identification should be to the species level if possible. Use magnifiers, identification sheets, and field identification books to help you identify organisms. If unsure note it with a question mark. For algae, identifying to genus is often all that is practical in the field.

There are two types of data being collected in the primary survey – percent cover and species presence/abundance. Percent cover takes into account both living and dead material – species presence/abundance only records living organisms.

Percent Cover

1. A total of 36 intersections will be sampled. For most quadrat frames you will sample at the intersection of strings and the point at which the string meets the frame. Lower a plumb bob or knitting needle at each intersection.

2. Identify what the plumb bob or knitting needle touches; this may be rock, shell, sand, mud, or other substrate.

3. Make a tick beside the appropriate organism/substrate in the "No. intersects" column on the primary quadrat form.

4. Repeat this for each of the 36 string intersection sampling points.

5. If one living species overlies another, such as a rockweed over a barnacle, make a tick by both living species. If the plumb bob hits a living organism on a substrate, such as a barnacle on a rock, only make a tick beside the living organism. A tick beside a substrate category indicates that the substrate is bare.

The database will calculate percent cover for each species by dividing the sum of the tick marks for each species (how many times you 'hit' that species with your plumb bob) by 0.36.

TIPS

- Be sure you have at least 36 tick marks when you are finished. You may have more than 36 check marks if some of your sampling points have one living species overlying another.

- It's easier than you'd think to repeat or skip an intersection point, especially if you've got interesting and/or mobile critters in your square. Using a pattern for sampling (back & forth, up and down etc.) and sticking to it will help reduce error.

- Be sure to drop the needle straight down and faithfully record what is directly under it. It's ok to "just miss" critters with this study, as angling slightly to get them will bias the data. You'll get to record them in the presence/abundance column. See "Adding Species" if you get something that is not listed on the sheet.

Species Presence/Abundance

After the intersects have been checked, go through the entire quadrat and estimate the abundance of each visible species. Seaweeds can be carefully shifted but do not dig or move rocks. For each species present, note an abundance estimate as follows:

1-20 Count or estimate the number and enter it.
21+ Put an "A" for abundant.

This will include every living organism that you had a tick for in the percent cover check, but not substrates. It will also include those plants and animals that fell between the intersects. It may also include animals that move into or out of the quadrat.

For plants, count clumps, or individuals by their attachments (e.g. a multi lobed rockweed with one holdfast is just one plant). For encrusting organisms, count the number of patches (which are often clones of the same individual anyway). Estimate numbers if necessary for time considerations.

TIPS

- Try to have the recorder and observer sit opposite each other so they can more easily see critters the other might miss; if there are more people in the group they can be set at right angles for complete coverage

- First make sure that every organism that has a tick in the intersects column gets an abundance number. Then work systematically through the quadrat, gently shifting algae if necessary, looking for other species.

- This is usually easier than you'd think, as most critters are not out in the open in the middle of the day.

- When in doubt, always err in favor of "more" data; data can later be reduced but not expanded. Jot down comments, details, doubts etc.

PRIMARY QUADRAT SHEET

For each primary quadrat, fill out a Primary Quadrat Sheet. There are potentially twelve of these (two at each of six tide levels).

SITE CODE
Enter the three letter site code for your location (eg. SVB for Saltspring, Vesuvius Beach). If in doubt, write out the site name or check with the Station Sheet.

DATE
Date of the survey in YY/MM/DD format.

REPETITION
Unless you are repeating the same site in the same season, this will be **1**.

QUADRAT HEIGHT
Which tide level you are at (in half meter increments).

QUADRAT NUMBER
This will be **A** if you are at the quadrat right on the transect line, or **B** if you are at the quadrat that is one meter away.

SUBSTRATE

Circle which substrate type represents the majority of the quadrat. Choices are:

Bedrock	solid rock
Boulder	greater than 256mm; dinner plate plus sized
Cobble	64-256mm; apple to dinner plate sized
Pebble	2-64mm; pea to apple sized
Sand	0.06-2mm; sugar granule sized
Mud	finer than sugar
Shell	mostly shell fragments

NUMBER OF INTERSECTS

Put a tick in this column each time the needle (or plumb bob) touches a substrate or organism. Dead animals or unattached plants do not count (dead molluscs count as "shell"). See "Adding Species" if you find species that are not on the list.

EST TOTAL

Count (or estimate) every attached plant or live animal inside the quadrat and put a number between one and twenty or an A for abundant in this column. See "Adding Species" if you find species that are not on the list.

TIPS

- The best way to print Primary Quadrat sheets is on both sides of a sheet – that way both quadrats at one tide level can be on one page.

- If a particular substrate or organism is well represented you might find the space to put ticks becoming overcrowded. Anticipate this for things like "rock" in higher quadrats and start with small tick marks.

Adding Species to the Lists

Ideally, every commonly encountered species for your area will be listed on the primary and secondary sheets. These lists will be slightly different due to the habitat differences above and below rocks, and will eventually be adapted to represent the most common species in your region.

However, you will often encounter organisms that are not on the list. Take extra care to identify them, making sure you are not confusing them with a common species. If you find an unfamiliar species, or one that is not listed on the primary or secondary sheet you are using, follow these steps:

1. First check the Master Species List to see what the possibilities are – there may be many (eg. 16 sea stars, 13 fish) or just a few (eg. 4 barnacles).

2. Then refer to Whelks to Whales, Beachcombers Guide and any other field guides you have for pictures and information. Compare similar species, paying close attention to the identification tips on the master list as well as habitat and tide level information.

3. Note that the master list clumps many species that are difficult to identify. For instance, there are numerous types of free living segmented worms but they are hard to identify in the field – on the master list there are just a few possibilities, most notably a clam worm group and a scale worm group (both of which are already on the primary and secondary sheets).

4. Once you've identified the species (or group), add it to the list in one of the empty spaces. Be sure to use the common and/or scientific name from the Master Species List (usually taken from Whelks to Whales). To avoid confusion, include at least the first three letters of the genus and species. For instance, if you find a mottled star, which isn't on our field lists, you'd add "mottled star Eva tro" on the sheet. That way it's clear you are talking about *Evasterias troschelii*, the mottled star.

Efforts will be made to update species lists and eventually customize them for each region – this will be easier once data can be studied. For now, it is important that we standardize common names, as they are used by most volunteers but are often different from guide to guide (see Appendix C for a listing of field guides). For GSA's lists, and when adding new species, the sources for common names will be:

Fish - Coastal Fishes of the Pacific Northwest (Lamb & Edgell)
Algae - Pacific Seaweeds (Druehl)
Most Invertebrates - Whelks to Whales (Harbo)

If the invert isn't in Whelks to Whales, the following books will be used:
various: Beachcomber's Guide to Seashore Life
shelled molluscs: Shells & Shellfish of the Pacific Northwest (Harbo)
nudibranchs etc: Pacific Coast Nudibranchs (Behrens)
crustaceans: Pacific Coast Crabs & Shrimps (Jensen)

TIPS

- when discussing or comparing pictures and descriptions in different field guides, use the scientific name; common names are very often different

- unfortunately, scientific names have their moments as well – be particularly wary of algae (a gradually improving taxonmic mess) and the following troublesome genuses:
    1. Nucella – was Thais (dogwinkle snails)
    2. Lirabussinum – was Searlesia (whelk snails)
    3. Urticina – was Tealia (anemones)
    4. Lottia – was Collisella (limpets)

Secondary Quadrat Analysis

A secondary quadrat analysis determines the different kinds and amounts of species living underneath rocks. Identify organisms to the species level if possible. Use magnifiers, identification sheets, and field identification books to help you identify organisms. If unsure note it with a question mark.

Set Up

Choose rocks that are approximately 20cm if possible. They can be anywhere beyond the second quadrat; be especially careful not to step in this area while doing the primary quadrats. They must be at the same tide level as the primary quadrats – follow the contour of the beach if necessary.

Note that unlike relocating the primary quadrats, it is not necessary, or even desirable, to turn over the same rocks every year for the secondary survey. Just be sure the rocks you do choose are at the same tide height as the corresponding primary quadrat.

Abundance

1. Record the size of each rock base (average diameter, in centimeters) on the secondary quadrat form. Use one column per rock, recording the approximate diameter of the base of the rock at the top of the column.

2. Carefully turn the rock over, having people ready to spot animals that scurry for cover.

3. Identify and record the abundance of organisms/plants under the rock, both attached and unattached. Do not count organisms on the top of the rock or the upper half of the sides of the rock (anything that could be easily seen before turning the rock). Do not dig into the substrate (except perhaps to id a partially visible animal).

4. Count each animal or plant and enter a number in the appropriate column. If there are more than 20, enter an A for abundant. See "Adding Species" if you find species that are not on the list.

5. Carefully return each rock to its original position after you are finished recording the data.

TIPS

- Don't forget the rock diameters. Measure odd shaped rocks by taking a length and width and averaging the two numbers.

- Don't pick thick rocks that are deep in sand or mud – few critters can live under such rocks.

- Be careful when recording numbers to get them in the right column for the right rock – it's easy to get mixed up.

- Try putting mobile animals in a tray with some seawater – they are easier to identify there, won't be stepped on and won't be counted twice. Return them when you are finished with that rock.

SECONDARY QUADRAT SHEET

SITE CODE
Enter the three letter site code for your location (eg. SVB for Saltspring, Vesuvius Beach). If in doubt, write out the site name or check with the Station Sheet.

DATE
Date of the survey in YY/MM/DD format.

REPETITION
Unless you are repeating the same site in the same season, this will be 1.

QUADRAT HEIGHT
Which tide level you are at (in half meter increments).

SUBSTRATE
Most of the rocks you pick will be cobble sized; a few will be just big enough to be small boulders. For this category, circle which substrate type the rocks occur in or on. Choices are:

Bedrock	they lie on solid rock
Boulder	greater than 256mm; dinner plate plus sized
Cobble	64-256mm; apple to dinner plate sized
Pebble	2-64mm; pea to apple sized
Sand	0.06-2mm; sugar granule sized
Mud	finer than sugar
Shell	mostly shell fragments

ROCK SIZE
At the top of each column, just under the number of the rock, is a spot to put the diameter of each sample rock in centimeters. You only need to do this on the left side of the page.

ABUNDANCE CODE
Estimate the abundance for each plant or animal you find under the rocks. Put this number in the column where the rock number and species name intersect. If there are more than 20 put an "A". If the species is not on the list, add it to the bottom (record the Genus sp. for these).

Appendix A Communities and Sites

as of Jan 2002

Comox	Cook Spit	XCS
	Point Holmes	XPH
	Union Bay	XUB
Cortes	Boulder Point	CBP
	Bullock Bluff	CBB
	Carrington Bay	CCB
	Coulter Island	CCI
	Gorge Harbor	CGH
	Manson's Bay	CMB
	Mary Point	CMP
	Poison Cove	CPC
	Red Granite	CRG
	Seaford	CSF
	Von Donop Inlet	CVD
	Whaletown	CWT
Gabriola	Degnen Bay	GDB
	Spring Beach	GSB
Nanaimo	Blood's Creek	NBC
	Cedar by the Sea	NCS
	Piper's Lagoon	NPL
	Tweedhope	NTW
Pender	Bricky Bay	PBB
	Brooks Point	PBP
	Medicine Beach	PMB
	Roseland	PRS
Saltspring	Cable Cove	SCC
	Fernwood	SFW
	Quarry Beach	SQB
	Vesuvius Beach	SVB
Victoria	Bazan Bay	VBB
	Coles Bay	VCB
	Fisgard Light	VFL
	Smuggler's Cove	VSC
	Witty's Beach	VWB
	Whiffin Spit	VWS

Appendix B Materials And Equipment

Paperwork

- tide data
- previous years Transect and Station sheets
- previous years photos of landmarks (and quadrats)
- blank Primary Quadrat forms (at least 12)
- blank Secondary Quadrat forms (at least 6)
- field guides (esp. Whelks to Whales & Pacific Seaweeds)
- techniques manual
- index card with date and site code (if taking quadrat photos)

Equipment

- 100 meter tape measures (2)
- 60m spool of line
- weighted tide markers from 1.0 to 3.5 (6)
- quadrat frames (3-6)
- knitting needles (at least 3)
- clipboard with pencils tied on (3)
- 1 or 2 pencil sharpeners if pencils aren't mechanical
- brightly colored rulers to measure rocks (3)
- waterproof paper as an emergency backup on really nasty days
- small tray for holding & identifying mobile critters
- survey rods (2) *
- site level *

* rods & level are often not necessary but should be available at every survey in case conditions have changed and you can't use the relocation method

Optional Items

- multitool (for quick repairs)
- camera & film (if taking quadrat pictures; not optional if landmarks have changed)
- handheld GPS (once coordinates have been recorded, it would be useful for relocating sites)

Personal Stuff

- first aid kit
- sunscreen
- hat
- water
- snacks
- kneepads
- raingear/windbreaker
- rugged shoes
- warm layer
- sunny disposition

Appendix C References

Canadian Hydrographic Services tide & current tables (the method for manually calculating tide heights is covered in each year's edition of these tables)

Field Guides with common names, in rough order of importance.

ESSENTIAL
Whelks to Whales (Harbo, 1999)
Pacific Seaweeds (Druehl, 2000)
Beachcomber's Guide to Seashore Life… (Sept, 1999)

MORE COMPREHENSIVE
Shells & Shellfish of the Pacific Northwest (Harbo, 1997)
Pacific Coast Crabs & Shrimps (Jensen, 1995)
Pacific Coast Nudibranchs (Behrens, 1991)
Coastal Fishes of the Pacific Northwest (Lamb/Edgell, 1986)
Sea Stars of BC, SE AK & Puget Sound (Lambert, 2000)
Sea Cucumbers of BC, SE AK & Puget Sound (Lambert, 1997)
Pacific Coast Pelagic Invertebrates (Wrobel & Mills, 1998)

VERY HELPFUL
Seashore Life of the Northern Pacific Coast (Kozloff, 1993)
Exploring the Seashore (Snively)

OTHERS
Coastal Fish ID – CA to AK (Humann, 1996)
Pacifc Coast Inshore Fishes (Gotshall, 1989)
Common Seaweeds of the Pacific Coast (Waaland, 1977)
Pacific Coast Subtidal Marine Invertebrates (Gotshall & Laurent)
Living Shores of the Pacific Northwest (Smith, 1976)

detailed reviews of many of these books can be found at
www.wavelengthmagazine.com