

Chapter 4.

Seagrass Mapping & Pre-monitoring Preparation

Seagrass-Watch activities initially map the distribution of seagrass meadows at a locality or in a region to better understand the seagrass resources of an area. Community volunteers are often limited to mapping the accessible intertidal seagrasses, although in some cases subtidal seagrass meadows can be included. Mapping strategies should first be checked with the Seagrass-Watch Coordinator to ensure validity and rigour. Mapping activities should be coordinated through the Local Community Coordinator to ensure that as much of the region is covered within the shortest period of time. Once field mapping is completed, the data sheets can be returned to the Seagrass-Watch Coordinator, via the Local Community Coordinator. After the data from the mapping activities has been validated and analysed, GIS maps can be prepared for the region and fed back to the community groups. These maps will assist the development of a monitoring strategy and recommend appropriate locations for monitoring sites.

4.1. Mapping the seagrass resource

The most important information that is required for management of seagrass resources is their *distribution*, ie. a map. It would be inappropriate to set up a monitoring program if the most basic information is unavailable - that is, whether seagrass is present or absent. The following section provides a guide of how to plan and then map the seagrass resources in a region or locality.

4.1.1. Planning the mapping task

When planning a mapping task, there are several issues that need to be considered.

Scale

The selection of an appropriate scale is critical for mapping. Mapping requires different approaches depending on whether survey area is relative to a region (tens of kilometres), locality (tens of metres to kilometres) or to a specific site (metres to tens of metres).

The next consideration is that scale includes aspects both of extent and resolution. In both broad and large scale approaches, the intensity of sampling will be low (low

resolution), with a statistical sampling design that allows the results to be extrapolated from a few observations to the extent of the study area. For finer scale examinations of seagrass meadows, the sampling intensity required can be high with greater precision (high resolution).

Scale also influences what is possible with a limited set of financial and human resources. The financial, technical, and human resources available to conduct the study is also a consideration.

Accuracy

Determining the level of detail required when mapping an area also depends on the level of accuracy required for the final map product. Errors that can occur in the field directly influence the quality of the data. It is important to document these. GPS is a quick method for position fixing during mapping and reduces point errors to <3m in most cases. It is important for the observer to be as close as possible to the GPS aerial receiver to minimise position fix error.

Choosing a Survey/Mapping strategy

The selection of a mapping scale represents a compromise between two components. One is the maximum amount of detail required to capture the necessary information about a resource. The other is the logistical resource available to capture that level of detail over a given area.

Generally, an area can be mapped using a grid pattern or a combination of transects and spots. When mapping a region of relatively homogenous coastline between 10 and 100 km long, we recommend that transects should be no further than 500-1000 m apart. For regions between 1 and 10 km, we recommend transects 100-500 m apart and for localities less than 1 km, we recommend 50-100 m apart. This however may change depending on the complexity of the regional coastline, i.e., more complex, then more transects required.

To assist with choosing a mapping strategy, it is a good idea to conduct a reconnaissance survey. An initial visual (reconnaissance) survey of the region/area will give you an idea as to the amount of variation or patchiness there is within the seagrass meadow. This will influence how to space your ground truthing sites.

Reconnaissance surveys can be done in the field (using a boat or aircraft) or simply using aerial photographs and marine charts. This pre-mapping activity will help give more accurate information regarding the location and general extent of seagrass meadows to be mapped.

When mapping, ground truthing observations need to be taken at regular intervals (usually 50 to 100m apart). The location of each observation is referred to a point, and the intervals they are taken at may vary depending on the topography.

When ground truthing a point, there are a variety of techniques that can be used depending on resources available and water depth (free dives, grabs, remote video, *etc.*). First the position of a point must be recorded, preferably using a GPS. Otherwise use a handheld compass to determine the bearing, triangulating to at least 3 permanent landmarks or marker established as reference points. A point can vary in size depending on the extent of the region being mapped. In most cases a point can be defined as an area encompassing a 5m radius. Although only one observation (sample) is necessary at a ground truth point, we recommend replicate samples spread within the point (possible 3 observations) to ensure the point is well represented.

Observations recorded at a point should ideally include some measure of abundance (at least a visual estimate of biomass or % cover) and species composition. Also record the depth of each point (this can be later converted to depth below mean sea level) and other characteristics such as a description of the sediment type (eg. shell grit, rock, gravel, coarse sand, sand, fine sand or mud), or distance from other habitats (reefs or mangroves).

4.1.2. Mapping the Seagrass Meadow.

Check the tides to help you plan when is the easiest time to do the mapping, e.g., spring low is best for intertidal meadows and neaps for subtidal.

Necessary materials & equipment

You will need:

- Compass or portable Geographic Positioning System (GPS) unit*
- Clipboard with pre-printed data sheets (see Appendix I) and pencils.*
- Suitable field clothing & footwear (e.g., hat, dive booties, etc)*
- Aerial photographs or marine charts (if available) of the locality*
- 50 centimetre x 50 centimetre Quadrat (preferably 5mm diameter stainless steel).*
- Waterproof labels for any specimens collected (pre-printed labels ensure that all essential data are recorded for each sample).*
- Plastic bags - for seagrass samples*
- Seagrass collection permit (Permits are a legal requirement in some states).*
- Weatherproof camera (optional)*
- Seagrass identification and percent cover sheets (see Appendix III)*

General field procedure

The objective of mapping is to try and determine the edges/boundaries of any seagrass meadows and record information on species present, % cover, sediment type, and

depth (if subtidal). If mapping can be conducted at low tide when the seagrass meadow is exposed, the boundaries can be mapped by walking/ wading/ swimming around the perimeter of the meadow and making observations every 5 – 25 metres depending on size of the area and time available. An important element of the mapping process is to find the inner (near to the beach) and outer (towards the open sea) edges of the seagrass meadow.

Observations need to be taken at regular intervals. On your chart, select a starting point to begin sampling and go to that site. Points can either be:

- within transects across the meadow, or
- haphazardly scattered over the entire meadow.

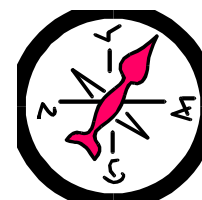
Transects do not have to be accurately measured using a tape. You can estimate distances between points depending on the size of the meadow. e.g., in a small meadow you can have points 20m or 50m apart, but in a large meadow points may be 100m or 500m apart.

Record the position of the point

- ☞ Record the position of the points using a GPS or compass. If using a hand-held compass to determine the site location, use at least 3 permanent landmarks or markers as reference points. Record the compass bearings and mark the reference markers on the map. Roughly mark the point on the chart and assign it a code.

Taking a Compass Bearing

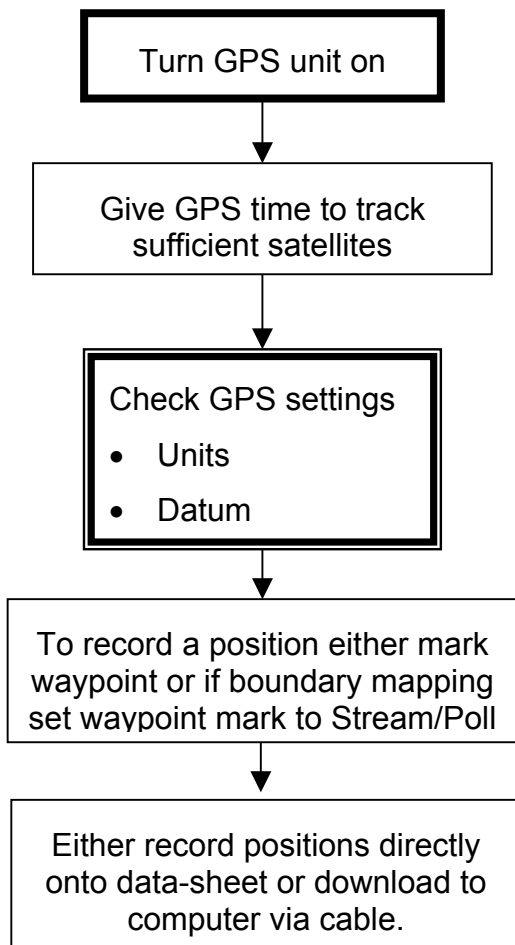
- Hold the compass in front of you at chest height and level to allow the needle to travel freely.
- Turn to the direction for which you want to take a bearing.
- Allow the needle to stabilise.
- Move the bezel (wheel) on the compass until the bezel arrow is over the needle and pointing to zero degrees indicating north.
- Your bearing is the intersection of the bezel and the red arrow on the base plate.
- Record the bearing on your data sheet, e.g., 80°.



Finding a Compass Bearing

- Alternatively, if you have been given a bearing to follow, turn the bezel until the bearing is in line with the red arrow on the base-plate.
- Now turn your body until the needle lines up with the North arrow (keep the needle head between the markers).
- You should now be facing your bearing.

Using a GPS



Trouble shooting & hints

- When position fixing it is important to give the GPS antenna a clear signal of the sky. A GPS needs to receive signals from a number of satellites (usually more than 4) to take an accurate fix. Be aware that when using a GPS amongst high terrain, signals from some of the satellites may be blocked or unclear.
- It is important to give the GPS sufficient time to position fix. If you are moving when the position is fixed, it may add error. The less movement, the greater the accuracy. Give the GPS at least 5-10 seconds to position fix.
- GPSs that are more accurate when moving, are those which have the ability to "stream" or "poll". These can be useful when boundary mapping. If the GPS does not "stream" then the operator will need to take a waypoint every few metres.



- Ensure the GPS units are known to the user, as it is often common to miss read decimal minutes as minutes and seconds (e.g., 14° 36.44' is not the same as 14° 36' 44").
- When using a GPS for the first time or in a new region (world zone), ensure the almanac is set correctly. Most GPSs today will detect that they are in a new region, and will automatically download the new almanac which may take approximately 15 minutes.
- When position fixing a subtidal ground truth site with a GPS, it is important for the observer to be as close as possible to the GPS antenna to minimise position fix error. This can be difficult in small boats under conditions of strong wind and current.
- Global Positioning Systems (GPS's) have the ability to record your location on the earth's surface using different datums (different fixed starting points). Datums that record positions in longitudes/latitudes coordinates you could be familiar with include WGS (World Geodetic System) or AGD (Australian Geodetic Datum). You can choose which datum (AGD or WGS) your GPS screen shows. Both are equally correct to use. However, if you are trying to find coordinates from a map which are written down as AGD, and your GPS is following WGS – there could be up to 160m discrepancy. Check out and know your GPS - CONSISTENCY IS THE KEY.

Record general point information

When at a mapping point, the minimum information required on the mapping datasheet:

- Record the observer, location (e.g., name of bay), date and time.
- Describe the sediment type (eg. shell grit, rock, gravel, coarse sand, sand, fine sand or mud).
- Write any other comments if any (eg. lots of algae).
- Record the water depth if the point is subtidal.

Record seagrass parameters

- ☞ At the mapping point, haphazardly toss a quadrat within an area of an approximate 5 metre radius around you.
- ☞ Within the quadrat:
 - Estimate the overall percentage seagrass cover (use standard guide sheets).
 - Identify the seagrass species present within the quadrat (use ID sheets).
 - Estimate the percent composition of these species within each quadrat.
- ☞ Haphazardly toss the quadrat another two times within the point area, recording the data for each of the quadrats.

Take a photograph

Photographs provide a permanent record and can ensure consistency between observers.

- ☞ Photographing every quadrat would be expensive, so instead we recommend that you photograph a quadrat from every 10th mapping point (ie. 10% of the mapping points will have a quadrat that has been photographed) or if the meadow changes or if there is something unusual. It is best to photograph a quadrat from two angles:
 - from directly above and
 - from 45-60 degrees (navel height?)
- ☞ Make sure the photo details are noted on the data sheet so the photo can be matched with the quadrat details.
- ☞ Another option is to video the quadrats and analyse back at home or in the laboratory.

Collect a voucher specimen

- ☞ If you have the appropriate permit, collect a voucher specimen of each seagrass species you encounter for the day (only 1 or 2 shoots which have the leaves, rhizomes and roots intact). Label each specimen clearly and put into a plastic bag.

Continue mapping

- ☞ Move on to the next mapping point and repeat the process. The number of mapping points you survey will be entirely up to you. If you need to accurately monitor an area, then we recommend intensive surveying (sample lots of mapping points). It is also beneficial to try to get a good spread of mapping points over the area, as some of the changes in the seagrass meadow will not necessarily be obvious.

At completion of field mapping

- ☞ When you return from the field even though you will be tired it is worth checking through the information you have gathered to make sure there are no data gaps.
- ☞ Wash field gear and pack away.

Creating the map

The simplest way to map the distribution of seagrasses is to draw the meadows on a paper marine chart from the GPS positions of the ground truth sites. The problem with this type of mapping however is that the final map is in a format that does not allow manipulation and transformation. The layout of a paper map is permanent, which makes it difficult for future seagrass mapping studies to be compared, queried and analysed. If resources are available, we recommend that the data be transferred to a digital format and a Geographic Information System (GIS) be used. A detailed description of using and mapping with GIS is beyond the scope of this manual, and we recommend consulting with a scientist experienced in mapping and reading McKenzie et al. (2001).

4.2. Designing a monitoring plan

Once the extent and characteristics of the seagrass resource are known from the mapping activities, then a monitoring plan can be designed. Monitoring plans should be designed to

- Ask appropriate questions and set achievable goals
- Collect accurate and precise data that meets the requirements of the users
- Report data in an informative manner
- Be easy to work through
- Use available time and resources efficiently

Holding a community consultation meeting with Seagrass-Watch volunteers to design a monitoring plan and select the locations for long-term monitoring is often a good start. Site selection can also be assisted by consultation with environment management agencies, local government, and seagrass researchers. The position of monitoring sites may also be dependent on volunteers, as often volunteers may elect to adopt a site which is close to their place of residence. Ongoing Seagrass-Watch monitoring should also be coupled (if possible) with existing environmental monitoring programs (eg. water quality, beach profile, *etc*) to increase the ability to identify impacts.

The Seagrass-Watch Coordinator or a qualified Seagrass Ecologist/Biologist should endorse the monitoring plan after developing it with the group. This will ensure that the plan will meet the requirements of the data users and that the collected data will be accurate and precise. It is also good to revisit the plan after every year or when significant changes occur.

4.2.1. Issues to consider when designing a plan

The type of monitoring plan developed depends on the following issues:

Why are you monitoring?

You first must identify the purpose for monitoring. This question establishes the base of the monitoring plan. If this basic question cannot be answered with the resources available, it may be necessary to refocus on what it is you are trying to achieve. You also need to consider who will use the information and how will they use it? Different Seagrass-Watch groups have different reasons for monitoring and information needs should drive the design of a monitoring plan. For example, some groups are interested in the regional impacts on intertidal seagrasses from land run-off, while others are interested in the localised impacts of anchoring on subtidal seagrasses. The “why” question will help determine the extent of how detailed the monitoring plan needs to be developed

What will you monitor (methods and level of data quality required)?

The parameters that you monitor will depend on the available resources and skills. When you have decided what it is you are trying to achieve, it is then necessary to seek expert advice on what should be monitored and the most suitable methods available.

Where will you monitor, when and who is going to be involved and how?

Where you monitor will depend on the purpose for monitoring and the area to be monitored. It is important to choose sites that are representative of the area to be monitored and that can be reached during all conditions. When you monitor will be influenced by what you are monitoring and what information you are trying to collect. Knowing who is to be involved and what role they play in the monitoring plan will affect the "when" of monitoring.

Ensuring data is credible and managed

The methods used in the Seagrass-Watch program have been developed with Quality Assurance and Quality Control in mind. Particular groups and regions may also put their own additional measures in place (e.g., frequency of refresher workshops or interaction between other groups or volunteers in different sites, localities or regions).

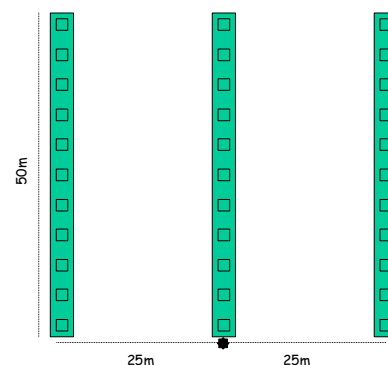
It is assumed that all Seagrass-Watch groups will be using the Seagrass-Watch database for all data storage. This database is maintained at the Northern Fisheries Centre in Cairns and the Marine Plant Ecology Group is the custodian. Before the data is stored on the database, it is important that the data is screened for any questionable results and then entered onto the database if no problems are detected. Field data collections sheets are important so that the data is received in a standard manner and information collected cannot be confused.

4.2.2. Examples of monitoring designs

Example 1. Intertidal fixed transects site

A community group of 25 people met with the Seagrass-Watch Coordinator and decided that they wanted to monitor seagrass status and resilience across their region. With their available resources and capital, they felt that they were able to monitor a total of 15 sites. As the region was relatively large, it was decided that the sites should be grouped into 5 localities with 3 sites at each locality. It was decided that only intertidal sites would be possible due to logistics of diving, issues of insurance for volunteers, the time required and the diversity of volunteers (including families, schools and elderly).

As the tidal window for access to the intertidal banks was 2-4 hours, it was decided to establish permanent marked, fixed transect sites and to sample every 3 months. After discussions with scientists, it was decided that the best design would be to have 3 parallel transects, 25m apart. The within site transects would run perpendicular to shore. This type of site also has the advantage of enabling within site spatial analysis and can also provide a measure of within site variance if required.

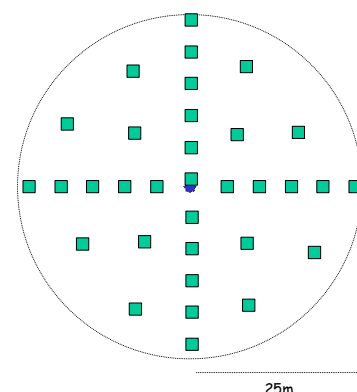


The volunteers were also interested in the resilience of their seagrass meadows, as major floods from a large river in the region episodically impacted the region. As some of the meadows were composed of *Halodule uninervis*, a seed-monitoring program was also initiated and seed sampling was conducted at the same time as seagrass status monitoring.

Example 2. Intertidal fixed point site

A volunteer and recreational angler met with the Seagrass-Watch Coordinator and were very keen to monitor seagrass status in an area where they regularly visit on fishing trips. The locality could only be accessed by boat and the volunteer could only spare limited time for monitoring during visits. With their available resources they felt that they were able to monitor only 1-2 sites every 3 months. This information could however, augment other Seagrass-Watch monitoring in the region.

As speedboats and commercial netters frequented the monitoring site, it was decided that only a single marker would be fixed at each site. Also, as the time was limited, the volunteers were willing to forgo some of the rigour of their information collected. After discussions with scientists, it was decided that the best design would be fixed point sites. Approximately 33 quadrats would be spread either evenly or randomly within an area with a radius of 25m. Also due to the limited time, volunteers would pace out the distances between quadrats, rather than laying tapes.

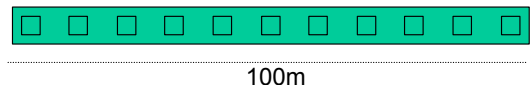


This type of site has the disadvantage of not enabling any spatial analysis and not providing a measure of within site variance. It still provides however, sufficient information on the status of seagrasses at that locality.

Example 3. Subtidal fixed single transect

A SCUBA diving group of 10 people were concerned about the impact of boating activities adjacent to a popular beach. The group met with the Seagrass-Watch Coordinator and decided that they wanted to monitor seagrass status across the seagrass meadow adjacent to the beach. With their available resources and capital, they feel that they are able to monitor a total of 2-3 sites.

After discussions with scientists, it was decided that the best design would be to have a fixed transect of 50-150m in length at each site. Also, due to the possibility of divers disturbing quadrats close together, it was decided to set quadrats at every 10m. The results of a preliminary pilot study indicated that the transect need only be 100m long (very little additional information was obtained by sampling 150m). This was also satisfactory as not to compromise non-decompression bottom times. The transects would also run within the same depth contour. As boats frequented the site, it was decided not to fix a mark into the substrate, but rather take an accurate position fix with a GPS. Also, it was decided to sample every 3 months.



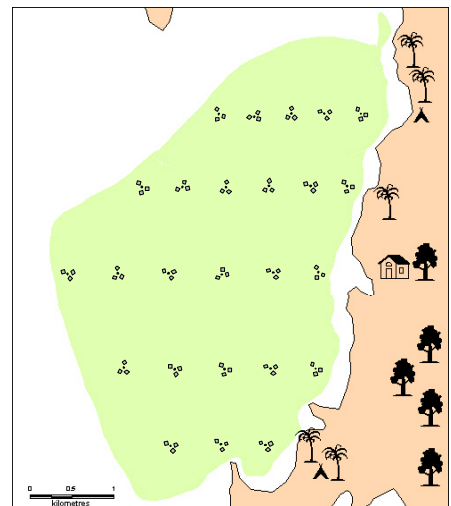
This type of site however, has the disadvantage of not enabling any spatial analysis within site and not providing a measure of within site variance. However, it still provides sufficient information on the status of seagrasses at that locality.

Example 4. Subtidal spots in defined area

A group of divers were concerned about the impact of boating activities across a large shallow (<5m) subtidal meadow adjacent to a major continental island. The meadow was a popular turtle feeding area and many commercial tourist operators traversed the meadow on the way to the tourist destinations. The group met with the Seagrass-Watch Coordinator and decided that they wanted to monitor seagrass status across the seagrass meadow. They considered that to adequately monitor the entire meadow they would need a lot of sites, but were concerned that existing methods could be labour intensive and time consuming.

After discussions with scientists, it was decided that the best design would be to have many sites spread across the meadow, rather than collect a lot of detailed information at a few sites. A number of spots were chosen across the meadow based on the results of a mapping survey. The positions of these spots were assigned from GPS readings and not permanently marked. The arrangement of spots was in a grid, rather than random, as this was logistically easier to work in the field and less time consuming locating positions.

Spots were located 100-500m apart, and each spot was defined as an area with a radius of 5m. The sampling plan was to monitor every 3 months. Divers (mask & snorkel) would free-dive to the bottom, and measure seagrass status within 3 haphazardly placed quadrats, at each spot. Information was recorder by an assistant on the vessel. This type of monitoring strategy has the advantage on giving relatively good information across a larger scale (kilometres).



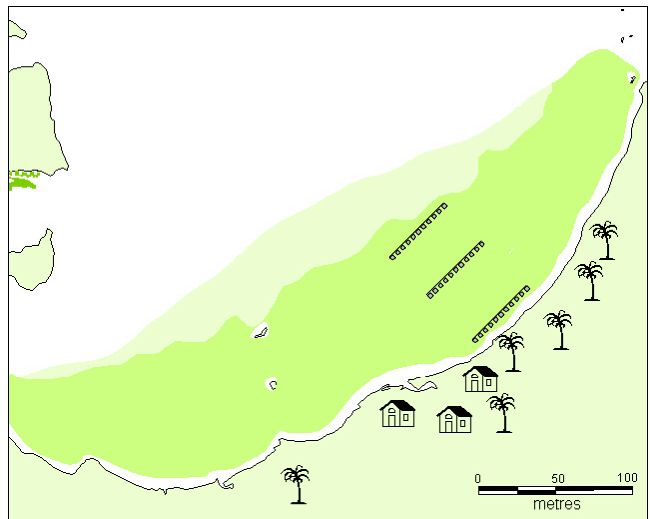
Example 5. Depth transects across a meadow

A community group of 10 people from a small township met with the Seagrass-Watch Coordinator and decided that they wanted to monitor the dense *Zostera* meadow adjacent to their town. The group were concerned about the gradual loss of the *Zostera* meadow, which was reported to have extended much further out to sea in the past. This loss of the seagrass at the seaward extent had been attributed to poor water quality from a nearby catchment. Recently, management practices had been implemented in the catchment to restore water quality and the community group wanted to ensure that the *Zostera* meadow was no longer contracting. It was decided that only intertidal monitoring would be possible due to logistics of diving, issues of insurance for volunteers, the time required and the diversity of volunteers.

After discussions with scientists, it was decided that the best design would be to have three transects distributed across the meadow, with one shallow transect parallel to the shoreward edge and another deep parallel to the seaward edge of the meadow. A third mid-depth transect would be placed half way between the other 2.

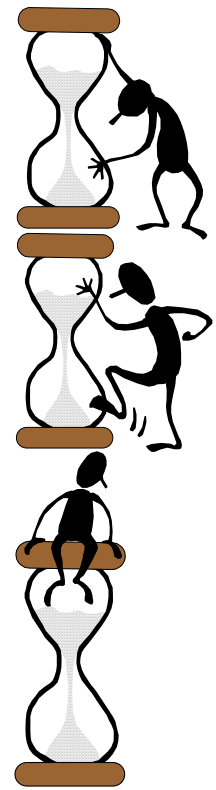
Quadrats would be sampled every 5 metres along each 50m depth transect. As the tidal window for access to the intertidal banks is 2-4 hours, it was decided to establish permanent marked, fixed transect sites. Also, it was decided to sample every 3 months.

This type of site has the advantage of detecting changes in the extent of the meadow with depth (if water quality deteriorates, the deep transect would decline in abundance, etc).



4.3. How often to sample or monitor

- ⌘ Determining how regularly to repeat each sampling/monitoring event is not simple, as it depends on the issues of concern, the question being addressed by the monitoring plan, and the availability of people (time). There are no hard and fast rules,
- ⌘ The only condition is that all monitoring sites should be examined once (1 time) every 12 months, at approximately the same time of year.
- ⌘ The most frequently a site should be examined is every 3 months (90 days) unless otherwise advised by the Seagrass-Watch Coordinator. Most research on seasonality of seagrass communities has shown that seagrass abundance in adjacent months is similar (*not significantly different from each other*). So the most frequent sampling to give a difference would be around 60 days apart, but we recommend 90 days. Also, frequent visitation to sites may cause physical damage to the seagrass, which could result in the monitoring program monitoring the effect of visitation.
- ⌘ Times when the Seagrass-Watch Coordinator would recommend more frequently than 90 days would be after a major flood event or similar impact (e.g., extensive dredging or major storm event). These decisions are made after consultation with researchers and other specialists.



4.4. Understanding the data

Analysis and interpretation of data can be challenging due to the variation within and between sites in the monitoring program and should only be conducted by qualified and experience people. This varies due to seasonal conditions and episodic events. The purpose behind a monitoring project will influence what needs to be reported and how much detail is required for the interpretation of the results. Interpreting the data involves organising the data to show findings and to develop conclusions and recommendations.

Conclusions are an explanation of why your data looks the way it does and what factors have influenced the results. *Recommendations* describe what action should be taken and what further information should be gathered.

Be wary of jumping to conclusions based upon short term data. Seagrass resources need to be studied over years rather than months for reliable results. Unfortunately, a full discussion of data interpretation is beyond the scope of this manual.

4.5. Pre-monitoring preparation

Make a List

Make sure you have a list or checklist of equipment that you'll be using on the day. It is important that you have everything you need to sample before you travel into the field. Without simple essentials like quadrats or datasheets, monitoring and data collection will not be possible on the day.

Make a Timetable

Create a timetable of times of departure and arrival back, and what the objective of the day is and what is to be achieved on the day. Give a copy of this to all volunteers involved in advance so they can make their arrangements to get to the site on time. List on this timetable what the volunteers need to bring (e.g., water, lunch, towel *etc*).

Book a Vessel

If you are monitoring subtidal sites or sites which are best accessed by water, organise a suitable vessel at least several weeks in advance,

Permits

Ensure you have appropriate permits (e.g., QDPI Marine plant permit, Marine Park).

Have a Contact Person

Arrange to have a reliable contact person to raise the alert if you and the team are not back at a specified or reasonable time.

4.6. Safety

- Assess the risks before monitoring - check weather, tides, time of day, etc.
- Use your instincts - if you do not feel safe then abandon sampling.
- Let someone else know where and for how long you will be sampling
- Wear proper clothing and footwear depending on the weather, e.g., hat, diving booties or old shoes with tough sole and good grip.
- Be sun-smart - wear hat with good cover, sunglasses (preferably polarised lenses) and use sunscreen (preferably 40+).
- Adult supervision is required if children are involved
- Use common sense when walking to and from a site, ie, beware of holes, oysters, broken glass, etc.

- Do not put yourself or others at risk. Beware of unknown water, currents and tides.
- Be aware of dangerous marine animals. If crocodiles occur in your area, check with QPWS.
- Have a first aid kit on site or nearby and re-acquaint yourself with the treatment of marine stings (e.g., jellyfish, stonefish)
- If entering private property to reach a site, first seek permission of the owners
- Keep your site as clean as possible by removing excess rubbish
- If free-diving, have a surface buoy tethered to the diver so the position of free-diver is always known to the person on watch and the skipper of the vessel.
- If SCUBA diving follow safe non-decompression diving procedures.
- Communication device (ie mobile phone working in area or marine radio)
- If diving or on boats, make sure you have the phone numbers of: Diving Emergency Service Telephone (1800) 088200 (24hrs), or Queensland Emergency Services Townsville 07 47251066, depending which location is closer to you.

Further Reading:

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