

REEF LIFE SURVEY

Standardised Survey Procedures For Monitoring Rocky & Coral Reef Ecological Communities

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INTRODUCTION





This manual describes the standard Reef Life Survey (RLS) methods for estimating densities of fishes, large macroinvertebrates, and sessile communities on rocky and coral reefs. These (and compatible) methods have been used in thousands of surveys all around the world and at some locations for more than 20 years.

Visual census techniques such as these provide an effective, non-destructive way to monitor species at shallow-water sites because large amounts of data on a broad range of species can be collected within a short dive period, with little post-processing time required. The broad taxonomic range covered allows detection of human impacts affecting different levels of the food web, making these methods ideal for assessing and monitoring ecological consequences of point source impacts such as pollution, oil spills, ocean warming and coral bleaching events, as well as the effectiveness of management actions such as the declaration of Marine Protected Areas (MPAs), for example.

INTRODUCTION

These survey methods were designed to maximise the collection of ecological information related to all conspicuous taxa that can be obtained during a dive with a single tank of air. The basic unit monitored is a 50-m long transect line. Along this transect line three survey methods are applied, each focusing on different major taxonomic groupings (Method 1 for fish, Method 2 for macro-invertebrates and cryptic fish, and Photo-quadrats (PQ) for sessile invertebrates and seaweeds). The width of survey area is different for Method 1 and Method 2, and PQ.

Because data can vary with relatively slight modifications to protocols (e.g. with different transect band-width or diver swimming speed for fishes), it is important that these methods are consistently applied. Data generated are most usefully applied in a relative sense (i.e. for comparing sites or times when data are collected using the same methods).

Data collected by different divers on a field trip should be compared for consistency between divers as soon as possible, particularly during early surveys.



HOW IT WORKS

A single complete survey consists of the following components:

- **METHOD 1: Fishes** are surveyed in two 5 m wide by 5 m high bands or (“blocks”), parallel with the 50 m transect line.
- **METHOD 2: Invertebrates and cryptic fishes** are surveyed in two 1 m wide by 2 m high bands (or “blocks”) on either side of the transect line.
- **PQs: Digital photo-quadrats** are taken at 2.5 m intervals along the transect line (i.e. 20 per 50 m transect)

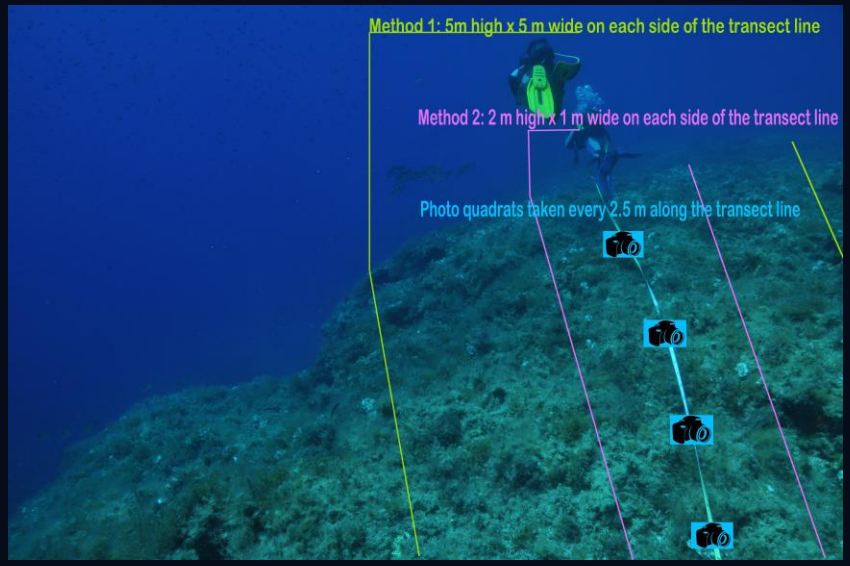


Figure 1. Layout of the survey and the blocks underwater.

Two divers can efficiently survey a transect by dividing tasks between them.

For example, one diver lays the transect line by swimming along a defined depth contour while the other follows taking photo-quadrats. Then, both divers record fishes in 5 m wide bands whilst swimming back along the transect line, one either side of the line. Both divers then return along the line recording invertebrates, one either side again. The survey is now complete and the transect line can be reeled in. Two transects set at different depths can usually be surveyed on the one dive.

SURVEY EQUIPMENT

- 50 m fibreglass transect line.
- Camera for photo-quadrats.
- Either catch bag or clips on BC to hold slate & transect line. *(It is very important to be able to clip your slate onto your BC to allow the use of two hands during the invertebrate/cryptic fish survey when surveying in kelp).*
- Slate, pencil (and a spare pencil) and waterproof paper.
- GPS to record site position.



SURVEYING A NEW SITE







Transects should be positioned on hard substratum (patches of sand or silt are acceptable, but aim for at least 90% hard substratum). Artificial reef is also acceptable.

Select reefs that extend for at least 50 m along a given depth contour.

Reference points in relation to the shore should be recorded on the datasheet where possible.

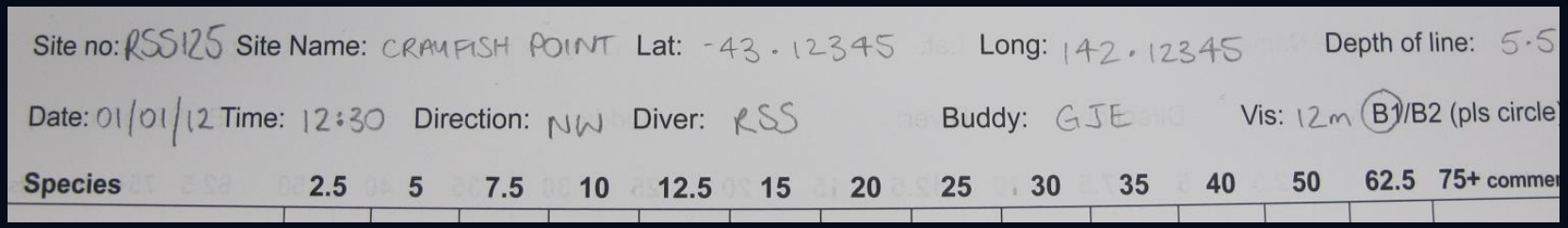
It is important that the direction from the anchor or the GPS point is recorded so that if the transect is resurveyed at a later date then the line will be placed in the same direction.

Record the position where the transect line is to start in decimal degrees to 5 decimal places using WGS 84. [Note: a boat at anchor will sit away from the anchor.

SURVEYING A NEW SITE

Choice of depth is up to the divers, and will depend on wave action (the deeper the less turbulence), shelter (in sheltered habitats reefs will normally not extend to much depth), air consumption rates (the shallower the more time available), decompression tables (the shallower the more time available), and other activities that the divers want to undertake on the dive (e.g. having bottom time and air remaining to allow photography). The survey depth is always recorded on the datasheet, and represents the average depth that the transect line has been laid along.

Each site is identified by a unique number and letter code. These are allocated by RLS and can be found for existing sites on the website map or by contacting RLS. For new surveys (or resurveys where the site code isn't known), however, a temporary site code can be used by the diver, formed from their initials and a number in a sequence of their new sites, e.g. RSS125 would be the 125th new site surveyed by Rick Stuart-Smith.


Site no: RSS125 Site Name: CRAYFISH POINT Lat: -43.12345 Long: 142.12345 Depth of line: 5.5

Date: 01/01/12 Time: 12:30 Direction: NW Diver: RSS Buddy: GJE Vis: 12m (B1)/B2 (pls circle)

Species	2.5	5	7.5	10	12.5	15	20	25	30	35	40	50	62.5	75+ comme

SURVEYING A NEW SITE

A local site name (such as a geographical feature) should also be recorded for each site.

All divers surveying a particular site (or within 200 m of another transect, that is on the same patch of reef) should use the same site code and site name.

In cases where more than one transect is surveyed at a site, these transects will still use the same site number, but will have different depth values; it is the site number x depth x date combination that distinguishes different transects in the database. It is important to ensure both buddies have the same transect depth, site number and date for all surveys done together, and that the depth value differs from other pairs for that time and place.

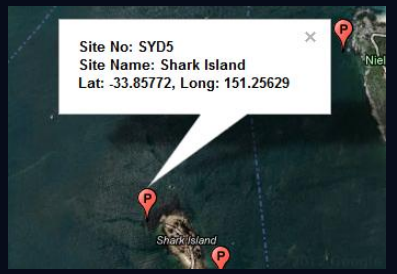




RE-SURVEYING AN EXISTING SITE

If resurveying an existing site, the site code should be obtained from the map of survey sites on the RLS website, or by contacting RLS. Please contact us if you would like a copy of the existing sites and site map for your local area.

If you are going to re-survey an existing site and use the new site number and site name, it is crucial that you go to the EXACT GPS coordinates associated with that site. If you can't guarantee you will get to the exact location of one of the existing RLS sites (i.e. within a few metres), then treat the survey as if it were at a new site (i.e. number the site with your old numbering system and collect new GPS coordinates to go with it).





BEFORE THE SURVEY

Prior to all surveys, dive teams need to be clear on dive safety procedures, both to minimize the risk of problems developing, and so that participants all know what actions are required if an accident does occur. Safety margins should be factored into all dive plans, and buddy checks completed before entering the water. Each diver must be certain of what they are doing and where they are going.

It is essential that all members of the group collaborate and record the same general site details on each datasheet, and that datasheets of buddy pairs have all survey details exactly matching (i.e. Site Name, Site Number, Latitude, Longitude, date, Depth, and Direction). If this information is not recorded before the dive, then it must happen directly after the dive.

METHOD 1 – FISH SURVEYS (M1)

TARGET GROUP: *All fishes* and other large swimming animals (e.g. squid, octopus, jellyfish, seals, turtles, whales etc.)

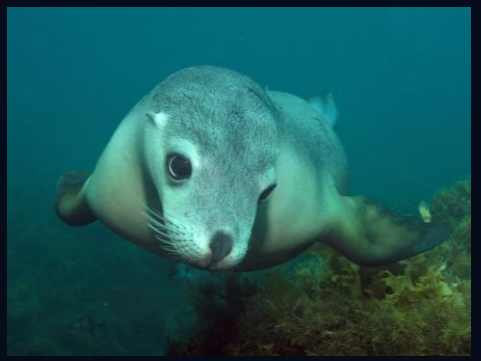
During the fish survey, the number and estimated size-category of all fishes sighted within 5 m blocks either side of the transect line, and within a 5 m high ceiling (and 5 m deep floor if applicable, see section on methods for surveying walls in appendix 2) is recorded as the divers swim slowly along the block. The deeper side of the line is referred to as “Block 1” or “B1”, and the shallower side, “B2”. Data for the two blocks are collected and recorded separately whether done by one or two divers.

Size-classes of total fish length (from snout to tip of tail, or longest distance, including for stingrays) used are 2.5, 5.0, 7.5, 10.0, 12.5, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0, 50.0, 62.5 cm, and above. Lengths of fish larger than 62.5 cm should be estimated to the nearest 12.5 cm and individually recorded.

Fish species sighted outside of the 5 m blocks, or at a time other than during the fish swim should be recorded separately—particularly if they are rare or may be outside of their usual distributional range. These species when seen “off-line” should be recorded as “method 0” (see page 20).







METHOD 1 - TECHNIQUE

Visualise a 5 m wide and high “tunnel” (bordered along one edge by the transect line). Divers swim along the middle of this about 1 metre from the seabed, but can move to the right or left to search the entrances to caves and under ledges (see figure 2). [As a reference, the distance of 2.5 m is approximately the length of a tall diver with arm outstretched in front from fin tip to finger tip, but you should measure this on yourself to become familiar with this distance]. Divers should practise estimating distances underwater under varying visibilities.

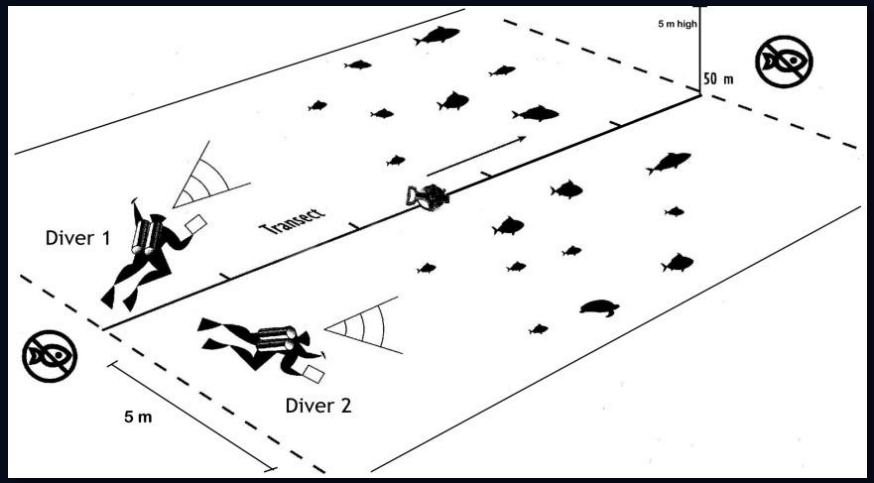


Figure 2. Stylised representation of method 1 survey technique

Record the size and number of individuals of all fish species seen within the block.

If identification is not possible, then take a photograph, draw a picture, and/or write a descriptive note (the more information the better). Be sure to ask others/check books at the end of the dive. Do NOT ignore unidentified species. Make a record of any fish you see that you can’t identify but are sure is different from other species recorded. It is much better to include (e.g. as unidentified member of a particular genus or family) than make no record at all – it is still important species richness information.

METHOD 1 - TECHNIQUE





- Where fish are schooling, estimate abundance by counting a subset and then multiplying by the number of similar subsets you would estimate to fit into the school.
- Don’t count fish that overtake you.
- If you recognise the same fish that has been recorded in the other block (i.e. see a fish that has obviously moved across the transect line), still record this animal (this balances out other fish that moved across the line in the opposite direction, and were not counted), but don’t re-record one that you know you have already counted within the same block.
- As best as possible, avoid counting fish when there are other divers in close proximity as this can affect fish counts (plan dives so fish counts can be done with minimal disturbance). If sea lions or other large marine mammals are around, then make sure that their presence is noted on data sheets since this can greatly affect the fish survey.

METHOD 1 – HOW TO DEAL WITH HIGH DIVERSITY AREAS

Surveys of high diversity areas, such coral reefs, requires substantially more survey experience, preparation and attention to detail. In such areas, when it is impossible to record counts for all fishes seen, there is a defined order of priority for accuracy of information.

- Priority (1): get an accurate species list; i.e. record the names of every new species seen before worrying about anything else
- Priority (2): individually record the abundance and size of large or rare species
- Priority (3): estimate of abundance of other species
- Priority (4): partition abundance estimates among estimated size classes for other species

Note that all of these components must still be undertaken by the end of the fish survey (*before* starting Method 2), but that they should be done in this order, often with the last two priorities done at intervals along the line or at the end of the line if necessary.

METHOD 2 – MACROINVERTEBRATE & CRYPTIC FISH SURVEYS (M2)

TARGET GROUP: Mobile invertebrates and fishes in families likely to be overlooked in M1 (see next slide for details on the target group)

Large macro-invertebrates (large molluscs, echinoderms and crustaceans) and cryptic fishes (i.e. inconspicuous species closely associated with the seabed) are censused along the same transect lines set for fish surveys. During M2 searches, divers swim along the bottom, counting all mobile macro-invertebrates within 1 m horizontal distance of the line, to a maximum of 2 m height above or below the line on steeply-sloping reefs. Data for the two blocks (either side of the line) are recorded separately.

A mental tally of the number of the most common two or three species can be kept to minimise the number of times you need to stop to make a record on the slate, but at locations where large numbers of macro-invertebrates (particularly sea urchins) are present, divers should write down data on the underwater slate at least each 5 m along the transect line.

Size information is not required for invertebrate species, with the exception of lobsters and abalone, for which the carapace length and shell width should be estimated, respectively.

Record size information for all cryptic fish.

The invertebrate and cryptic fish data are analysed separately from the fish survey, so any cryptic fishes that may have already been recorded on the M1 fish survey should still be re-recorded in M2.





METHOD 2 – MACROINVERTEBRATE & CRYPTIC FISH SURVEYS (M2)

Target group details (also see Appendix 1)

- ‘Large’ invertebrates refers to those that are more than 2.5 cm (approximately 1 thumb tip) when mature.
- Invertebrates counted include large molluscs (e.g. nudibranchs, abalone and whelks, giant clams, scallops), echinoderms (e.g. feather stars, sea cucumbers, sea stars, sea urchins) and crustaceans (e.g. lobsters, large crabs and hermit crabs).
- Cryptic fishes are those closely associated with seaweeds or the seabed such as gobies, blennies, triplefins, cardinal fishes, scorpionfishes, frogfishes (anglerfishes), cat sharks, rays, and moray eels. All families considered cryptic and to include in M2 are listed in Appendix 1.
- Fishes **not** regarded as cryptic, hence not generally counted in M2, include wrasses and damselfishes, for which method 1 provides better density estimates. If such species are seen during M2, but were not recorded during M1, they should be recorded as “Method 0” (see slide 20) – but *never* added to M1 datasheets afterwards.
- Invertebrates *not* counted include any species permanently attached to the seabed other than scallops, pearl oysters or giant clams. Thus, edible oysters, mussels, sponges, anemones (other than the large ‘swimming’ anemones), barnacles and corals are not counted. Small (<2.5 cm) molluscs also are not counted, as these can occur in very high abundance and take up too much dive time. Small abundant shrimps (<2.5 cm) are also not counted, nor are brittlestars and chitons, even if they grow larger than 2.5 cm.

METHOD 2 - TECHNIQUE

- Stay close to the bottom and push aside any seaweeds to reveal the substratum. If large seaweeds are present, it usually helps to clip your slate off to your BC and use both arms in a “breaststroke” fashion to part the seaweed for this (this also helps ensure that the full 1 m width can be effectively searched). In coral dominated areas, care should be exercised to maintain good buoyancy to stay as close to the bottom without touching it and breaking the coral (and likewise avoid any gear dangling and breaking coral).

- Some urchins live curled up in seaweeds and can be felt as the seaweeds are moved aside. These should be counted.

- Record abundance of all invertebrates and cryptic fishes on all surfaces of the substrate in 2 m high and 1 m wide bands on each side of the transect line (see figure 3). This includes the top and bottom of some overhangs, or at least the portion of them within 1 m of the line. Search all crevices, cracks and walls for animals visible from the entrance but do not turn over rocks or boulders.

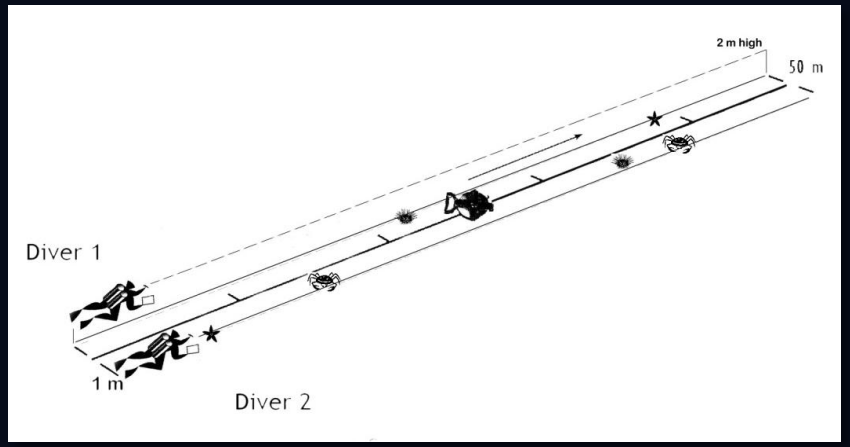


Figure 3. Stylised representation of method 2 survey technique

METHOD 2 - TECHNIQUE

- It is easy to accidentally “narrow” your focus and search a band less than 1 m wide when in dense kelp. To avoid this, using the tape as a ruler, measure where on your body 1 m reaches from fingertips across your outstretched arm and chest. Then, as you search, regularly reach out to the tape to remind yourself of the outer boundary of the band. This is particularly important when deciding whether to count an animal that is close to 1 m away from the tape.

- It is also easy to accidentally “broaden” your focus to wider than 1 m when in areas of bare rock or coral and when not swimming close enough to the substrate. This is easily fixed by always swimming close enough to be able to reach out and touch the tape to the side of you to regularly check the distance as described above. In exposed situations with wave surge though, it is sometimes necessary to stay up a bit above the seabed (and away from barnacles, sea urchins and corals).

- Estimate and record size of cryptic fishes, lobsters and abalone using the same size categories as for M1.

- If identification is not possible, take a photograph (of both the upper and lower views for molluscs) and make a note on your data sheet.

- Although most invertebrates on the M2 swim are recorded as a count only, rock lobsters and abalone need to estimated using the same size categories as fish. Abalone size is estimated across the widest part of the shell and rock lobster size is measured from the antennal horns to the rear edge of the carapace.

METHOD 2 – MANUFACTURED DEBRIS

- Manufactured debris search should be done during the Method 2 search only, and items counted individually.
- Manufactured debris classified into the following categories: Fishing gear, plastic, cloth, metal, glass, wood, and other.
- The codes, 'species name' and 'common name' to use for these categories are:

Code	Species name	Common name
def	Debris - Fishing gear	Hook & line gear, netting gear – NB: Two attached items are just counted as one
dep	Debris - Plastic	Any plastic debris
dec	Debris – Cloth	Any cloth debris
dem	Debris – Metal	Any metal debris
deg	Debris – Glass	Any glass debris
dew	Debris – Wood	Any timber debris > 10cm
deo	Debris – Other	Any debris **OTHER THAN** fishing gear, made of plastic, cloth, metal, glass or timber
dez	Debris – Zero	No Debris found

Comments are to be included on the comments page of the data entry template as to what the diver did with the debris e.g. “Removed” or “Left”.

It must be decided by the diver whether debris will be recorded before starting the transect. If it is decided to do a debris search and nothing is found, then the code "dez" (debris zero) should be used and a "0" put in the inverts column to show that the search was done and that no debris was recorded.

METHOD “0” - M0

This method is not a defined part of an RLS transect, but rather a way of recording species that were not included within the time and space boundaries of M1 and M2.

This can be done at any stage of the dive and for any species, and serves two main purposes:

1. To allow a mechanism for recording the presence of species which were not recorded in M1 or M2 (this is particularly important for rare species, or those that are outside of their usual distributional range).
2. To allow people to record more species without ‘cheating’ by including those only seen beyond the 5 m or 1 m boundary for M1 or M2, or during a part of the dive in which they were not specifically undertaking the method designed to record those species (e.g. if a non-cryptic fish species, like a wrasse, was not seen during the fish survey (M1), but is seen whilst doing the invertebrate survey (M2)).

- **It is critical not to include such species in M1 or M2 as this will bias results**.

M0 observations can be recorded at any time, and on any part of the datasheet, provided it is clear that these are separate from the remainder of the data (usually the bottom of the page is best if there is space).







PHOTO QUADRATS (PQs)







TARGET GROUP: All algae, sessile invertebrates (including corals) and substratum categories (e.g. sand).

Digital photo-quadrats are taken directly downwards from approximately 50 cm above the seabed (usually sufficient to encompass an area of approximately 0.3 m x 0.3 m).

The percentage cover of different macroalgal, coral, sponge and other attached invertebrate species in photo-quadrats is later assessed using specialised computer software and is thus not part of the survey.

PHOTO QUADRATS (PQs) - TECHNIQUE

Using a digital camera, 20 quadrats are photographed along each 50 m transect, at distances of 2.5, 5, 7.5, 10, 12.5, 15, 17.5 m, and so on up to 45m, then at 47.5 and 49 m positions as marked on the transect line.

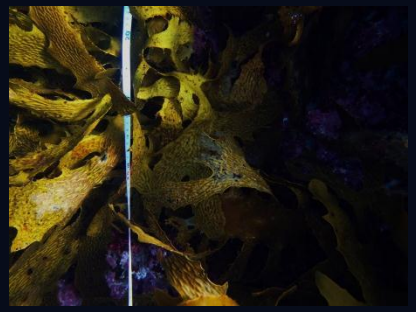
A photo showing the divers depth gauge or dive computer should be taken at the start and end of the photo-quadrat run along each transect (to 'bookmark the photo-quadrats), and a single shot should also be taken at the start of the line, looking along the line to show the general habitat (unless experienced with wide-angle photography, it is best to turn the flash off for this shot, but then turn it back on for the PQs).

Photo-quadrats are usually centred on the transect line, with the line running across the shortest axis of the picture (see examples below).

If the survey tape is not lying on the bottom, don't worry about trying to get the tape in the photo, and instead lower the camera to 50 cm from the bottom to ensure a clear photo of the substrate.



GOOD – In focus and sufficiently lit. Transect line vertical across shortest axis



NOT SO GOOD – Seaweed in focus, but large dark areas



BAD – Too much back-scatter, seaweeds not easily identifiable

PHOTO QUADRATS (PQs) - TECHNIQUE

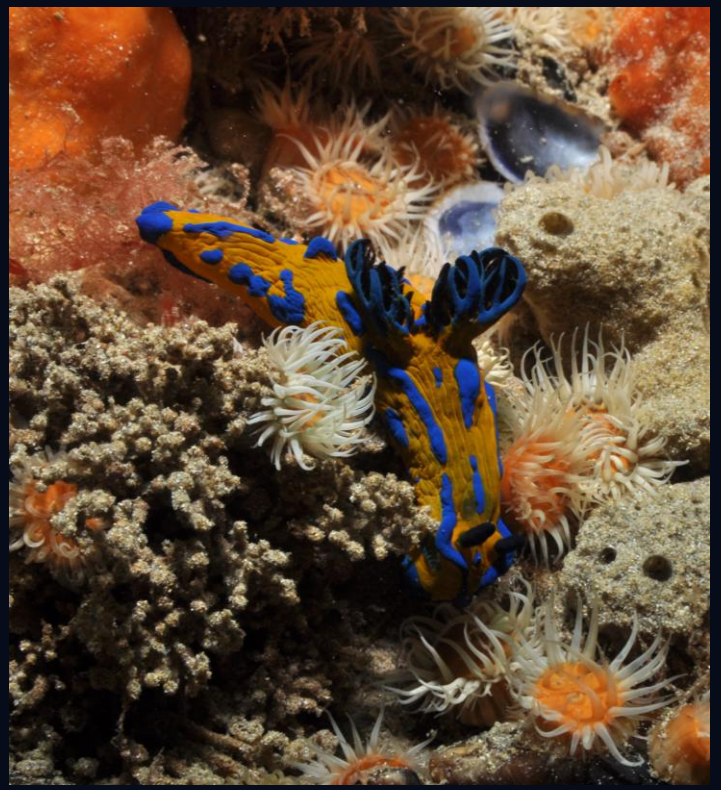
A flash should generally be used. If a separate strobe is not available and the camera's in-built flash is used, a closer shot that encompasses a smaller area of the seabed, but more clearly shows the seabed, is preferred over a larger quadrat in which the substratum is unclear due to turbidity or backscatter.

The exact area photographed is not critical because information is calculated from each image as a percentage, not total density. It is more important to take a sharp image without dark areas or too much backscatter than to worry too much about the size of image. If you need to go closer to take good clear images, then increase the number of photos taken (for example, take 40 pictures if they are only 15 cm x 15 cm each).

Use wide angle lens or zoom at widest angle when available. Use highest digital resolution and largest recorded image size possible. Save images in highest resolution .jpg rather than raw.

PQs should be downloaded and labelled as soon as possible, following the naming convention on the next page.

PQs can be sent to RLS via email, Dropbox, or post.



LABELLING PHOTO QUADRATS

PQs should be labelled consistently to include all of the following 5 bits of information:

- Site code (e.g. NSW12)
- The initials of the photographer/RLS diver who is submitting the PQs.
- Transect depth (followed by ‘m’ for metres)
- Date (6 digits, e.g. 021108 for 2 November 2008)
- Site name (this can be abbreviated, but should be easily identifiable)

Underscores can be used to separate numbers from two of these naming components.

e.g. for PQs taken by Rick Stuart-Smith at site number NSW12 at 7 m depth on 25 January 2010 at Bushranger Bay, Bass Point, the labels would be:

NSW12_RSS7m250110BushrangerBay

Photo-quadrats should be labelled as a batch for each transect, using the *rename* function if you use Windows. This involves highlighting all photos for one transect, leaving the cursor on the first of these highlighted quadrats, right-clicking and going down the bottom of the scroll list to the *rename* function. This highlights the title of the first photo-quadrat and details should then be typed in. The rename function will apply this code to all PQs for that transect followed by (1), (2) etc.

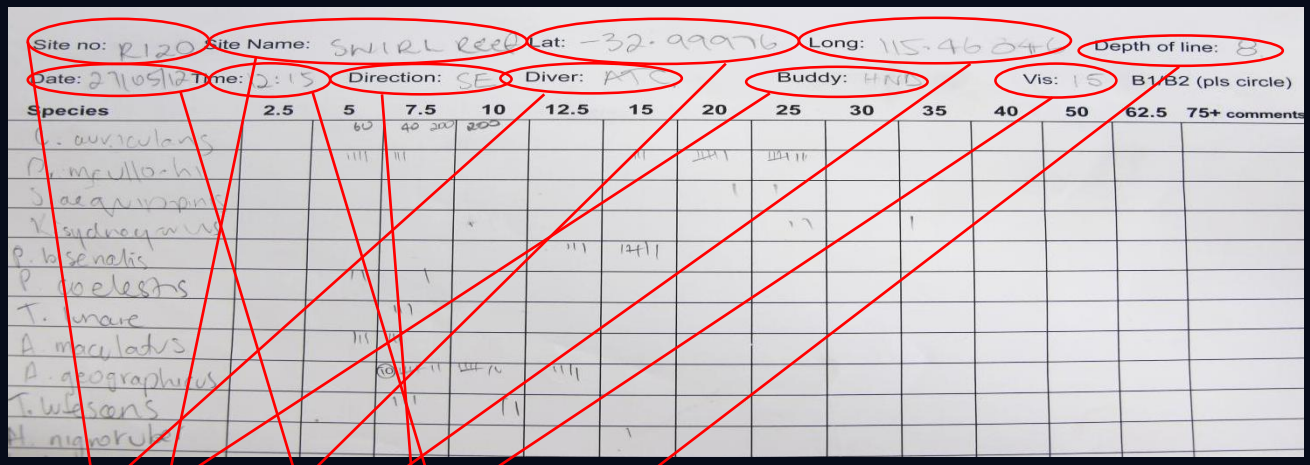
It is very important that the details in the PQ labels match the details for that survey in the datasheet exactly to allow these two parts to be matched up in the RLS database – so cross check depth and site codes in particular, to ensure they match what you have entered into excel and what your buddy has entered.

All images for each transect should be put in a folder for that transect, with the folder labelled with the same format.

DATA ENTRY

Data should be entered onto specifically-designed RLS Excel templates, which can be downloaded from the RLS website or requested by email or phone. Numerous surveys can be entered onto these templates, one below another, but be careful to ensure the appropriate site numbers, depths etc. are changed when new transects are started.

Please contact RLS if you have any problems or questions with the data entry template



ID	Diver	Buddy	Site	Site Name	Latitude	Longitude	Date	vis	Direction	Time	P-Qs	Depth	Meth	Block	Code	Species	Total	Inverts	2.5	5	7.5	10	12.5	15	20	25	30	35	40	50	62.5	75	87.5	100	112.5
										12:00		0-2	0-2						1	2	3	4	5	6	8	10	12	14	16	20	25	30	35	40	45
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	cau	Cons aurticulans	500	0		60	240	200													
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	pmc	Parma mcculloch	23	0		4	3			3	6	7									
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	sae	Scorpis aequipinnis	2	0							1	1									
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	ksy	Kyphosus sydneyanus	3	0								2		1							
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	pbi	Pseudolabrus biserialis	9	0					3	6											
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	pco	Pomacentrus coelestis	3	0		2	1														
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	tlu	Thalassoma lunare	3	0			3														
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	ama	Austrolabrus maculatus	6	0		3	3														
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	age	Arripis georgianus	29	0			17	8	4												
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	tlut	Thalassoma lutescens	5	0			3	2													
##	ATC	HND	RI20	Swirl Reef	-32.9998	115.4605	27/05/2012	15	SE	12:15	ATC	8	1	1	hni	Hypoplectrodes nigrorub	1	0						1											

Figure 4. Example of how underwater data sheets relate to the Excel data entry template.

TIPS FOR ACCURATE TRANSCRIPTION OF SURVEY DATA

- When underwater, write words on the underwater data sheets as clearly as possible with printed letters. Don't forget that others may need to read your entries down the track to crosscheck.
- Record which block you are working on and make a clear distinction (draw a line) between data belonging to different blocks and between data from methods 1 & 2.
- Record abundance information as either a written number or by using tally lines in groups of 5. Always distinguish between groups of numbers with commas or by underlining (e.g. avoid 32 being interpreted as a 3+2) and take particular care with written 11 (eleven) as this looks identical to two tally strokes.
- Try and use recognised names for animals (preferably scientific but common names are fine). It is o.k. to make up your own naming conventions for species but make sure you are consistent and that you add the correct name clearly in PEN (preferably red so it stands out) at the end of the line after checking it up in books at the end of the day.
- Data should be entered onto the template as soon as possible after the dive to improve accuracy and prevent loss of important information (i.e. before memory becomes fuzzy!) see figure 4.
- Method 0 observations should be given a value of "0" in the block column of the data entry template as they don't relate to a specific survey component.

HOW TO DEAL WITH UNIDENTIFIED SPECIES

In some cases, especially when doing tropical surveys, you may come across species which aren't in any identification book and you just can't identify it to species level. If this happens:

1.) Email RLS a photo of the unknown species - if you don't have a photo then it is probably most accurate to record it to genus level if known (i.e. *Genus* spp.), or even family level if genus is unknown (i.e. Family spp.)

2.) If RLS can't provide a species level identification then the photo should be labelled according to the following syntax:

Scenario a.) *Genus ?species*

This naming convention is used when you are sure of the genus and you believe your species may be a form or variant or another described species. E.g. *Pomacentrus ?coelestis* would be a *Pomacentrus* species which may be *coelestis* or an undescribed species closely resembling *P. coelestis*

Scenario b.) *Genus species* [?]

This is for when you are unsure of both the genus and the species but you believe your species may be a form or variant or a particular described species. E.g. *Pomacentrus coelestis* [?] would be used for a damselfish which you believed may be a variant of *Pomacentrus coelestis* but could still possibly belong to a different genus. This is the same as the general scientific protocol of adding preceding the genus name with the question mark (but is easier to sort and search)

Scenario c.) *Genus sp.* [identifying character]

When you are sure of the genus (or family) but the species can't be determined with confidence, a qualifier can be placed in the square brackets. E.g. *Pomacentrus sp*. [blue ear spot]

It is critical that the photo of the unknown species receives the same naming convention and that the photo is sent in at the same time as the data.

SUBMITTING DATA & PQs TO RLS

Following entry of data (usually multiple surveys), Excel templates can be forwarded electronically to:

enquiries@reeflifesurvey.com

Please ensure a new data entry template is started after sending each file through to avoid sending RLS files containing data previously sent (duplicates).

Photo-quadrats can either be burnt onto a CD and sent to:

RLS data team
Institute for Marine and Antarctic Studies
University of Tasmania
Private Bag 49
Hobart, Tas 7001

Alternatively Photo quadrats and data can be uploaded and “shared” with RLS via Dropbox.

If you don’t have a Dropbox account – it is free and easy to install. Please contact RLS for the download link. For instructions on how to upload and share photos and folders once you have Dropbox on your machine, please see Appendix 3.

APPENDIX 1. – GROUPS OF INVERTEBRATES & FISH FAMILIES COUNTED IN METHOD 2

Table 1. Invertebrate groups counted in the Method 2 search

PHYLA/GROUPS	ORDER/SUB-GROUPS	RULES/EXCEPTIONS
Echinoderms	Echinoids	Count all
	Crinoids	Count all
	Holothurians	Count all
	Asteroids	Count all
	Ophiuroids	ONLY count basket stars (because they are exposed)
Crustaceans	Crabs & hermit crabs	Count only if they grow bigger than 2.5cm
	Lobsters	Count and size all
	Shrimps	Cleaner shrimps only (Don't count small shrimps such as hinge-beak shrimps).
	Barnacles	DON'T count any
	All others	Count only if: (1) grow bigger than 2.5cm
Molluscs	Gastropods	Count only if: (1) mobile, AND (2) grow bigger than 2.5cm. Also NOT Patellidae, Polyplacophora
	Bivalves	Count giant clams (e.g. Tridacna spp.), razor clams (e.g. Pinna spp.), scallops (e.g. Pecten spp.) and pearl oysters (e.g. Pinctada spp.). Don't count other bivalves including edible oysters.
	Cephalopods	Count all
	All others	Count only if: (1) mobile, AND (2) grow bigger than 2.5cm
Worms (including Polychaetes)	All	DON'T count any
Sessile groups	Ascidians	DON'T count any
	Sponges	DON'T count any
	Bryozoans	DON'T count any
	Hydroids	DON'T count any

Table 2. Families considered to be cryptic and should be recorded if found during a method 2 swim.

FAMILY	COMMON NAME	FAMILY	COMMON NAME	FAMILY	COMMON NAME
Agonidae	Poachers	Cyclopteridae	Lumpsucker	Pempheridae	Bullseye
Ambassidae	Glassfishes	Cynoglossidae	Tonguefish	Pholidae	Gunnels
Anarhichadidae	Wolf eels	Dasyatidae	Stingrays	Pinguipedidae	Grubfishes
Antennariidae	Anglerfishes	Diodontidae	Porcupinefish	Platycephalidae	Flatheads
Aploactinidae	Velvetfishes	Eleotridae	Gudgeons	*Plesiopidae – excluding Trachinops	Longfins
Apogonidae	Cardinalfishes	Gnathanacanthidae	Red velvetfish	Pleuronectidae	Righteye flounder
Ariidae	Catfishes	Gobiesocidae	Clingfishes	Plotosidae	Catfishes
Aulopidae	Sergeant bakers	Gobiidae	Gobies	Priacanthidae	Bigeyes
Bathymasteridae	Ronquils	Grammistidae	Soapfishes	Pseudochromidae	Dottybacks
Batrachoididae	Frogfishes	Hemiscylliidae	Longtail carpet sharks	Psychrolutidae	Fatheads
Blenniidae	Blennies	Heterodontidae	Bullhead sharks	Rajidae	Skates
Bothidae	Lefteye flounder	Holocentridae	Squirrel and soldier fishes	Rhinobatidae	Shovelnose rays
Bovichtidae	Thornfish	Hypnidae	Coffin rays	Scorpaenidae	Scorpionfish, orbicular velvetfish
Brachaeluridae	Blind sharks	Labrisomidae	Tropical blennies	*Serranidae - excluding “Anthias”, Caesioperca, and Lepidoperca	Rockcods & Seaperches
Brachionichthyidae	Handfishes	Leptoscopidae	Pygmy stargazers	Scyliorhinidae	Catsharks
Bythitidae	Blindfishes and cuskeels	Liparidae	Snailfishes	Soleidae	Soles
Callionymidae	Dragonets	Lotidae	Burbots	Solenostomidae	Ghostpipefishes
Caracanthidae	Crouchers	Monocentridae	Pineapplefishes	Stichaeidae	Prickleback
Carapidae	Pearlfish	Moridae	Beardies	Synanceiidae	Stonefish
Centriscidae	Razorfish	Muraenidae	Moray eels	Syngnathidae	Pipefish & Seahorses
Chaenopsidae	Tubeblennies, flagblennies	Notothenidae	Icefishes	Synodontidae	Lizardfishes and Sauries
Chironemidae	Kelpfishes	Ophichthidae	Snake and worm eels	Tetrabrachiidae	Anglerfishes
Cirrhitidae	Hawkfishes	Ophidiidae	Lings	Tetrarogidae	Waspfishes
Clinidae	Weedfishes	Opistognathidae	Jawfishes	Torpedinidae	Numbfish
Congridae	Conger eels	Orectolobidae	Wobbegongs	Trachichthyidae	Roughies
Congrogadidae	Eel blennies	Paralichthyidae	Large-tooth flounder	Tripterygiidae	Threefins
Cottidae	Sculpins	Parascylliidae	Catsharks	Uranoscopidae	Stargazers
Creediidae	Sand divers	Pataecidae	Prowfishes	Urolophidae	Stingarees
Cryptacanthodidae	Wrymouths	Pegasidae	Seamoths	Zaproridae	Prowfish
				Zoarcidae	Eelpouts

APPENDIX 2. – SURVEYS IN SPECIAL CIRCUMSTANCES

SURVEYING WALLS

Vertical walls can be surveyed using the RLS methodology, but extra consideration needs to be paid to how the survey works, given that the methodology requires fishes to be surveyed in 5 m wide bands out *horizontally* from the transect line. A ceiling of 5 m should be applied to all transects (see fish survey methods above), but for wall surveys a floor of 5 m below the transect line should also be applied. For the invertebrate survey, the standard vertical height limits of 2 m above (for block 2) and below (for block 1) apply.

A number of scenarios exist, depending on whether the wall reaches the surface and where on the wall the transect line is laid (see the diagrams in the following pages). If the wall does not reach the surface (or very close to it), and the line is in a depth of 5 m or less, then the survey can go ahead using the standard method, with a maximum of 5 m vertical distance of wall below the transect line surveyed for fishes in B1, and 5 m out from the transect in both B1 and B2. If the wall does reach the surface, or the transect line is laid more than 5 m deeper than the top of the wall, then the “wall method” needs to be used for fishes.

THE WALL METHOD

For near vertical surfaces, B1 encompasses all fishes below a plane extending 5 m out from the transect line to a maximum depth of 5 m below the transect line, while all fishes within 5 m above it are in B2. This is essentially the same as the standard method, but with blocks placed one on top of the other instead of side by side. It is essential to always follow one or the other method, with no intermediate configuration, although switching between methods on a single transect will be necessary in some cases (i.e. when a wall is only present along part of the transect).

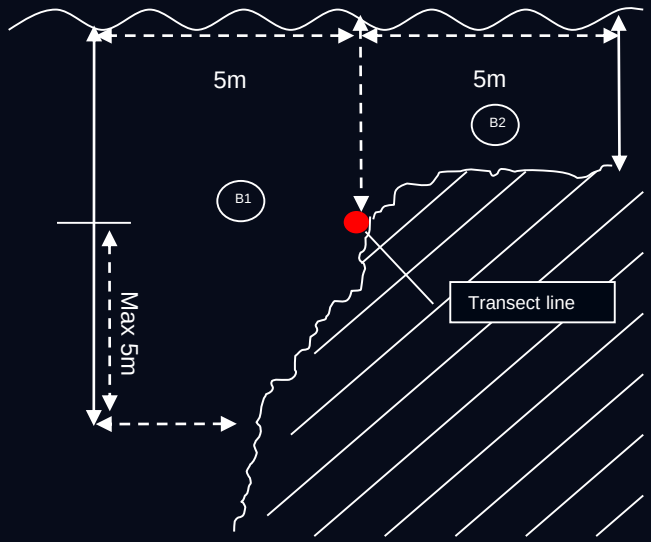


Figure 5. Representation of standard method on a wall that doesn't reach the surface.

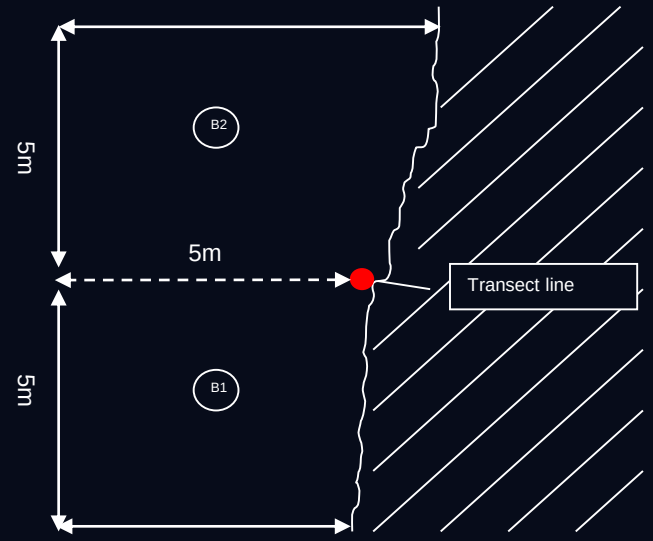


Figure 6. Representation of wall method for walls that reach the surface, or when transect line is set > 5 m below the top of a wall.

THE WALL METHOD



a.) Standard Method

b.) Wall Method

Figure 7. When to use wall method. A decision needs to made as to when to switch to the wall method. Generally, somewhere between these two scenarios would be most appropriate, before the area covered in B2 becomes too small using the standard method. In Figure a.) the standard method can still be used but in Figure b.) The Wall methodology would need to be adopted. Divers need to be consistent with their decisions for using the wall methodology.

SURVEYING NARROW REEF

A survey may still be undertaken on a wall that reaches the surface, but is less than 10 m high above sand (and is thus too short for the wall method to be applied), as is the case for many breakwaters or shallow rocky shores. In this case, only one block should be surveyed along the line (for both fishes and invertebrates/cryptic fishes). A second line should then be subsequently set, so that two blocks are still surveyed, “end on end” (N.B. please ensure they are still labeled as “block 1’ and ‘block 2’ in the data entry). Photo-quadrats should be taken on both lines. If you have any queries regarding the application of this method, please feel free to contact RLS organisers for clarification.

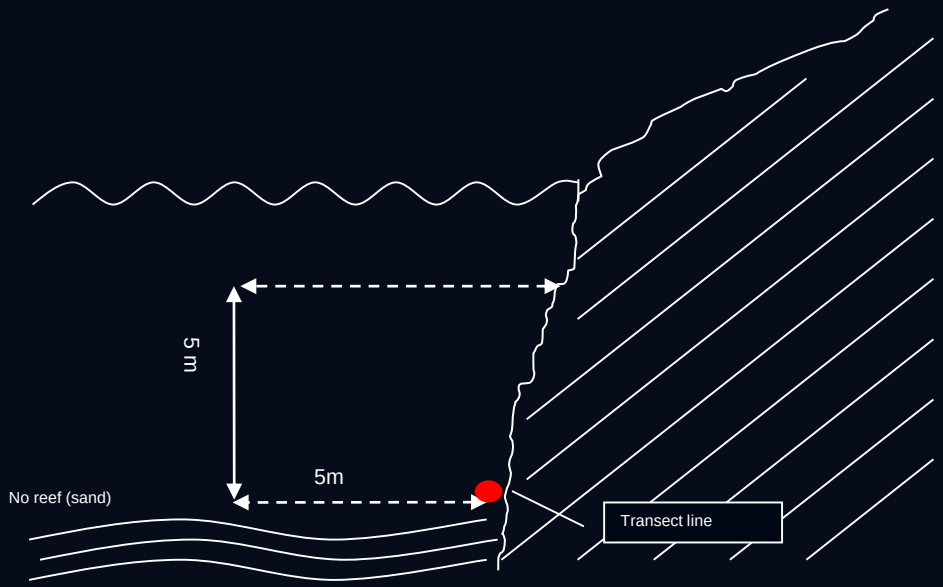


Figure 8. Reef less than 10 m wide and/or wall less than 10 m high (e.g. groyne). Only 1 block is surveyed and a second line should be surveyed on one end in the same manner.

SURVEYING JETTIES/PIERS

Many jetties are built over sand and sometimes seagrass, substrates that the RLS methods were not primarily designed to survey, and it is therefore not recommended that a large proportion of survey effort is placed under jetties. However, in some regions where the coast is formed by long sandy beaches, jetties, wrecks and artificial structures may provide the only habitat for reef-associated species. Some jetties also have substantial cover of sessile invertebrates (e.g. ascidians) on the substrate, and this can also act as a “reef” in harboring greater densities of mobile invertebrates than areas of bare sand or seagrass. The usefulness of the invertebrate survey data from a jetty survey is greatly influenced by the choice of which jetty (and more importantly the substrate underneath), however, and it is preferable to choose jetties with as much reef/rubble/debris underneath as possible.

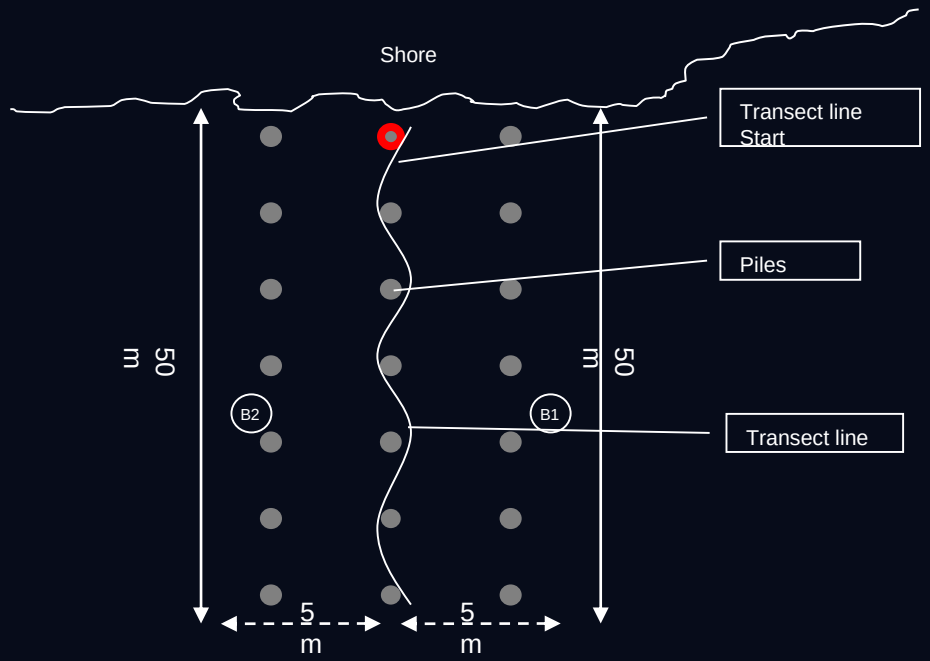


Figure 9. Stylised representation of a jetty survey. Note that the transect line should zig-zag closely around piles

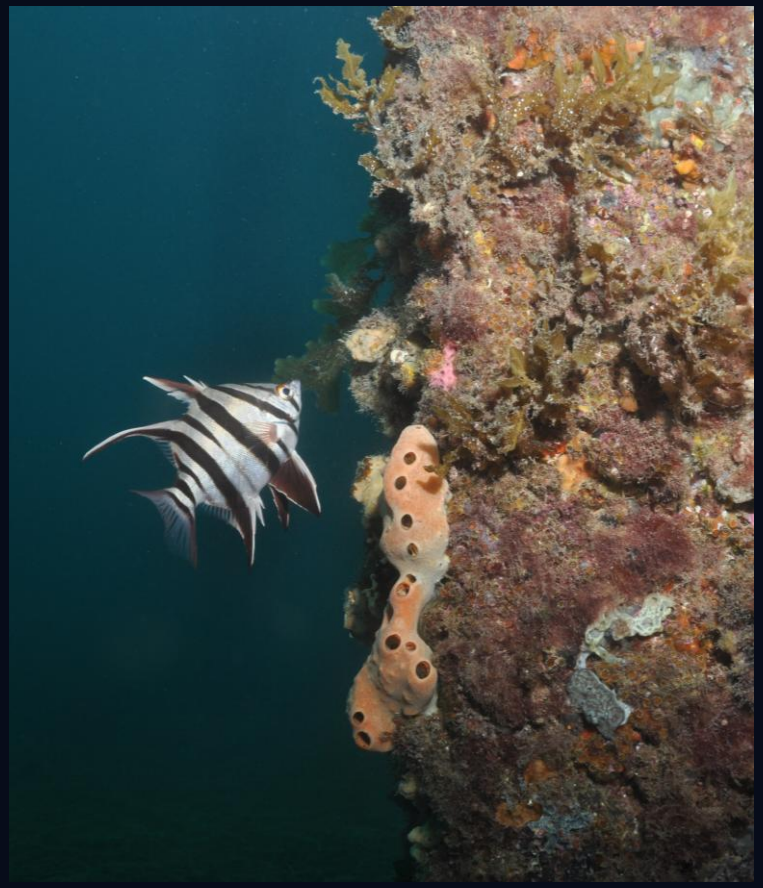
SURVEYING JETTIES/PIERS

The method for conducting a survey under a jetty is not much different from a standard reef survey other than needing to pay attention to the following:

The transect most often needs to be run out perpendicular to shore, as opposed to along a depth contour. This should not greatly affect results as jetties are usually in areas of gentle slope and the difference in depth between the two ends is rarely great.

Both the fact that the survey is a jetty survey and the pile that the transect line starts (e.g. the 5th pile from shore) should be specified in the data entry template in the part for comments.

The transect should follow a logical row of piles, with preference for an area that will have equal jetty cover on both blocks (e.g. if there are 3 rows of piles, run the transect down the middle one). See Figure 9.



SURVEYING JETTIES/PIERS

The transect line should be run out in a “zig-zag/chicane” fashion around consecutive piles, such that every second pile will be included in each of the blocks for the purposes of the invertebrate survey (which also means that the line should lie within 1 m of each pile). If start of the line is tied to a pile, that pile should be counted in the block that the next pile isn’t in – i.e. if the first pile encountered whilst running the line out is in block 2, then the pile that the line is tied to should be counted in block 1. The choice of which side is which block (because there is typically no “offshore” or deeper side on a jetty survey) is entirely up to the surveyors, but buddies should communicate to ensure they have not recorded the same block.

The invertebrate search includes counts within 1 m either side of the line (as usual), plus counts on all surfaces of each pile in that block up to 2 m height off the bottom. If the line has been run out correctly this will mean that the bottom 2 m of every second pile is searched on each block.

The photo-quadrats for a jetty survey should be taken horizontally on both the outside and inside of each pile that the line passes, instead of vertically at the bottom at the usual 2.5 m intervals. If there is reef or sessile invertebrate substrate, then take photo-quadrats vertically downwards at least once between each pile in addition to the pile photo-quadrats.

In cases where there is reef substrate under and around a jetty, the decision whether to do a “jetty survey” as described above, or a standard survey over reef along a depth contour is at the discretion of the diver, but generally reef surveys are preferred.

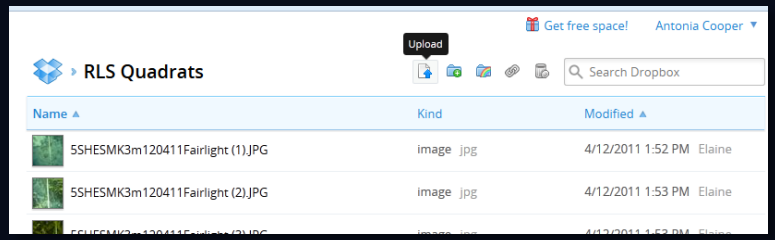
APPENDIX 3. – UPLOADING DATA TO DROPBOX

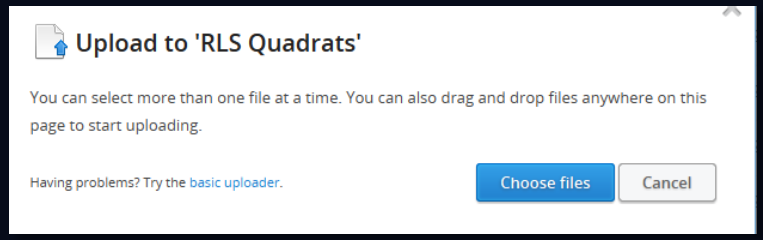
You can upload photos to Dropbox 2 ways:

- By Dragging and dropping to your Dropbox folder on your desktop
- By uploading them via the Dropbox website

To drag and drop from your Desktop all you need to do is open your Dropbox folder and either drag a whole folder into it, or create a new folder and drag the photos you wish to add into it. This will take a while if there are lots of photos. Once each photo has a green tick at the top right corner of the icon, then the photos are uploaded and can be shared. If you wish to keep a copy of your PQs for your own records, then copy and paste rather than using the 'drag' function.

To upload via the website, log into the Dropbox website (www.dropbox.com) , create a new folder (unless you wish to add photos to an existing folder, then skip this step), and click the "upload" icon at the top of the page, and then "choose files" (see below).





UPLOADING DATA TO DROPBOX

Once your files are uploaded, click on the “Shared folder Options” at the top of the page and type in the Reef Life Survey email address (reeflife.survey@utas.edu.au) in the “Invite more people” box. This will send us an invitation alerting us that there are photos which need to be downloaded.

We recommend you set up your Dropbox so that you have a folder named RLS_[Name] (i.e. RLS_Rick Stuart-Smith) and keep that folder shared with RLS. That way you can just drag or upload whole folders of transect photos as per the PQ naming convention.

It is very important to label the photo quadrats correctly, especially if you are adding more than one transect worth of photos into your Dropbox folder.

REFERENCES

Edgar, G. J., N. S. Barrett, et al. (2004). "Biases associated with the use of underwater visual census techniques to quantify the density and size-structure of fish populations." Journal of Experimental Marine Biology and Ecology **308**(2): 269-290.

Edgar, G. J. and R. D. Stuart-Smith (2009). "Ecological effects of marine protected areas on rocky reef communities: a continental-scale analysis." Marine Ecology Progress Series **388**: 51-62