

Manual for monitoring seagrass in Palau



Palau International Coral Reef Center

Cover photo: Geory Mereb measuring seagrass in Ngeriklerker, Ngardmau

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Section 1: SEAGRASS IN PALAU

1.1 General Introduction

Seagrasses are angiosperm (flowering plants – **omung el delomel**) that grow in sediment on the sea floor with pointy, long leaves and a buried root-like structure (**risel**) (rhizomes--see Appendix I for more understanding of the different parts of seagrasses). They often form large “meadows” or beds which look like grassland and they provide habitat for many marine organisms.

There are various reasons why one monitors seagrasses. This manual is used to provide guidance for assessment and monitoring of seagrasses in Marine Conservation Area (MCAs) that are established in seagrass beds. Communities establish Marine Protected Areas for two main purposes: 1. conserve fish and 2. conserve invertebrates such as sea cucumbers and giant clams. Often, people think that the habitat is the least of the concern. However, to know whether the closed area is being effective in achieving its purpose, one needs to know what the habitat is like in order to analyze the animals that use the habitat (***Alsekum meng soad el momedengei el kmo tial conservation area ng oureor ma lechub eng diak eng dirrek el kired el mo medengeli a teletelel a kereker meng mosebeched el dirrek el momedengeli a teletelel a usbechelel a ngikel er tial kereker***). Simply monitoring the animals without knowing the condition of the habitat can not help you understand the positive (increase), negative (decrease), or no change of the animals living within the closed area (***Alsekum ngdiak dodengei el kmo ngua ngerang a teletelel a kereker eng meringel er kid a mo medengei el kmo ngerang meng mo betok malechub eng mo mekesai a ngikel ma cheled er a chysel a conservation area***). This is why monitoring seagrass is an important factor in managing and conserving MPAs and their resources (***A uchul meng dirrek el kired el omes ra klungel a char meng mo sebeched el meduch el omecheliu er a conservation area***).

This manual is intended for the use on monitoring seagrasses in Conservation Areas by community members and/or Conservation Officers to inform decision makers for appropriate actions for effective management MPA in coastal marine communities. Protocols in this manual were adopted from the “SeagrassNet Manual for Scientific Monitoring of Seagrass Habitat” (Short *et al.* 2006). For further questions, please contact Palau International Coral Reef Center.

1.2 Seagrass of Palau

Palau has a total of 10 seagrass species (**bedengel el char**) but within a given seagrass bed, on average of 5-7 species can be found. *Thalassodendron ciliatum* is found only in the reef flats of Kayangel Islands, Ngeruangel, and Velasco reef. This species looks like *Cymodocea serrulata* and can be sometimes mistaken. However, the *Thalassodendron ciliatum* is restricted to the north island and is not found around Babeldaob or the southern islands. *Cymodocea serrulata* can be mistaken with *Thalassia hemprichii*. The main distinguishing features of the two are the leaves and the rhizomes (see field guide on Appendix I).for identification). *Cymodocea serrulata* has leaves that are flat, green, and sometimes have reddish lateral stripes and their rhizomes are smooth without scales. On the other hand, *Thalassia hemprichii* has leaves that are ribbon-like and slightly sickle-shape and have rhizomes that are not

smooth. *Halodule pinifolia* is found on sandy beaches and is only found on the east coast (***Despedall ra Melekeok el mora Ngaraard***), of Babeldaob where there are beaches. It is also found throughout the rock island beaches. The leaves of this particular species are the thinnest of all tropical seagrasses. *Halophila minor* is an uncommon seagrass species (***bedengel a char el kmal mekesai***), which has only been observed in Ngermeduu Bay (***medal a lbobang ma Ngesebokl***). The main distinguishing features of this species and *Halophila ovalis* is the number of cross veins on the leaf. *Halophila minor* has less than 8 veins whereas *Halophila ovalis* has more than 8 veins (see Appendix I for field guide identification). The most common species of seagrasses that are encountered in Palau are the *Enhalus acoroides*, *Thalassia hemprichii*, *Halophila ovalis*, *Halodule uninervis*, *Syringosium isoetifolium*, and *Cymodocea rotundata* (see Appendix I for the different types of seagrass species in Palau).

Section 2: MONITORING PROCESS

2.1 What is monitoring?

Monitoring is the repeated gathering of data and observation of a system, usually to detect change. For the purpose of this manual, the system is the MCA, which is located on a seagrass meadow. The level of change and accuracy will vary according to the method used. For the monitoring of MPA, the main purpose of collecting data is to detect change on specific organisms such as seagrass, fish, and invertebrates.

2.2 Why monitor?

In order to determine whether a site that has been closed to the public is meeting its objectives when the community decided to close it, monitoring is necessary to detect changes (both good and bad). This information can help the responsible authority to take actions to either maintain the good things that are happening to an MPA or to change the bad things that are happening so that the MPA is meeting the goals and objectives of the community.

Section 3: ESTABLISHING MONITORING SITE

3.1 Choosing monitoring site

It is advocated by seagrass monitoring programs that a good seagrass monitoring site should be:

- A seagrass meadow which is typical/representative of a location (*Delul a char el ngii a chochotii a teletelel a char er sel basio*)
- A seagrass meadow that is relatively homogeneous (*Ngungil el klou a char er ngii*)
- A seagrass meadow in a place which you can come back to and monitor again at regular intervals (*basio el sebeched el di beot el mo er ngii ra bek el taem*)
- A seagrass meadow that is removed from any large obvious impact such as marina, a dredge channel, or a sewage outfall (*basio el diak a telemellel a kereker er ngii, diak a kliis me luchub eng mekikiong el omaoch el mo er ngii*)

However, because this manual is designed to guide the monitoring of an MPA, most likely a site has been delineated and that setting up the monitoring site will have to take the above criteria into consideration where appropriate.

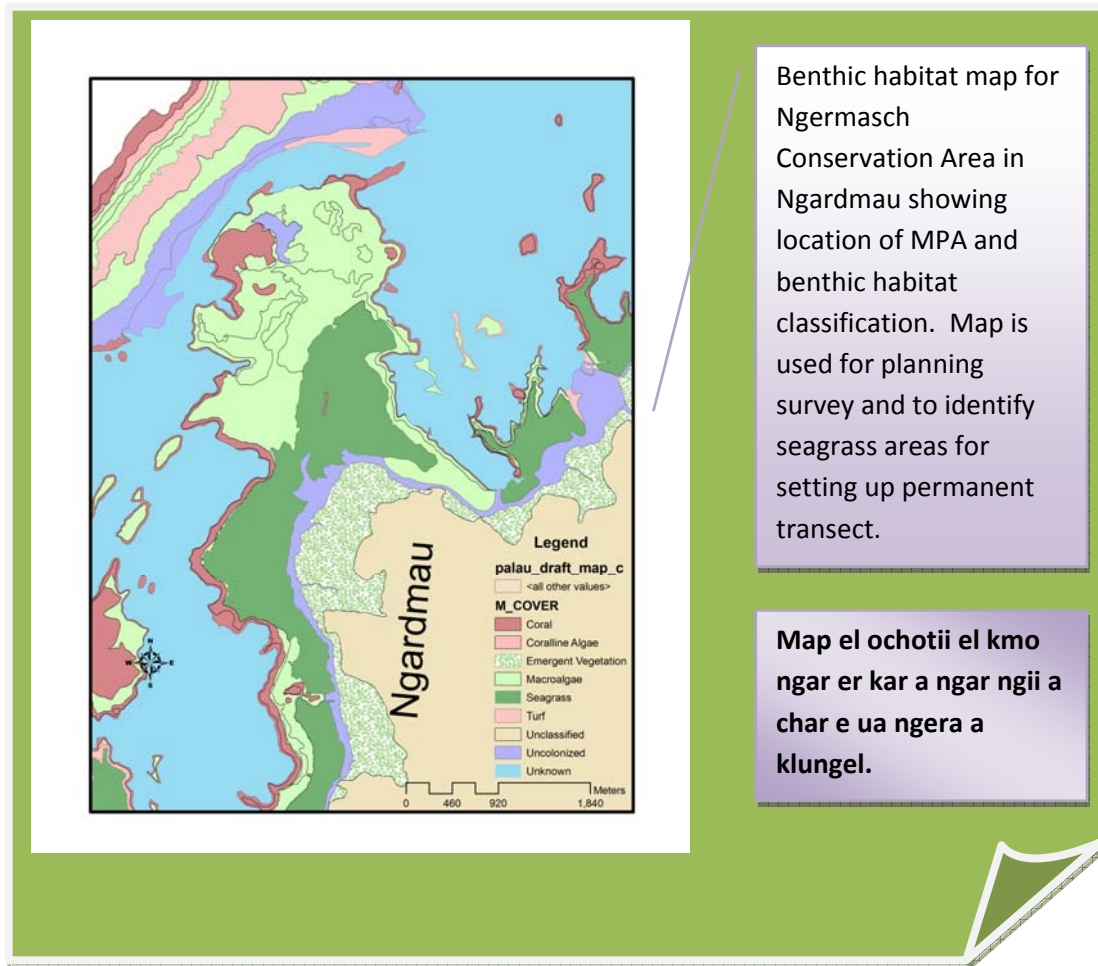
3.2 Sampling Intervals (oingerang e kede mesuub)

Monitoring protocols for assessing seagrass cover follows that of SeagrassNet; therefore this manual has adapted the sampling interval for those protocols. Sampling intervals are done 4 times per year **(January, April, July, October)**; during a particular day of a month depending on the best sampling tide (best time is at low tide but depending on the site, sampling may be done during high tide, for instance, if a site is soft, muddy or sandy that cannot be walked on at low tide, best sampling time would be a high tide).

3.3 Locating the monitoring site

It is recommended that setting up the site would follow the following:

1. Locate the MPA site on a map (this method is appropriate for seagrass habitat, therefore if MPA is not a seagrass consult another protocols or talk to an appropriate person).
2. If and where possible, use aerial photographs, satellite image (Google earth or available satellite products), and available benthic habitat maps to determine the seagrass meadow (*delul a char*).
3. It is recommended that you visit the site initially before setting it up. This will enable you to plan field activities (i.e. knowing whether the sediment is soft or not will help determine whether you set up the site at low tide or high tide; if the sediment is soft then it will be difficult to walk at low tide, although it is the preferred time to conduct field activities) (**ke momedengei el kmo sebechem el merael er ngii al meched a chei ma lechub eng diak**).
4. Determine the extent of the seagrass meadow (**omes ra kulngel a char**)(i.e., sketching the meadow or getting GPS coordinates for the edges. Place temporary marker about 1m (3ft) inside the continuous seagrass meadow from land.



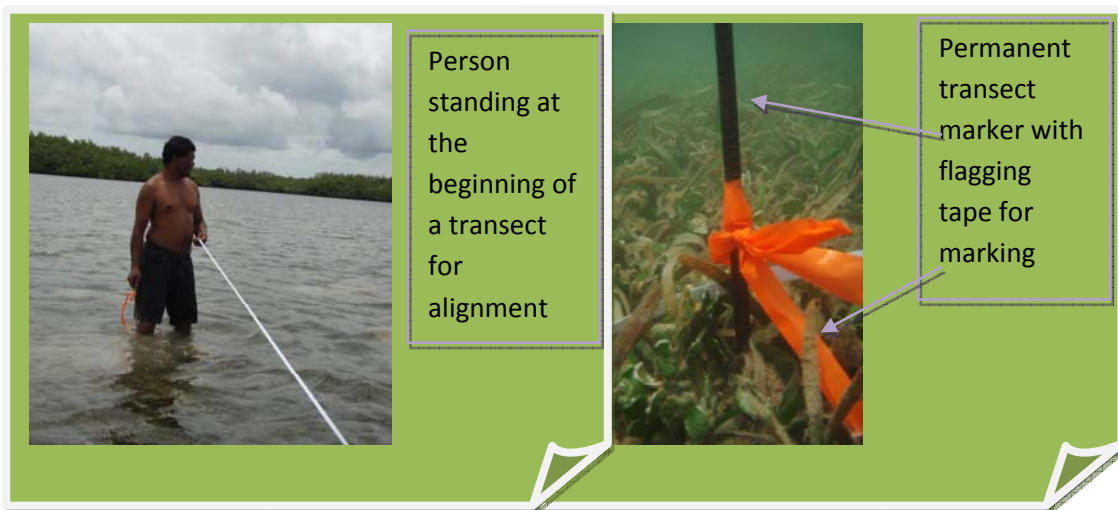
3. 4 Setting up the monitoring stations

The method for monitoring seagrass in this manual is adapted from the SeagrassNet monitoring protocols. The SeagrassNet monitoring protocols use three transects (labeled as Transect A, B, and C). Transect A is set up at the edge of the seagrass meadow at the landward side, Transect B at the middle of the meadow, and Transect C at the seaward edge of the meadow. Each transect will be 50 meters long.

1. Go back to the site where you place a temporary marker (use GPS or your established landmarks). Place a permanent marker by driving a rebar into the sediment so that only few centimeter of the rebar is above the sediment. Use some sort of label or float to mark your marker so that it will be easy to find again. Take GPS reading of the marker you have just established.



2. Laying out Station A: Have one person stand and hold the end of a 50 meter measuring tape at the permanent marker (which is the starting point: 0 m) and another person takes the reel of the measuring tape and move to the left until 50 m is reached. The person moving with the tape should ensure that the tape is parallel to the shoreline and follows the same depth contour. After the 50 m measuring tape has been laid out, place a permanent marker at the 25 m and at 50 m. This will make the transect permanent and that it can be found again.



3. Laying out Station C: Move to the seaward edge of the meadow to establish the permanent transect of Station C. You can either use compass bearing readings to align Station C with Station A or have two people stand at the left and right ends of Transect A and use them to align. Again, the aim is to establish a permanent transect that runs along the same depth

contour. After you have laid out the tape that is parallel to Station A, place the permanent markers at 0 m, 25 m, and 50 m just as it was done for Station A.

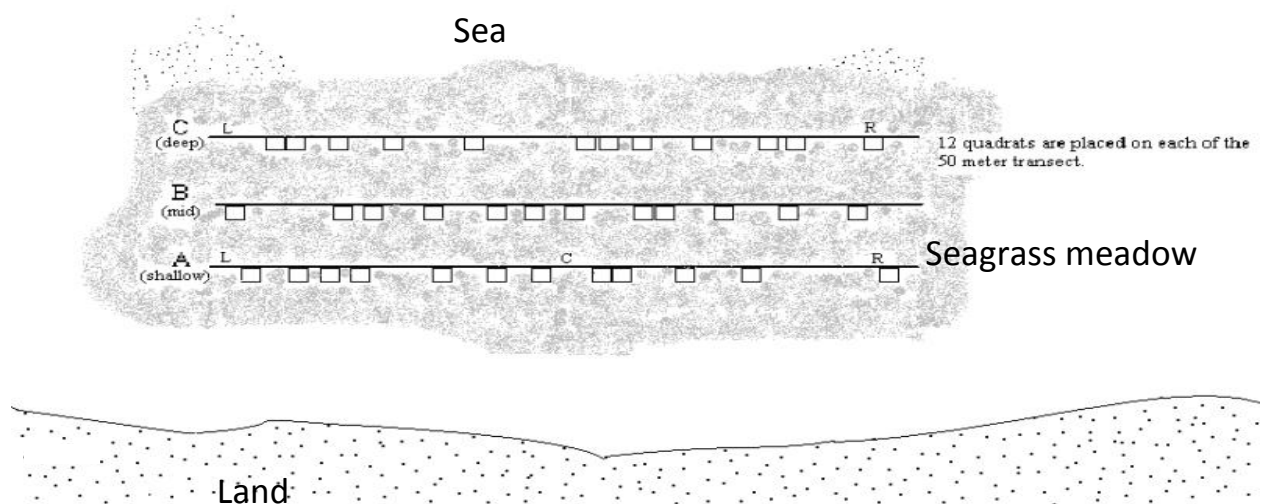
4. Laying out Station B: This transect will be established midway between Station A and C or it can be established at the seagrass species transition, i.e., if there is a change from *Thalassia hemprichii* dominance to a *Cymodocea rotundata* dominance, etc. Again, the aim is to establish a permanent transect that follows the same depth contour and is perpendicular to Station A and C. The left and right corners of this transect should align with left and right corners of Station A and C.
5. Make sure that you take GPS readings for each transect marker and record them on your data sheet. Do not forget to fill the appropriate information on the data sheet (see data sheet on Appendix III).

Uleklatk: A kot eng kired el loia Station A e mochu station C. Sel bol merek e ngii a mosebeched el loia Station B er a belngel a Station A ma C.

Section 4: MONITORING METHODS

4.1 Monitoring the status of seagrass (**Teletel a dolai ra klungel a char**)

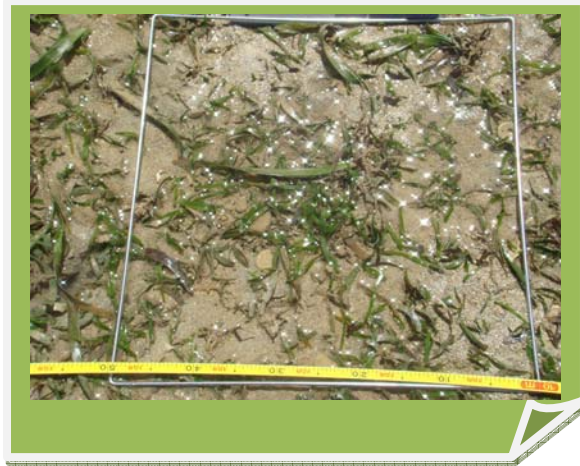
The method for estimating the percent total cover (*klungel a char*) and species cover (*klungel chimol bedengel a char*) is based on the SeagrassNet monitoring protocols. The quadrat method will be used to estimate the percent cover by placing 12 quadrats on each transect. The quadrats are placed on the beach side of the transect. The location of the quadrats on a transect are based on preselected random points along the 50 m transect (see example of quadrat positions below).



Photographs (Siasing)

Photograph of each quadrat is taken for reference. This can be used to double check the percentage cover estimation that is done in the field. To take a photograph:

1. Place quadrat at the correct location on the transect (pre-selected random point)
2. Stand over the quadrat on the seaward side and take a photo of the quadrat as vertical as possible, make sure not to make disturbance to resuspend the sediment as this will affect the visibility.



Species and total percent cover estimation

To determine total percentage cover of a seagrass within a quadrat,

1. Place a quadrat on the correct location within the transect (pre-selected random point)
2. Determine percentage cover of all seagrass within the quadrat (do not include algae)
3. Determine all species present in the quadrat
4. Determine percent cover for each species
5. Percent cover for each species = total cover of seagrass in the quadrat,
6. Record the percent cover of seagrass and species on the data sheet

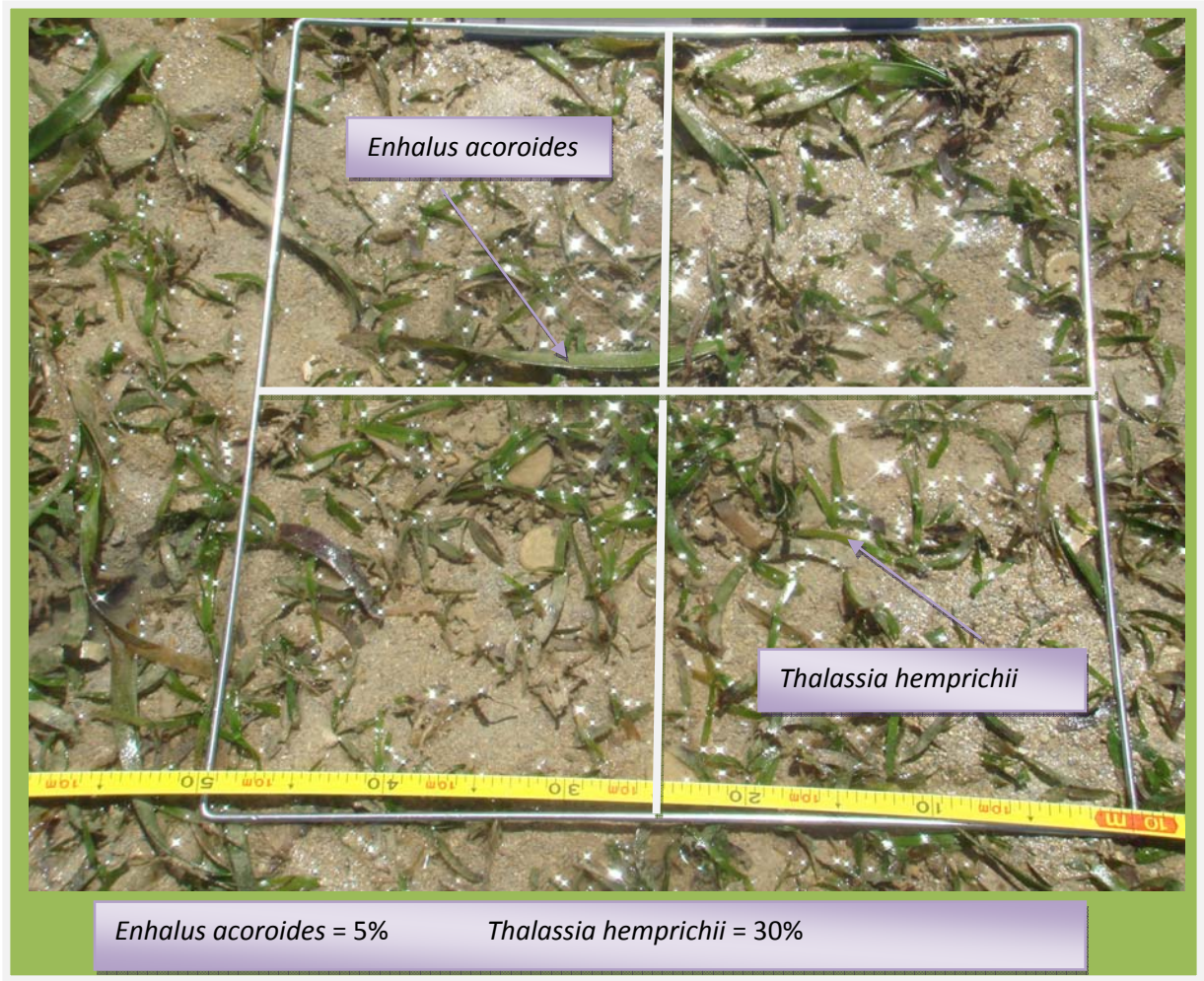
Example: if total cover is 35% and there are 2 species then,

Thalassia hemprichii = 30%

Enhalus acoroides = 5%

Total = 35%

(composition of all species must equal the total)



4.2 Necessary Materials (**dongu el dousbech**):

- 50 m measuring tapes (3)
- 0.25 m² quadrat (50 x 50 cm) (1)
- Handheld GPS unit
- Tide table
- Underwater camera (optional)
- Markers to mark the monitoring station (12, 3 markers/station)
- Seagrass field guide
- Water proof data sheet
- Ruler in centimeters (optional)
- Recording light sensor, Onset-Hobo Li Light (optional)
- Recording therometers, iButton Loggers (optional)
- Small water bottle for salinity water samples (optional)
- Salinity refractometer (optional)
- Depth measurement: depth sounder, weight on rope (optional)

Optional data to collect

Canopy Height

Measure the height of the leave blades of the dominant species using a ruler in centimeters. Randomly select a clump of seagrass blades from the quadrant and measure its height, ignoring the tallest 20% of leaves. Extend the leaves to their maximum length without uprooting and measure from the sediment to the tip of the leaf. Record the canopy heights on the data sheet.

Flower and Fruit count

Check each seagrass species in the quadrat for flowers or fruits. If they have, count the number of sexually reproductive parts (the sum of all flowers or fruits) of each species and record it on the datasheet.

4.3 Monitoring Station Measures/Cross-Transect Measures (optional)

Station measures and cross-transect measures are collected if one wants to collect more data to gain more understanding of seagrass management. Therefore, these are optional steps but can be collected to gain more knowledge.

4.3.1 Station Measures

Light Level

Different species of seagrass have varying light requirements in order to survive. The minimum light requirement for seagrass has been identified at 10-20% of surface light, higher than other marine plants, presumably because of the high photosynthetic demand to survive rooted in anoxic sediments. Adopted by the SeagrassNet monitoring protocols, Onset-Hobo Light sensor is used to measure and log light levels at each site. The light loggers are deployed two weeks before the quarterly sampling. They are then collected on the day of sampling. Record the day the light loggers were deployed and the day of the sampling on the data sheet. Because the Hobo Li light is adopted by the SeagrassNet, there are specific procedures to follow such as launching and downloading the HOBO Light Intensity Logger Data to a PC computer. For further information on this, you may contact Palau International Coral Reef Center.

Water Temperature

Water temperature plays an important roll in plant metabolism and photosynthesis, as well as the different types of plants and animals within a seagrass meadow. Adopted by the SeagrassNet monitoring protocols, iButton loggers are used to monitor the water temperature. The iButton loggers are attached to station A and C just above the sediment-water interface. Record the “day out”, the day you collect the iBotton from the field, on the datasheet. At each monitoring event (every 3 months), the iButton temperature loggers are removed and replaced with a fresh set of two (2) loggers. Just like the

HOBO Light procedure, the iButton is also adopted by the SeagrassNet and requires more specific instructions. For more information on this, please contact Palau International Coral Reef Center.

Salinity

Water salinity is also important to understand because it affects the distribution and growth of the different species of seagrasses. The water samples for measuring salinity are collected once during the monitoring from each permanent station marker.

1. With a small clean bottle, collect a small water sample from within the seagrass area. Make sure the water is collected below the top of the seagrass leaves.
2. Submerge the bottle with the lid on then carefully remove the lid to fill the bottle; replace the cap on the bottle before removing it from within the seagrass canopy.
3. With a refractometer, measure the salinity (ppt) and record it on the data sheet.

Tidal Stage

The best time to sample is at low tide during the spring phase, when the water is at the lowest because it makes the finding of the permanent parkers easier. Identify the tidal stage and record it on the data sheet as:

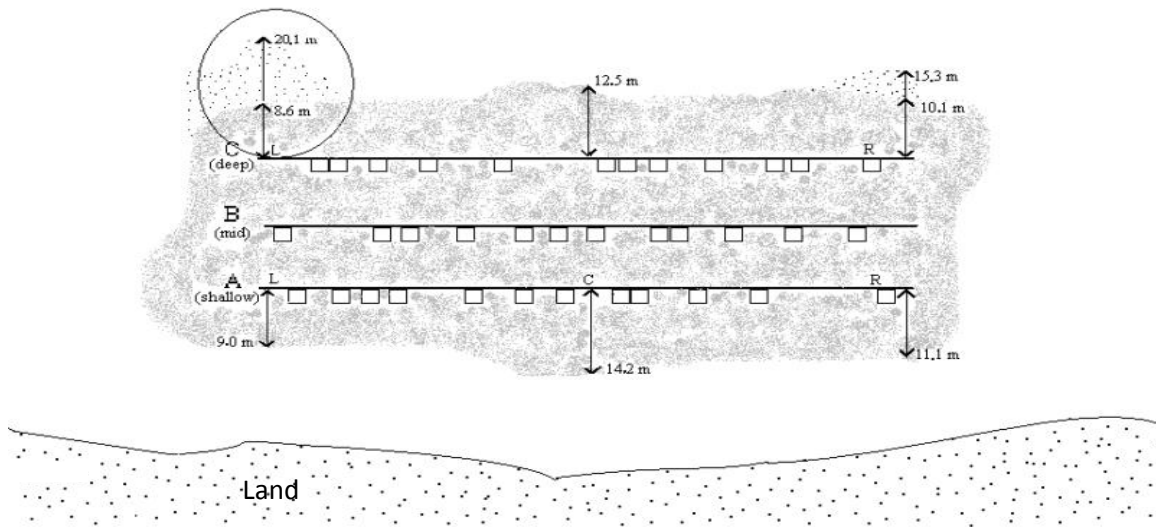
- High or low to identify the condition of the tide when the sampling is conducted
- Spring or neap to identify the phase of the tide at the time of sampling

4.3.2 Cross-Transect Measures

Distance to seagrass edge and last shoot

The measurement of the three 50 meter cross-transect (A-Shallow, B-Mid, and C-Deep) will be recorded during each monitoring event which is every three months. The measurement will be taken at the 0 meter mark, 25 meter mark, and the 50 meter mark of each of the three cross-transects. In order to find the extent of the seagrass growth at the time of sampling, two types of measurements will be taken.

1. Distance to the edge (m) = Distance to the edge of the continuous meadows
2. Distance to the last plant (m) = Distance to the most onshore shoot from cross-transect A and the most offshore shoot from cross-transect C (see figure below for example)



Depth

The water depth will be measured on the 0 m, 25 m, and the 50 m of each of the three stations (9 places in all). Using a depth measurement (i.e., depth sounder, weight on a rope marked with depth, etc.), measure the depth from the top of the substrate to the water surface of each of the nine cross-transect sites. Record the depth as well the time on the data sheet.

Surface Sediment

To assess the surface sediment, the observer must feel the texture of the surface sediment and describe the substrate in that location as one of the following: mud, sand, fine sand, coarse sand, shell, gravel, coral rubble, or rock. Record on the data sheet the sediment type on the 0, 50, and 25 m marks of each of the stations.

Section 5: COMPLETION OF MONITORING

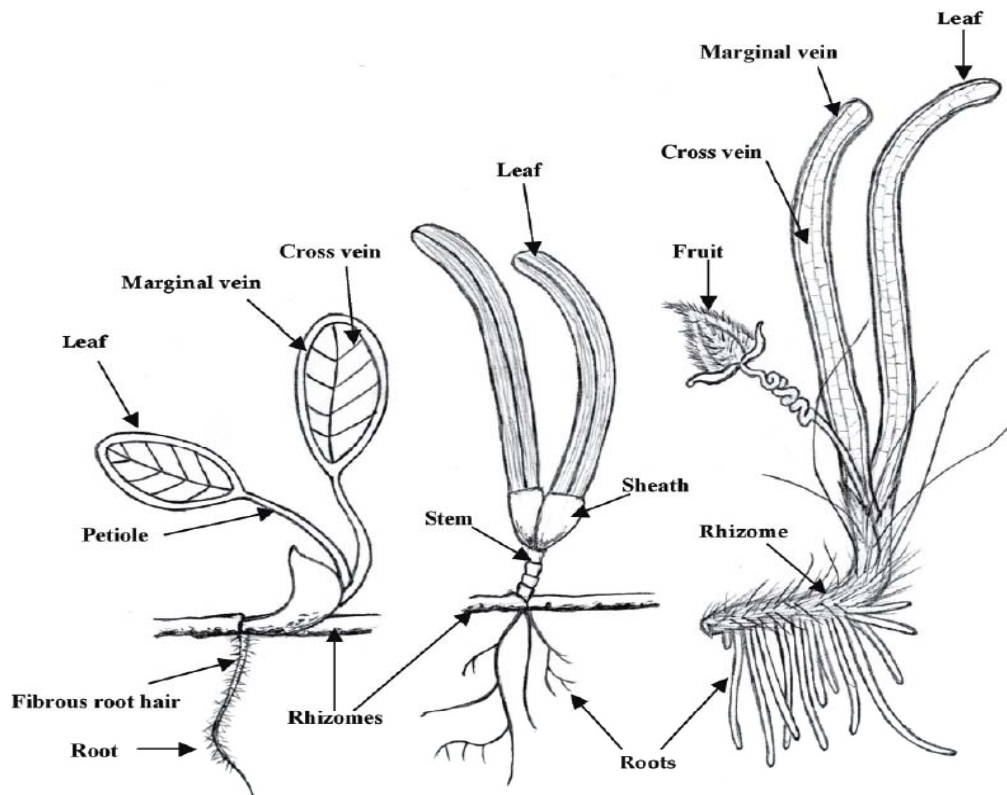
- Check data sheet to ensure that all sections are filled such as: site name, transect code/number, name of observers, sampling date/time, etc.
- Check site for any left belongings
- Wash and pack gears and equipments

REFERENCES

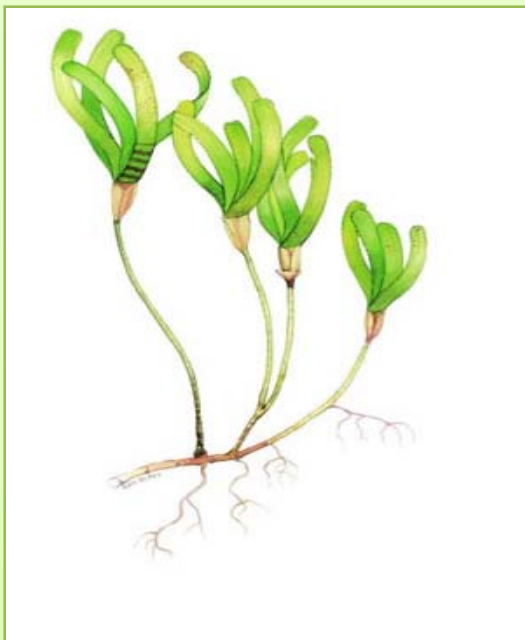
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Schematic diagram showing the names of each part of three seagrasses, *Halophila minor*, *Cymodocea serrulata* and *Enhalus acoroides*. (Drawn by Irving Dwight, a staff of PICRC).



Thalassodendron ciliatum

Within Palau, this species is only found in the reef flats of Kayangel Islands, Ngeruangel Marine Reserve, and the Valasco Reef





Cymodocea rotundata

- Flat, strap-like leaves 2-4mm wide
- Rounded, smooth leaf tip
- Smooth rhizome
- Scars from well developed leaf sheaths form a continuous ring around the stem
- Found on shallow reef flats



Cymodocea serrulata

- Linear strap-like leaves, 5-9mm wide
- Serrated leaf tip
- Leaf sheath is broadly triangular with a narrow base
- Leaf scars do not form a continuous ring around the stem
- Found on shallow subtidal reef flats and sand banks



Thalassia hemprichii

- Short black bars of tannin cells in leaf blade
- Thick rhizome with scars between shoots
- Hooked/curved shaped leaves
- Leaves 10-40cm long
- Common on shallow reef flats





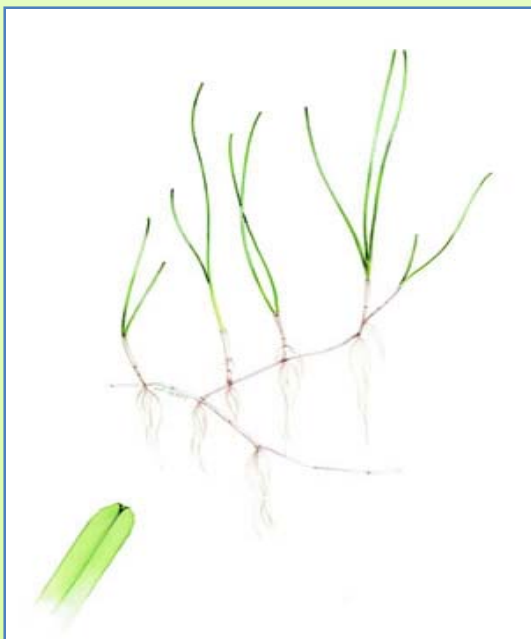
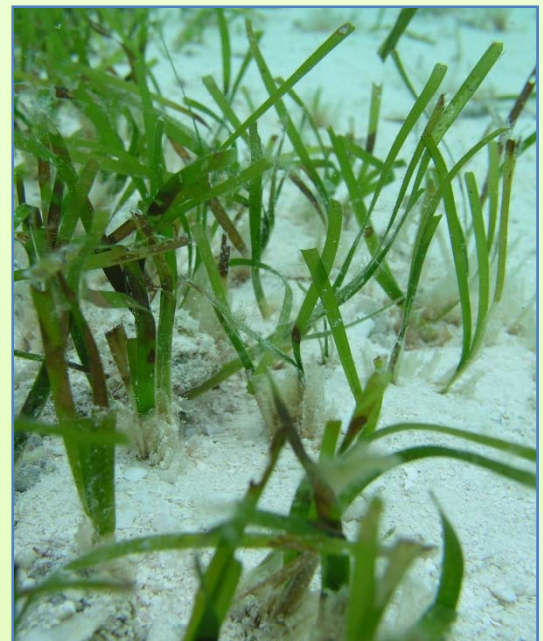
Enhalus acoroides

- Very long ribbon-like leaves 30-150 cm long
- Leaves with inrolled leaf margins
- Thick rhizome with long black bristles and cord-like roots
- Found on shallow/intertidal sand/mud banks (often adjacent to mangrove forests)



Halodule uninervis

- Usually larger than *Halodule pinifolia*
- Trident leaf tip
- 1 central longitudinal vein
- Rhizome usually pale ivory, with clean black leaf scars
- Dugong preferred food
- Found on shallow/intertidal sand or mud banks



Halodule pinifolia

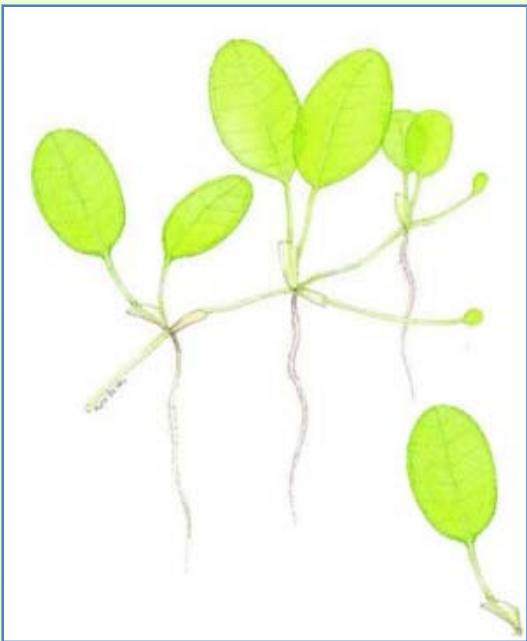
- Fine, delicate leaves up to 20cm long
- 1 central vein
- Black central vein splits into two at the rounded leaf tip
- Usually pale rhizome, with clean black leaf scars
- Found on intertidal sand banks





Halophila ovalis

- Oval shaped leaves in pairs
- 8 or more cross veins
- No hairs on leaf surface
- Preferred dugong food
- Common early colonising species
- Found from intertidal to subtidal depths



Halophila minor

- Less than 8 pairs of cross veins
- Small oval leaves occurring in pairs
- Wedge-shaped leaf sheath
- Found on shallow/intertidal sand flats



Syringodium isoetifolium

- Cylindrical in cross section (spaghetti like)
- Leaf tip tapers to a point
- Leaves 7-30cm long
- Found on shallow subtidal reef flats and sand banks



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