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Sea Search: Community-Based Monitoring of Victoria's Marine National Parks and Marine Sanctuaries

Seagrass Monitoring

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Parks Victoria Technical Series No. 16

Sea Search: Community-Based monitoring of Victoria's Marine National Parks and Sanctuaries

Seagrass Monitoring

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FOREWORD

The establishment of Victoria's Marine National Parks and Sanctuaries in 2002 has created a world-class system to conserve Victoria's unique and diverse marine environment. To foster and encourage community stewardship for a marine protected area, Parks Victoria and Deakin University have developed a set of three technical series which will allow your community group to monitor your marine national park or marine sanctuary. The name given to this series set is *Sea Search* and focuses on community-based monitoring. This will encourage commuity interest in protecting your local marine area. Through community-based monitoring, a network of community monitoring groups can be established along the Victorian coastline.

Each technical series focuses on a specific marine habitat type and includes:

- Seagrass Monitoring – Technical Series 16
- Intertidal Monitoring – Technical Series 17
- Subtidal Monitoring – Technical Series 18

This set of technical series will allow your community group to learn about the animals and plants in your marine protected area in addition to applying scientific knowledge to obtain important biological information. Participation in long-term monitoring will allow your group to accumulate biological data which will provide information on the environmental status of your marine protected area.

By engaging in monitoring, your community group has an active role in management. Active involvement and participation by your community group will increase local knowledge and awareness of the marine protected area and add value to the operations of the management agencies.

Data collected by your community group can be used to provide management authorities with quality advice. Your group has an important role in achieving the objectives of marine national park and marine sanctuary management. Community-based monitoring will allow you and your group to connect further with the marine environment and enjoy the wonders of Victoria's unique and diverse marine plants and animals.

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1.1 What is community-based monitoring?

The newly created system of Marine National Parks (MNPs) and Marine Sanctuaries (MSs) in Victoria, provide the ideal opportunity for community groups to partake in community-based monitoring projects.

Community-based monitoring allows Friends and community groups to be interactive with their MNP or MS. It allows groups to conduct meaningful scientific surveys and collect biological information while having fun at the same time. All volunteers will learn new techniques and increase their knowledge of the marine plants and animals found in their marine protected area (MPA). Community-based monitoring is flexible and volunteers can choose when and where they would like to survey their marine habitat.

Biological information collected by community groups will assist in the management of Victoria's MNPs and MSs. Monitoring of Victoria's MPAs will allow community groups to develop awareness and to raise the profile of natural, cultural and social values of MPAs among the public. Community involvement can also build custodianship of an area and help communicate findings back to the broader community. Community-based monitoring of Victoria's MPAs is therefore valuable to management from both an ecological and social perspective. Community participation in activities allows communities and individuals to recognise that they have an important role in achieving the objectives of MNP and MS management (Parks Victoria 2003).

Figure 1.0 Friends of the Prom volunteers in preparation for intertidal seagrass monitoring at Corner Inlet, Victoria. (Image: R. Koss)

1.2 What does monitoring mean?

Monitoring is the repeated observation of a system, such as seagrass beds, usually to detect a change (McKenzie & Campbell 2002). The type of methods used in a monitoring program will vary the accuracy and detection of a change in a system. It is important that the methods in a monitoring program be designed to quantify the causes of change for a particular site (*See Section 3.4 for information on seagrass monitoring methods*). Monitoring can focus on a particular organism or habitat, with additional information collected on environmental conditions. A successful monitoring program examines a specific environmental concern, such as the change in seagrasses due to increase nutrient runoff from the land (McKenzie & Campbell 2002). Monitoring programs may be able to detect disturbance and distinguish such disturbances from natural variation in a system (Roob 2003).

Seagrass beds can change in several ways such as (McKenzie & Campbell 2002): a change in biomass without a change in the area, a change in area shape, depth or location of a bed, change in species composition, plant growth and productivity, fauna associated with the beds, or, a combination of, or all of these.

Through community-based monitoring, patterns of these changes can lead to effective management decisions for an area. Monitoring requires cost-effective data collection, selection of appropriate parameters and scales, and measures of change which are appropriate for determining the type of management action required (McKenzie & Campbell 2002).

The most efficient and appropriate monitoring parameters should be chosen to enable minimal monitoring effort required to detect change which is statistically and biologically meaningful (*See Section 3.2 for more information about choosing monitoring sites*). Biological parameters include: seagrass species composition and its percentage cover; seagrass length and density; epiphyte cover on the seagrass leaf and on the sampling area; and fauna counts. Physical parameters are equally important and include: sediment composition, water and air temperature, and depth.

The method of collecting data will be dependent on the use of the data. Accuracy and precision of data collection is a requirement for accountability in coastal management decisions. This, in turn, has created a need for statistical rigour in the design of sampling programs for monitoring of natural or human-induced environmental impacts (McKenzie & Campbell 2002).

To find out the closest Victorian MNP or MS which your community group can monitor, contact the Parks Victoria Customer Service line on **13 19 63** or visit their website at **www.parkweb.vic.gov.au** and click on Marine & Coasts.

1.3 What are the objectives of monitoring seagrass beds?

The primary objectives of any environmental research and monitoring programs related to protected area management are to provide information on the status of natural values and threatening processes, and to determine the nature and magnitude of these trends over time (Parks Victoria 2003). This will, in turn, provide increased knowledge, understanding of change, bench marking and provide vital signs to assist with management of these areas (Parks Victoria 2003).

The principal objectives of seagrass monitoring are to:

- characterise seagrass communities by providing data on population size structure of the different seagrass species in each bed.
- characterise animal communities associated with seagrass beds by providing data on population sizes on each bed.
- identify important spatial variation in seagrass species and animal communities across seagrass beds.
- determine the nature and size of natural changes in seagrass species populations and associated animal communities over time.
- detect impacts or threats on seagrass populations and associated animal communities and compare these results with reference sites (*See Section 3.3 to find out what a reference site is*).

Figure 1.1 S.E.A.L. Diving Services volunteers after seagrass monitoring at Corner Inlet Marine National Park, Victoria. (Image: R. Koss)

2.0 ALL ABOUT SEAGRASS

2.1 Why are seagrass beds considered an important marine habitat?

Seagrass beds are an ecologically significant marine habitat, and serve as a nursery area for juvenile marine animals, as well as providing food and shelter. Seagrass beds colonise and grow in areas of shallow water especially in the presence of unstable mud, silt and sand substrates. Some seagrasses grow at greater depths, but will vary according to the amount of sunlight they can receive through the water column. These areas are important in maintaining biodiversity and are vulnerable to environmental pressures. Due to this, many States have regulatory policies in place to protect seagrass beds (Roob 2003).

The seagrass canopy reduces wave and current velocities, which reduces erosion and enhances sedimentation on the sea bed (Roob *et. al.* 1998). Fish and crabs find protection under the long seagrass leaves as it is one of the few solid substratums available to smaller plants and animals in the expanse of sand and mud. In many coastal environments seagrass is often the only source of firm substratum suitable for colonisation by various seaweeds and animals (Thomas *et. al*. 1999). Numerous animals and most seaweeds can only survive when attached to a firm substratum and rely on the presence of seagrass along sheltered coasts (Walker *et. al.* 1999). Seagrass rhizomes (*See Figure 2.1 in Section 2.2 to find out what a rhizome looks like*) stabilise the fine sediment, keeping the water relatively clear. The seagrass itself is an important food source, providing the bulk of organic matter when broken down (O’Hara *et. al.* 2002). Most seagrass beds generally have only one or a few dominant species of seagrass (Nybakken 2001).

Figure 2.0 *Posidonia australis* seagrass beds exposed during low tide at Corner Inlet Marine National Park, Victoria. (Image: R. Koss)

2.2 What does seagrass look like and how does it survive in seawater?

Seagrasses are not true grasses, nor are they seaweeds. Seagrasses are angiosperms (flowering plants) adapted for life submerged in a marine or estuarine environment and are more closely related to terrestrial lillies and gingers (McKenzie & Campbell 2002). They grow in sediment on the sea floor. Like flowering plants on land, they produce flowers and seeds (Roob 2003). A seagrass plant consists of the leaf, leaf sheath and branching roots which arise from the rhizome (*See Figure 2.1 to view the different parts of a seagrass plant*). Identification of seagrasses relies largely on leaf, root and rhizome characteristics (Edgar 1997).

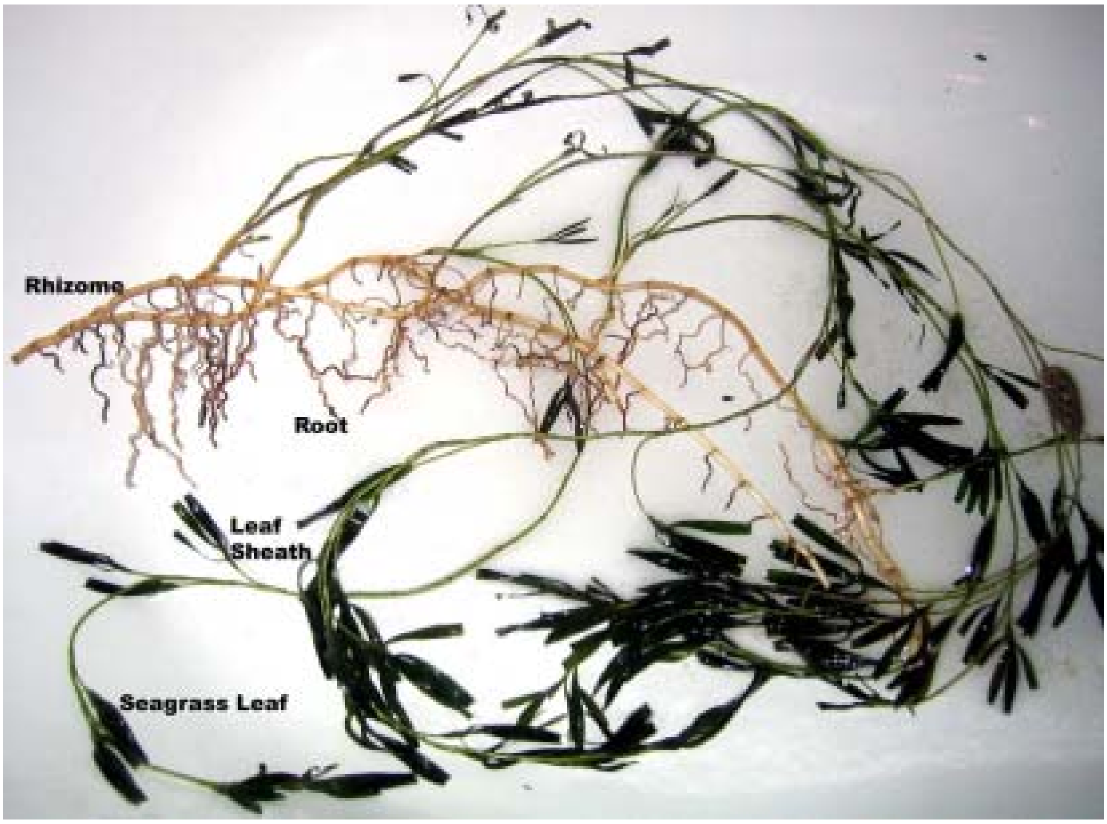


Figure 2.1 The appearance of *Amphibolis antartica* seagrass, consisting of the green leaves, leaf sheaths, branching roots and rhizomes.

The rhizomes and roots anchor the plant to the soft bottom and absorb nutrients. Erect branches and leaves grow off the buried rhizome. Air canals in the leaves carry oxygen down to the rhizomes and roots. The leaf contains a layer of green pigment (chlorophyll cells) which captures light to provide energy via photosynthesis for their growth (Roob 2003).

Chlorophyll is the green pigment found in plant cells and act as receptors of light energy for photosynthesis, which uses the light energy to create chemical reactions and form chemical bonds with carbon dioxide and water. Through photosynthesis, most plants are able to produce energy to assist in growth.

There are four physical requirements for seagrass growth (King *et. al.* 1995):

- tolerance of saline environments
- an ability to grow while completely submerged in the water
- an ability to anchor against wave action and tidal currents
- a capacity for pollination in the water.

2.3 Seagrass species found in Victoria

There are 55 Seagrass species in the world: over 30 occur in Australia and 6 have been identified in Victorian waters (Roob 2003; Poiner & Peterken 1995):

- *Zostera muelleri* commonly known as the Short eelgrass due to the thin and short leaves. (*See Page 7 for more information about Z. muelleri*).
- *Zostera capricorni* commonly known as Eelgrass due to the thin leaves. (See Page 8 for more information about *Z. capricorni*).
- *Zostera tasmanica* commonly known as Long eelgrass due to the long thin leaves. This species of seagrass was formerly named *Heterozoestera tasmanica*. (See Page 8 for more information about *Z. tasmanica*)
- *Posidonia australis* commonly known as the Southern strapweed or Broad leaf seagrass due to the long strap like leaves. (See Page 9 for more information about *P. australis*)
- *Amphibolis antartica* commonly known as Sea nymph due to the way the branched leaves sway in the water. (See Page 10 for more information about *A. antartica*)
- *Halophila australis* commonly known as the Paddle Weed due to its oval-shaped leaves. (*See Page 10 for more information about H. australis*)

The depth at which each of these seagrass species can be found is dependent on the following factors: exposure at low tide, wave action, turbidity, salinity levels due to freshwater inflow, substratum composition, exposure to available light, nutrients, and temperature (McKenzie & Campbell 2002). A combination of these factors will allow, encourage or deter seagrass from a specific location (*See Section 2.6 about changes in seagrass distribution*).

2.4 What do the Victorian seagrass species look like?

Zoestera muelleri

Zoestera muelleri is widely distributed along Victoria's coastline and grows in sheltered and moderately-exposed sand and silt to a depth of 2 m (*See Figure 2.2*). The leaf can grow to a length of 600 mm (Edgar 1997). The leaf tip is rounded and notched in the centre (Edgar 1997). This species requires extended periods of exposure to the atmosphere to survive (Roob *et. al.* 1998).

A

B

Figure 2.2 A) The appearance and **B**) live *Zoestera muelleri* at Corner Inlet, Victoria.
(Diagram and image: R. Koss)

Zoestera capricorni

Zoestera capricorni is generally a tropical or warm temperate species (*See Figure 2.3*). A population has been identified at Mallacoota in Victoria, growing in sheltered mud and sand areas to a depth of 7 m (Robertson 1984; Edgar 1997). The leaf can grow to a length of 500 mm ending in a blunt tip (Edgar 1997). This seagrass usually occurs as large meadows and is common in estuaries and coastal lagoons of New South Wales (Edgar 1997).

Figure 2.3 The appearance of *Zoestera capricorni*. The leaf tips are blunt as distinguished from *Z. muelleri* tips which are curved and notched. (Diagram: R. Koss)

Zostera tasmanica

Zostera tasmanica is widely distributed along Victoria's coast and grows in sheltered, moderately exposed sand and silt up to a depth of 3.5 m (Roob *et. al*. 1998) (See Figure 2.4). Due to its preference for deeper water, it is commonly found on the top and around the base of submerged banks in estuaries (Edgar 1997; O'Hara *et. al*. 2002). *Z. tasmanica* has an almost identical leaf shape to other Zoestera species. *Zostera tasmanica* can be separated from other Zoestera species on the basis of the leaf branching pattern. *Z. tasmanica* leaves have dark, wiry bases which arise vertically from the rhizomes, whereas Zoestera species are often curved parallel with the sediment near their bases (Edgar 1997). The only reliable way to distinguish between these two species is to observe a cross-section of the rhizome with a hand lens or microscope. *Z. tasmanica* has four to twelve vein-like vascular bundles arranged in a circle and other Zoestera species have only two (Edgar 1997). *Z. tasmanica* can only exist where it is exposed to the atmosphere for minimal periods of time and therefore is generally a deeper-water-growing species (Roob *et. al*. 1998).

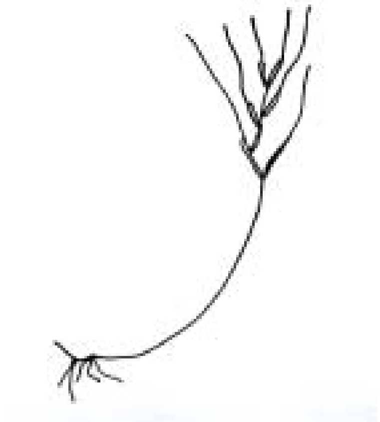
A  B 

Figure 2.4 A) The appearance and, **B**) live *Zoestera tasmanica* in Corner Inlet Marine National Park, Victoria. (Diagram and image: R. Koss)

Posidonia australis

Posidonia australis grows in sheltered and moderately-exposed sand and silt to a depth of 3.5 m (Edgar 1997) (*See Figure 2.5)*. It is mainly found in Corner Inlet, Victoria, and is the dominant seagrass on the submerged banks where it forms large meadows. Colonies of *P. australis* establish infrequently and seedlings are rarely observed. This species spreads via its rhizomes and reinvades disturbed areas very slowly (O'Hara *et. al.* 2002). The long, flat fronds sprout from a thick rhizome lying deep within the sediment (Roob *et. al.* 1998). Leaves grow from the base, which ensures a constant supply of fresh green leaves. Leaves can reach over 1 m in length and the seagrass beds can appear dense. During winter, leaf tips die and break off leaving less than 300 mm of leaf remaining (O'Hara *et. al.* 2002).

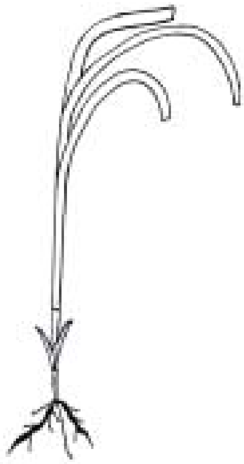
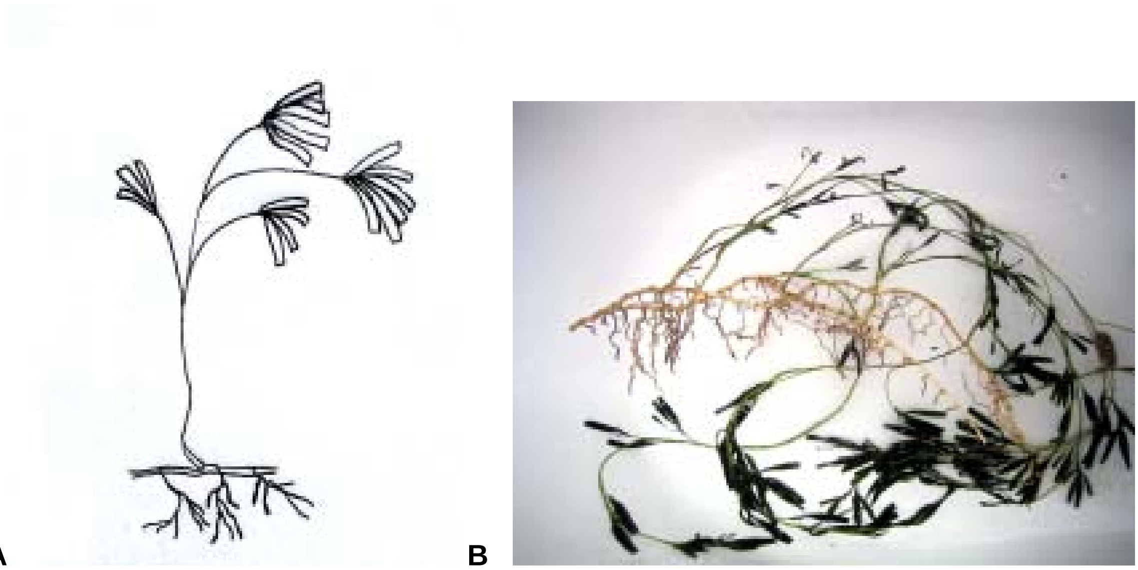
 A B 

Figure 2.5 A) The appearance and **B**) live *Posidonia australis* in Corner Inlet Marine National Park, Victoria. (Diagram and image: R. Koss)

Amphibolis antartica

Amphibolis antartica is distributed from the western part of Victoria's coastline to Wilson's Promontory and Port Phillip Bay (Robertson 1984; Edgar 1997). It grows to a depth of 23 m in sandy mud bottoms, or as patches on flat rock in moderate to fairly strong water currents (Robertson 1984). This species has woody, branched stems arising at irregular intervals from rhizomes with a regular arrangement of circular leaves (*See Figure 2.6*). The leaves are small relative to the stems, flat with smooth margins and have a blunt tip with two teeth at each end (Edgar 1997). The leaves occur in clusters of eight to ten and can grow to a length of 50 mm (Edgar 1997). The stems can grow to a height of 1.5 m (Edgar 1997).

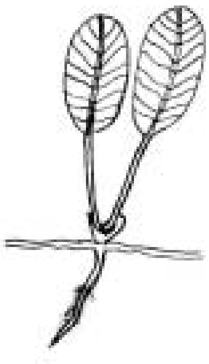


A B

Figure 2.6 A) The appearance and **B**) live *Amphibolis antartica* (Diagram and image: R. Koss)

Halophila australis

Halophila australis has limited distribution and grows sparsely across sandy patches or in mixed patches of Z*ostera* species (Roob *et. al.* 1998). This species has small oval leaves snaking out along long, slender rhizomes (O'Hara *et. al.* 2002) (*See Figure 2.7*). It grows in sheltered and moderately-exposed sand and silt to a depth of 3.5 m. The leaves are flat and ovate in shape. Leaves can grow to 10 -15 mm wide and have rounded unbroken ends. The leaves arise from branched stems, called stolons, that lie half buried in the sand (Roob *et. al.* 1998).


A


B

Figure 2.7 A) The appearance and, **B**) live *Halophila australis* at Corner Inlet Marine National Park, Victoria. (Diagram: R. Koss & Image: J. Stevenson)

2.4 The different types of animals found in seagrass beds

Mobile Animals

There are many different types of mobile animals found in seagrass beds, whether they are hiding inbetween leaves or using the leaves as a place to rest. Many of these animals fall into a large group called invertebrates. An invertebrate is any animal whose nerve cord is not enclosed in a backbone of bony segments (Purves *et. al*. 1992). A mobile invertebrate does not have a backbone, but has the capacity to move. This group includes animals such as snails, limpets, seastars, crabs, sea urchins. There are many different species occurring along the Victorian coast. Some of these animals, such as snails, limpets and sea urchins are herbivorous grazers which means they feed only on plant matter. These animals do not feed on the seagrass itself, but rather on the plant matter attached to the seagrass leaves, known as epiphytes (Nybakken 2001). Snails use the bottom of their body to move around. It acts like a big foot, allowing them to move over different substratums and seagrass leaf surfaces. The size of a snail can vary, depending on the species. The number of snails can vary, sometimes forming groups and at other times solitary (*See Figure 2.8 to view the two different types of snails*).

Sea urchins posses tube feet, like the seastar, but walk mostly about on their spines. The appearance of the sea urchin is of a bowl-like shell with a mouth on the under-surface (Underwood & Chapman 1995). The spines of the sea urchin protect it from other predators. Sea urchins are grazers and use their hard jaw plates located in their mouths to scrape away at seaweed fronds or encrusting epiphytes on seagrass leaves (Underwood & Chapman 1995).

An epiphyte is a small plant which grows attached to another plant. Encrusting algaes are common epiphytes which grow on seagrass leaves. The number of epiphytes found on a seagrass leaf is dependent on the season and other factors. (*See Section 2.6 for more information relating to epiphyte distribution*.)

Some snails and other animals, such as sea stars, crabs and some fish, are predators which means they actively seek and feed upon other animals. One type of predatory snail found in seagrass beds is the whelk. The whelk uses a special tube called a siphon to find its prey. The siphon sticks out in front of the animal as it crawls along (Underwood & Chapman 1995). This siphon can be moved from side to side, and by using it as a nose it can smell out its prey. When water passes over the siphon, the whelk is able to pick up the prey's smell and the direction it is coming from. The whelk will drill a hole through the shell of their prey to obtain the animal for food. The predatory whelk has a groove in the opening of the shell where the siphon comes out (Underwood & Chapman 1995). This feature is prominent on most predatory snails and can be used to distinguish between herbivorous and predatory snails (*See Figure 2.8 to find out the difference between a predatory and herbivorous snail*).

Figure 2.8 The predatory snail, *Cominella lineolata*, commonly known as the Lineated cominella or Checkerboard snail for its checkered appearance, on the left side. Notice the siphon groove on the bottom left of the shell and the oval opening typical of a predatory snail. The herbivorous (grazers) snail, *Turbo undulatus*, commonly known as the Turban shell, on the right side. Notice the round opening of the shell which is typical for herbivorous snails. (Image: R. Koss)

Seastars have a star-shaped or pentagonal body with five or more arms (*See Figure 2.9 for examples of native seastars*). Each arm contains part of the digestive system and the gonads on the internal side wall (Edgar 1997). The underside of the arm is lined by sensitive tube feet which are usually protected by a series of spines (Edgar 1997). The tube feet are usually pointed with a suction disc at the end allowing them to grip onto solid surfaces. This enables the animal to move about and capture prey (Edgar 1997). The mouth of the seastar is found on the central under-surface of the animal. The seastar can throw out a thin, sack-like stomach through its mouth. The stomach covers the prey where it can partially digest food outside the body (Edgar 1997).

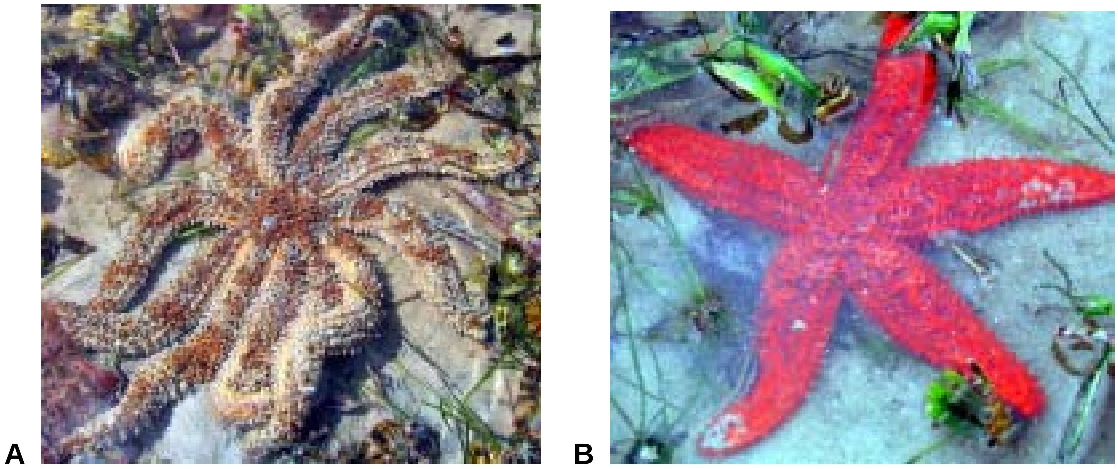


Figure 2.9 Native seastars amongst the *Posidonia australis* seagrass beds in Corner Inlet Marine National Park. A) The eleven arm seastar, *Coscinasterias muricata*, and B) the bright orange seastar, *Uniophora granifera*. (Images: R. Koss)

Some crabs are predators, feeding on smaller invertebrates. During the day, many take refuge between and under seagrass blades so as not to be seen by birds and other predators. The head is made up of six fused segments, a thorax (body) with eight segments, and an abdomen with six or seven segments (*See Figure 2.10 for an example of a crab*) (Edgar 1997). Crabs generally have a forked first antennae and a pair of compound eyes which may be stalked or directly attached to the head (Edgar 1997).

Figure 2.10 The pebble crab, *Dittosa laevis*, near a seagrass bed in Swan Bay, Victoria. This species is often found on mudflats near seagrass beds. (Image: A. Bunce)

Sessile Animals

Sessile invertebrates are attached permanently to a substratum, such as a seagrass leaf, and cannot move from this position. Sessile animals include mussels, oysters, barnacles, sponges and sea squirts. Animals such as mussels and oysters are abundant on or near seagrass beds. These animals are known as bivalves due to having two hinged shells (valves) (Underwood & Chapman 1995) (*See Figure 2.11 for an example of a bivalve animal*). Mussels attach to the seagrass blades by strong filaments which are produced by the foot of the animal and stick out through the shell (Underwood & Chapman 1995). Oysters stick to surfaces by using a glue, which acts like a cement, on one side of their shell (Underwood & Chapman 1995). By filtering large quantities of water, bivalves feed on small animals and particles in the water column. The water is pulled through the gills which act as a sieve, and hence this group of animals is given the term *filter-feeders* (Underwood & Chapman 1995).

Figure 2.11 The bivalve, *Electroma georgiana*, attached to *Posidonia australis* seagrass leaves at Corner Inlet Marine National Park, Victoria. (Image: R. Koss)

Barnacles are also filter-feeders. They are small animals which live inside a shell cemented tightly to a substratum. Once the juvenile form of the barnacle settles on a surface, it will never move and will grow into the adult form (Underwood & Chapman 1995). Barnacles use an elaborate system of modified legs to filter small organisms and particles out of the water column (Quinn *et. al.* 1992).

Sea squirts are filter-feeders and grow on seagrass leaves or on the sediment between seagrass plants. The outer layer is tough and leathery, ranging in colour from orange, pinks, dark reds to black (*See Figure 2.12*). Often they are covered by green and brown epiphytes (Quinn *et. al.* 1992). Sea squirts stick to the surface by a tough, calcareous base. They are filter-feeders pumping large quantities of water through their bodies via the two siphons found at the top of the animal (Underwood & Chapman 1995). If the siphons are touched or pushed, squirts of water may be released. Sponges pump large quantities of water through their bodies to filter out small particles and organisms for food.

Figure 2.12 Sessile invertebrates growing amongst seagrass plants in Corner Inlet Marine National Park, Victoria. A) A yellow ball sponge growing amongst *Zoestera tasmanica*, B) a red sponge growing around and in the *Posidonia australis* seagrass leaves and C) colonial sea squirts growing in seagrass beds in Corner Inlet Marine National Park, Victoria. (Images: R. Koss & J. Stevenson)

2.6 Reasons for change in seagrass distribution

The high-energy coastline of south-eastern Australia means that seagrass growth is confined to estuaries and protected embayments (Poiner & Peterken 1995). Over the past 40 to 50 years there have been significant declines in seagrass habitats across Australia (Butler & Jernakoff 1999; Walker *et. al.* 1999). There are many environmental factors, both human-induced and natural, which can influence the health and distribution of seagrass. These include eutrophication, light climate, salinity levels, pollution, boat traffic and changes in marine plants and animals.

Eutrophication

Eutrophication is the product of high nutrient loads entering the marine environment, usually from waste water discharged from sewer treatment works or run-off from phosphate-fertilised agricultural land (Roob 2003). High concentrations of nutrients can cause algae blooms and increased epiphyte growth, which can attach to and shade seagrass leaves (*See Section 2.5 for a definition of an epiphyte*). With a reduced amount of light, seagrass leaves are not able to photosynthesise effectively (*See Section 2.2 for a definition of photosynthesis*). A reduction in seagrass photosynthesis can cause a reduction in plant growth rates leading to eventual death of the seagrass.

Light Climate

An increase in sediment and turbidity in the water column, algal blooms and nutrient input from the land, reduces the absorption of light. This may influence seagrass growth and the depth at which it can grow. The amount of light in the water column can also affect seagrass species distribution along the sea bed (Roob *et. al.* 1998).

Salinity Levels

Seagrass is physiologically adapted to sea water (Roob *et. al.* 1998). Salinity levels are not independent of position or depth in the ocean, but are higher at greater depths. In shallow coastal areas, freshwater run-off lies on top of the dense saline water (Roob *et. al*. 1998).

Pollution

Seagrasses accumulate toxins, such as heavy metals, from the environment in their roots. These toxicants can be passed up the food chain by animals eating, living or decomposed seagrass leading to increased toxicity. Oil spills can also damage seagrass by directly poisoning or smothering the plants. Oil droplets are able to adhere to sediments, causing buoyancy and resulting in erosion of the sea bed within which the seagrass is growing (Roob *et. al.* 1998).

Boat Traffic

Boats causing damage to seagrass beds is common (Campbell & McKenzie 2001). Anchors and mooring chains from boats pull up seagrass when they are retrieved or dragged. Boat propellers may tear up and damage seagrass when operated in shallow water (Roob *et. al.* 1998; Campbell & McKenzie 2001).

Change in Marine Animal and Plants in Seagrass Beds

Community structure of marine plants can be changed by natural and human-induced disturbances to seagrass beds. An occurrence of eutrophication can cause an increase in algal grazers such as snails and limpets. By grazing and foraging in the seabed for food, swans and some species of fish can influence the distribution and density of seagrass (Roob 2003). Introduced species, such as the seaweed *Codium fragile var. tomentosoides* (Broccoli Weed), grow on seagrass beds, which leads to seagrass death and decreased abundance (Roob *et. al*. 1998).

Introduced Species

Accidental or deliberate introduction of species either as a consequence of transporting stocks for aquaculture, via release of ballast water from ships, or from fouling on the underside of ships, can lead to dramatic effects on the native species (Thompson *et. al.* 2002). The arrival of non-local species represents one of the most important threats to the intertidal habitat, especially for native species which have no natural defence mechanisms to introduced pathogens or predators. Unlike pollution and harvesting, introductions of exotics are irreversible (Thompson *et. al*. 2002).

Figure 2.12 Friends of the Prom volunteers and Parks Victoria Ranger, Jonathan Stevenson, monitoring *Posidonia australis* seagrass beds at Corner Inlet Marine National Park. (Image: R. Koss)

3.0 HOW TO MONITOR SEAGRASS BEDS IN VICTORIA'S MARINE NATIONAL PARKS AND MARINE SANCTUARIES

3.1 Safety procedures to follow before initiating seagrass monitoring

In each community group, one volunteer must be nominated to act as the supervisor of the seagrass monitoring group. This person will be responsible for contacting the Parks Victoria Ranger, organising dates for monitoring, assessing weather forecasts prior to the day of monitoring and organising and checking that each volunteer is fit and has the appropriate equipment and attire to proceed with monitoring. The following safety procedure is the checklist which the nominated supervisor must follow prior to monitoring:

1. Setting an appropriate date/s for seagrass monitoring can be done in consultation with the Parks Victoria Regional Ranger. This will provide an appropriate amount of time for the Park Ranger to organise volunteer insurance and time log forms, and monitoring equipment. To contact a Parks Victoria Ranger for your MNP or MS, call the Parks Victoria Customer Service Centre **13 19 63** and ask to be connected to the office associated with your MPA. Once dates have been set, the appropriate Fisheries personnel for the region should be notified by ringing the Departments of Environment and Sustainability and Primary Industries Customer Service (DPI & DSE) Centre on **13 61 86**. There are no seasonal restrictions for undertaking monitoring, but be aware that during winter months, sea water and air temperatures can be cooler.

2. The night prior to, and the morning of monitoring, assess the weather forecast, tidal movement and sea conditions. This can be done by checking the Bureau of Meteorology via the website: **http://www.bom.gov.au/weather/vic/**

3. Notify all volunteers to meet in one specific location before embarking on the monitoring. This ensures that no volunteers become lost. This is important especially if travelling to the monitoring site by boat.

4. Ensure all volunteers are wearing adequate clothing and footwear. Shoes must be sturdy, with a solid sole and a good grip. At some monitoring sites wetsuits, mask, snorkel, and fins, may be necessary to undertake monitoring (*See Appendix 5 for a complete personal and scientific equipment checklist*).

5. Protection against the sun such as a hat, sunscreen, sunglasses and water bottle is necessary. If rain is predicted, ensure you have adequate wet-weather gear such as a jacket or plastic poncho and a change of clothes.

7. A current first aid kit must be at the monitoring site.

8. Ensure that all volunteers are aware of dangerous marine animals (e.g. blue- ringed octopus, sea jellies and cone shells).

9. Do a head-count before moving to the monitoring site and ensure that all volunteers have signed the Parks Victoria Insurance Forms. These can be obtained from your local Parks Victoria Ranger.

10. Be aware of a sudden change in weather conditions and use common sense to stop monitoring if the situation looks dire. This is important if using a boat to access a monitoring site.

11. Ensure that at least one volunteer is a lookout for sudden large waves or changes in weather conditions.

12. If snorkelling or SCUBA diving, ensure a surface buoy with a dive flag in the monitoring area is visible to boats and other watercraft vehicles. At least one volunteer must act as a watch or lookout.

13. If SCUBA diving is involved adhere to the safe non-decompression diving procedures and safety standards, making sure a surface buoy with a dive flag is visible to all boats and other watercraft vehicles. Ensure one volunteer acts as a watch or lookout. If diving from a boat, the boat must be equipped with the regulatory safety equipment, in keeping with Australian Safety Standards. The Parks Victoria Diving and Snorkelling Operations Manual must be adhered to for all volunteers and can be obtained from your local Parks Victoria Ranger.

14. An operable communication device such as a mobile phone or marine radio should be present during each monitoring session.

3.2 How to choose a seagrass monitoring site in your marine national park or marine sanctuary

Mapping programs have been performed by Primary Industries Research Victoria Marine and Freshwater Systems (PIRVIC-MFS) and the Department of Sustainability and Environment (DSE) over the past five years. Reports, maps and geo-spatial databases are now available for The Gippsland Lakes, Corner Inlet and Nooramunga, Western Port Bay and Port Phillip Bay including minor estuaries such as Anderson, Shallow, Sydenham, Tamboon, Wingan and Mallacoota Inlets (Roob 2003).

Using the PIRVIC-MFS and DSE reports and maps, long-term seagrass monitoring sites in Victoria's MPAs can be chosen. With the assistance of a Parks Victoria Ranger, the seagrass bed sites chosen by volunteers can complement other reports and datasets used to predict threats and identify impacts in MPAs.

If no previous report or mapping programs have been undertaken in the MPA monitoring region, consultation with the local Parks Victoria Ranger (*Contact Parks Victoria on 13 19 63*) may assist in determining the best monitoring sites.

Monitoring site selection should represent the seagrass community for the MPA with consideration to the threats and impacts that can determine their distribution. Site selection should also incorporate the range of habitats used by the animals and plants and should not be logistically difficult to revisit. Ensure that the seagrass is the dominant habitat of the MPA and the terrain is even with no intersecting canals or very high sand or mud bars. A research permit is required before any monitoring can take place. The research permit form can be obtained through the DSE, (*Contact DSE on 13 61 86*). A research permit application can be done in conjunction with a Parks Victoria Ranger for the MPA .

Monitoring sites in Victoria's MNPs and MSs should not be permanently marked with pickets or any other structure. The use of a Global Positioning System in conjunction with a Parks Victoria Ranger, will give co-ordinates for monitoring sites to be re-measured over the long term (*See Appendix 1 for information on GPS Guide*).

3.3 What is a reference site and why should it be included in seagrass monitoring?

Seagrass monitoring studies should be designed with care so that seasonal changes are not confused with changes induced by human impacts (Kingsford & Battershill 1998). Any impacts caused by human activities can then be separated from any natural variation within the seagrass habitat system. There are many sources of natural and human-induced variations in a system which need to be considered in a monitoring design.

In a seagrass monitoring program it is important to measure as many sites as possible within the MNP or MS. This will ensure that trends or patterns are representative for the whole MPA. A reference site is a monitoring site outside of the MNP or MS. The reference site must be similar to sites within the MPA by having the same dominant type of seagrass species and substratum composition. In order to assess whether seagrass and associated animal and plant assemblages are changing due to the habitat being protected, areas which are not protected must also be assessed. Over the long-term, patterns in variation can be detected in both protected and unprotected seagrass habitat areas. If the variation is due to natural causes, this will be reflected in both protected and non-protected seagrass habitats over time. However, if a trend is occurring, for example, in the protected seagrass beds and this is not seen in the unprotected seagrass beds, then an assumption can be made that protecting an area may cause this variation. For example, in an MPA the seagrass plants may be longer in length than seagrass plants found in the non-MPA, therefore creating an MPA has allowed seagrass plants to be protected from impacts and are able to grow longer leaves.

If possible, it is important that each monitoring program has at least two reference sites. This of course will be dependent on seagrass habitat availability surrounding the MPA. Reference sites can be chosen in conjunction with a Parks Victoria Ranger. By monitoring MPA and reference sites over a long time-period, more trends can be identified and supported by the collected data.

3.4 How often should seagrass monitoring be conducted?

There are no set rules as to how often your group should monitor your MPA and reference sites. During summer the weather is warmer and more desirable to work in, or next to, the water. Winter poses the problem of cooler air and water temperatures, where thicker wetsuits or warmer clothes are needed. The frequency of monitoring is dependent on your community group and time commitments for each individual volunteer. It is also sensible to recognise that some volunteers may not wish to partake in seagrass monitoring during the winter months due to the cooler weather.

There are seasonal effects on the physical attributes of seagrass. For example, *Posidonia australis* have longer leaves during the summer period, up to approximately 1.5 m in length. During winter, the leaves break off and approximately 20 – 50 cm of leaf remains. If sampling of *Posidonia australis* were only to take place during summer, then the seasonal trend of leaf die back during winter would not be seen. This is a natural seasonal variation. Over time it is important to identify this as a natural trend. However, human-induced impacts may not show the same fluctuating trends through time. There may be a change to seagrass beds occurring slowly over time, or it may be a large scale impact which can take place within a few weeks. In order not to make the wrong assumptions it is best that monitoring take place each season if possible at both MPA and reference sites (*See Section 3.3 for details of selecting a reference site*). It is possible to choose sampling dates with the Parks Victoria ranger (*See Section 3.1 for Parks Victoria phone contact details*) who may recommend certain periods, during each season, which may produce favourable conditions for seagrass monitoring.

3.5 How to set up a seagrass monitoring site

What materials and equipment are needed?

- 3 x 50 m fibreglass measuring tapes (transect lines)
- 6 stainless steel tent pegs for temporarily holding down transect lines
- dive buoys attached to a sinker, if the monitoring site requires snorkelling or SCUBA
- GPS (Global Positioning System) or compass if no GPS is available
- Waterproof monitoring datasheet (*See the Sea Search website www.parkweb.vic.gov.au/seasearch to download the seagrass monitoring data sheet*), underwater slate, pencil and rubber bands to hold sheets in place.
- map of site (if available)
- three x 1 m^2 (1 m x 1 m) quadrats divided into 8 subquadrats (*See Section 3.7 for a detailed description on sub-quadrats*).
- rulers (the length of rulers required will vary with the seagrass species being monitored).

3.6 How to set out equipment when monitoring

The following method of monitoring has been adapted from the Seagrass Watch Survey, established by the Department of Primary Industries in Queensland, and Museum Victoria Science Reports baseline monitoring (McKenzie & Campbell 2002; O'Hara *et. al.* 2002).

- Three 50 m transect lines should be laid out across the seagrass bed with a distance of 25 m between each transect line (*See Figure 3.1 for the monitoring site set up*).
- Once a site has been located, mark the site using the GPS. If no GPS is available, use the compass to record three or more bearings from prominent land features. If a site map is available, make a note of the site location on the map.
- Using the compass, take a direction bearing of the transect layout. The direction will typically be perpendicular to the shoreline, but will vary for each site depending on the location of the seagrass bed.
- Record this bearing on the datasheet (e.g. 80°)
- Record the GPS position or three compass bearings at the 0 m position of the transect line.
- Place a tent peg in the hook at the 0 m position of the transect tape and bury it in the sediment to ensure that the start position of the transect does not move.

- Hold the transect wheel in your right hand as you walk or snorkel. This ensures that the sampling space on the right side of the transect line will not have foot holes or fin imprints in the surveying area.
- Using the compass bearing, move forward in that direction for 50 m.
- At the end of the transect, check your position and look back to ensure that the transect line has been laid out along the correct bearing and is as straight as possible.
- Place a tent peg through the end of the transect line to ensure water movement does not displace the line.
- The line that has been set is the middle transect line, Transect 2 (*See Figure 3.1*).
- Transect 1 will lie 25 m left and parallel to Transect 2. Transect 3 will lie 25 m right and parallel to Transect 2 (*See Figure 3.1*).
- The 25 m distance between Transect 2 and Transects 1 and 3, should be measured using the transect lines. Once the 25 m distance has been established, the transect lines are wound up and used for the 50 m transect line.
- All transects are left in place with the tent pegs until all monitoring of that transect line has been completed.

Figure 3.0 S.E.A.L. Diving Services volunteers prior to establishing a transect line and holding seagrass monitoring equipment at Corner Inlet Marine National Park, Victoria. (Image: R. Koss)

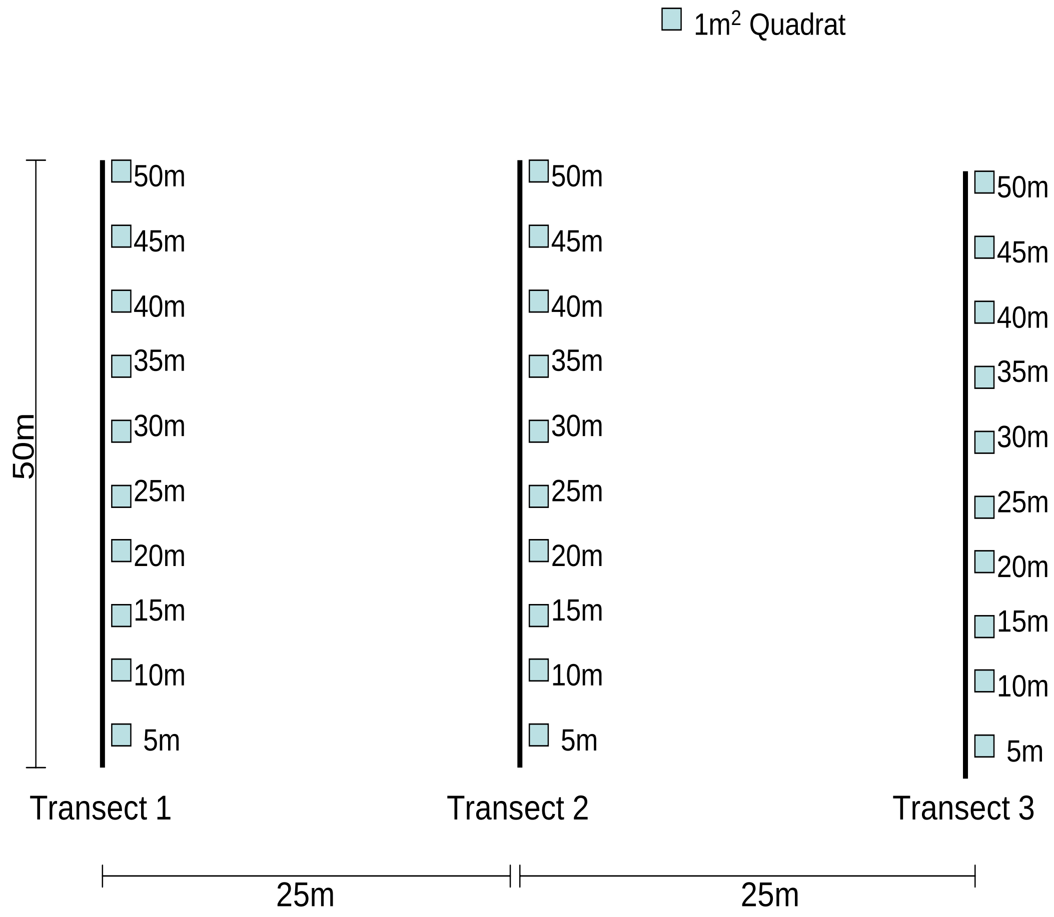


Figure 3.1 Transect and quadrat layout at the seagrass monitoring site. Quadrats are set every 5 m along the right side of the transect line starting at the 5 m position.

3.7 Why is the quadrat divided into eight subquadrats?

Why does seagrass monitoring require random subquadrat data collection?

The idea of random data collection is an important component in any scientific ecological monitoring. This decreases any biases in data collection and ultimately the final results. In order for no biases to be represented in the data collection, three subquadrats must be chosen in a random fashion.

How to create and choose random sub-quadrats

- The 1 m^2 quadrat is sub-divided into eight 25 cm x 50 cm subquadrats numbered 1 – 8 from top left to bottom right (*See Figure 3.2*). The three subquadrats randomly chosen are to be used for the three sets of data of epiphyte cover (*See Section 2.7*), seagrass length (*See Section 2.7*) and seagrass density (*See Section 2.7*).

- To choose three subquadrats randomly, use the numbers 1 – 8 separated on equally-sized paper (*See Appendix 3 for the set of random numbers*). Place these numbers in a non-see-through bag or a hat. Without looking in the bag / hat, one volunteer should pull out three pieces of paper, one number at a time. The three selected numbers correspond to the three subquadrats which should be sampled for the first quadrat only. These numbers are replaced into the bag or hat. For the next quadrat, three numbers are drawn out of the hat or bag, noted and then replaced. Each subsequent 1 m^2 quadrat will have three subquadrats chosen in the above random manner.
- Each quadrat for each transect line must have three random subquadrats chosen in the above manner. The numbers selected for each quadrat must be replaced into the hat / bag before a set of numbers can be drawn for the next quadrat. At the completion of randomly selecting numbers, each quadrat will have three random subquadrats to be monitored.
- It is fine for two quadrats to have identical sets of numbers chosen, provided the numbers were chosen at random and were in accordance with the above instructions.
- For data collection to be efficient, it would be best to choose the random subquadrats on land either immediately before the monitoring is conducted or the night before. The seagrass monitoring group's supervisor might choose to do this the night prior to monitoring.

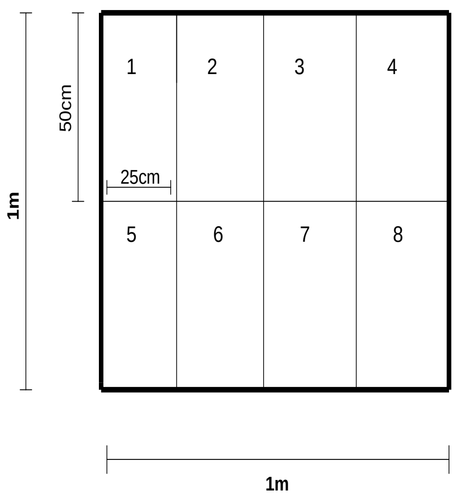


Figure 3.2 The 1 m^2 quadrat with the eight subquadrats. Subquadrat 1 starting at the top left corner and finishing with subquadrat 8 on the bottom right corner.

3.8 How to survey the seagrass monitoring site

Seagrass Monitoring Technique

- The first quadrat should be laid on the right side of the transect line at the 5 m mark (*See Figure 3.1*). The bottom line of the quadrat should be horizontal with the 5 m mark of the transect line and extend toward the 6 m mark. Quadrats should be laid on the right side of the transect line every 5 m for the 50 m transect line (i.e. 10 m, 15 m, 20 m, 25 m, 30 m, 35 m, 40 m, 45 m and 50 m).
- When looking down the transect line to the 50 m mark ensure that subquadrat 1 (*See Figure 3.2*) is lying at the top left of your sampling area.
- Monitor all the parameters in the quadrat as set out in Section 3.9.
- Once all parameters have been measured, move on to the next 5 m mark and repeat the procedure. The same process is used for all transects (*See Figure 3.1*).

Figure 3.3 Parks Victoria Ranger, Jonathan Stevenson, laying out the 1 m2 quadrat along the transect line to monitor *Posidonia australis* seagrass in Corner Inlet Marine National Park, Victoria. Note that when placing the quadrat, stand on the left side of the transect line to minimise damage to the seagrass to be surveyed. (Images: R. Koss)

3.9 What types of information need to be recorded?

Seven sets of data are to be collected from each quadrat which include:

- marine animals
- substratum composition
- seagrass cover abundance
- epiphyte cover abundance
- seagrass leaf length
- seagrass shoot density
- essential information.

It is best to count the number of mobile animals first as some animals are very quick to move if disturbed (e.g. crabs). There is no specific order in which the other data sets can be collected. All information collected will be written on the datasheet *(the datasheet can be downloaded from the Sea Search website www.parkweb.vic.gov.au/seasearch)* which can be photocopied and distributed to each volunteer.

How to Count Marine Animals

All mobile and sessile animals are to be counted in each 1 m^2 quadrat. All animals are only required to be identified to class level (*See Table 1.0 for animal classes*). If more information is known about any animal seen in the quadrat, this can be also written during data collection on the datasheet.

Count all mobile animals (e.g. crabs and seastars) in the 1 m^2 quadrat. Fast mobile animals, such as crabs, can quickly move out of the quadrat due to our disturbance. Note the type of animal and the number of individuals in the correct column on the datasheet .

Count all sessile invertebrates (e.g. sponges and ascidians) in the 1 m^2 quadrat. Note the type of animal and the number of individuals in the correct column on the datasheet.

Table 1.0 Class groups and types of animals which can be seen during seagrass monitoring.

CLASS	SESSILE OR MOBILE	TYPE OF ANIMAL
Anthozoa	Sessile and Mobile	Anemones, sea pens, corals
Cirripedia	Sessile	Barnacles
Malacostraca	Mobile	Crabs, shrimps, lobsters
Gastropoda	Mobile	Herbivorous and predatory snails such as abalone, limpets, top shells, whelks, cowries, trumpet shells, cone shells, sea slugs, nudibranchs
Bivalvia	Sessile and Mobile	Mussels, oysters, scallops, cockles, pipis
Asteroidea	Mobile	Seastars
Echinoidea	Mobile	Sea urchins
Ascidiacea	Sessile	Sea squirts
Porifera (Phylum)	Sessile	Sponges

A 

B 

Figure 3.4 A) A sponge growing on the stem of the seagrass *Amphibolos antartica* and, **B**) the velvet seastar, *Patiriella parvivipara*, amongst the *Posidonia australis* seagrass leaves at Corner Inlet Marine National Park. (Images: R. Koss)

How to Assess Substratum Composition

The type of substratum the seagrass is growing in must be identified for each $1m^2$ quadrat. The substratum type can be defined as: Fine Sand (F), Coarse Sand (C), Mud (M), Fine Silt (S), Shell Grit (SG) and Gravel (G). For ease of data collection, the abbreviated letters in brackets can be used on the datasheet.

Seagrass Watch (McKenzie & Campbell 2002) use the following definitions to accurately identify the substratum type.

- *Fine sand* has a fairly smooth texture with a grain size less than 63 µm (micrometres).
- *Coarse sand* consists of loose particles and has a coarse texture. The grain size is greater than 0.5 mm and less than 1 mm.
- *Mud* has a smooth and sticky texture usually very dark in colour. The grain size is less than 63 µm.
- *Fine silt* can appear like fine sand, however it is usually grey in appearance and does not have any roughness. The grain size is less then 63 µm.
- *Shell grit* is composed of broken shell pieces of varying sizes and can be very sharp and coarse to touch. As the main composition is old and broken shell, the appearance is often white in colouration.
- *Gravel* is very coarse in texture with some small stones apparent. Grain size is greater than 1 mm.
- Dig your fingers 2-5 cm into the substratum under the quadrat carefully so as not to destroy any seagrass plants. Do not dig your hand in too deep. Remove a small sample of the substratum.
- By looking at the substratum between your fingers, define and record the substratum type on the datasheet by circling one of the abbreviated letters. These letters are defined as: F = Fine sand, C = Coarse sand, M = Mud, S = Fine silt, SG = Shell grit and G = Gravel.
- At some sites the substratum may be a combination of sediments. If this occurs, list all those sediments on the datasheet, in order of dominance.

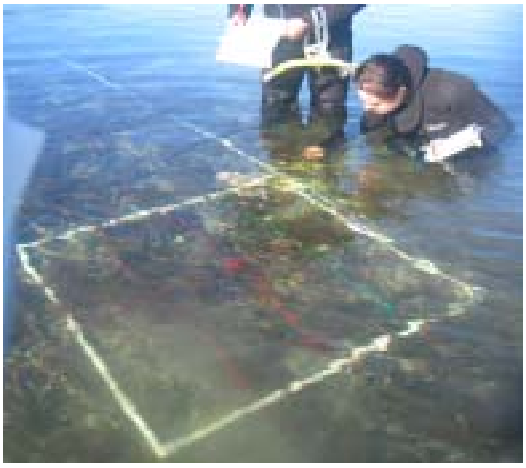


Figure 3.5 Analysing substratum type for *Posidonia australis* within the 1 m^2 quadrat at Corner Inlet Marine National Park, Victoria. (Image: R. Koss)

How to measure seagrass cover abundance

Cover abundance of seagrass is recorded for each whole 1 m^2 quadrat. (*See Appendix 2 for pictures of seagrass cover abundance classes*).

Cover abundance classes that are used are sparse, medium, dense and very dense (*See Table 1.1 below*).

- When looking at the 1 m^2 quadrat estimate how much of the quadrat is covered by the seagrass and note this on the datasheet using the abbreviated letters as defined in Table 1.1.
- If the seagrass is distributed unevenly in the quadrat, estimate how much of the quadrat would be filled if all the seagrass was placed in one half of the quadrat. For example, if the seagrass does not fill half of the quadrat, then the cover abundance would be medium. If the seagrass does not fill a quarter of the quadrat, then the cover abundance would be sparse.

Table 1.1 Cover abundance classes with percentage cover in the left column and corresponding class codes in the right column. The letters in brackets under cover class are the abbreviated forms to be used and noted on the datasheet during data collection.

PERCENTAGE COVER	COVER CLASS
≤ 25%	Sparse (S)
≥ 25 - ≤ 50%	Medium (M)
≥ 50 - ≤ 75%	Dense (D)
≥ 75%	Very Dense (VD)

Figure 3.6 Estimating seagrass cover abundance for the 1 m2 quadrat while standing, or lying in the water above the quadrat and looking down. (Image: R. Koss)

How to measure epiphyte percentage cover

Epiphytes are the small algae which attach to seagrass leaves (*See Section 2.3 for the definition of an epiphyte*). There may be seasonal variations in the amount of epiphyte cover found on the seagrass leaves (*See Section 2.6 for changes in seagrass distribution*). In each of the three subquadrats estimate epiphyte cover abundance in the form of a percentage cover.

- Choose one leaf randomly in the subquadrat. To choose one plant randomly, the volunteer must close their eyes, place their hand into the subquadrat and select a plant. The first plant selected must be measured. Estimate how much of the leaf surface is covered by epiphytical growth for one plant within the subquadrat. Note this percentage on the datasheet.
- Estimate how many leaves for all plants in the subquadrat are covered by epiphytical growth. Note this percentage on the datasheet.
- On completion of monitoring, calculate the sub-quadrat epiphyte cover. For example, if the leaf is covered with 50% epiphyte growth, and 20% of all the leaves from all plants are covered, then the subquadrat epiphyte cover is 10% (Multiply 0.50 x 0.20 = 0.10 or 10%).

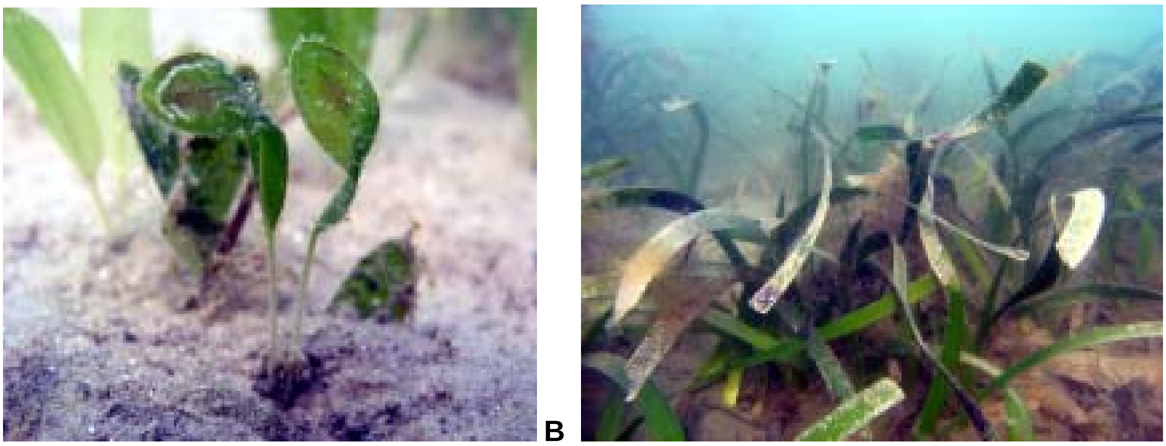


Figure 3.7 Brown and white epiphyte cover on sections of **A**) *Halophila australis* and **B**) *Posidonia australis* seagrass leaves in Corner Inlet Marine National Park, Victoria. (Images: J. Stevenson)

How to measure seagrass shoot length

- Three plants should be randomly selected within each subquadrat. This is done by closing your eyes and placing your hand in the subquadrat and selecting a plant that your hand touches.
- Using a ruler, measure each leaf from the base to the leaf tip.
- Note this measurement on the datasheet.

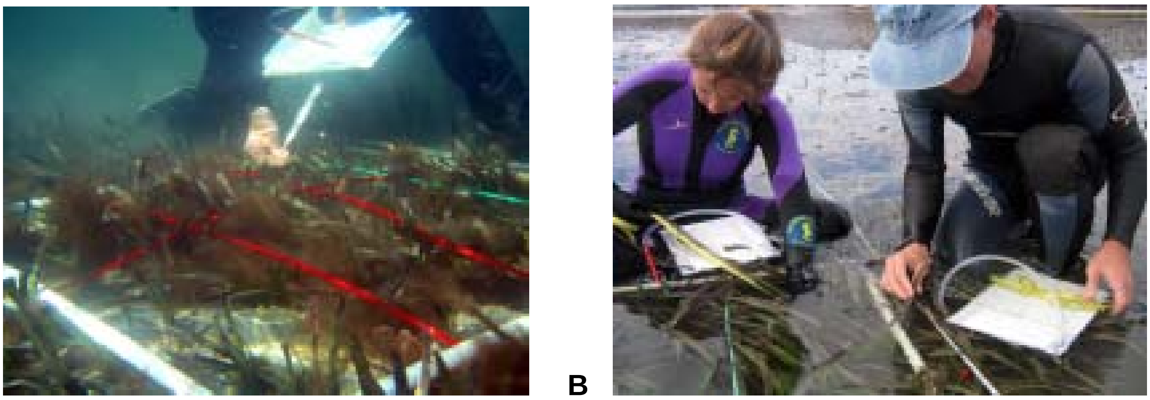


Figure 3.8 A) S.E.A.L. Diving Services and **B)** Friends of the Prom volunteers measuring seagrass leaf length of *Posidonia australis* in Corner Inlet Marine National Park, Victoria. (Images: R. Koss)

How to measure seagrass shoot density

- This measurement should only be taken for every second quadrat along the transect line starting at 10m.
- Count the total number of shoots in the three randomly selected subquadrats used for seagrass shoot length.

- Note these numbers on the datasheet.

What other essential information should be noted?

There are a number of important sets of informative data which need to be noted at the time of monitoring for each transect. These include:

- name of volunteer
- date of monitoring
- start and end time of monitoring
- temperature – both air and water (this information is available on the Bureau of Meteorology website: http://www.bom.gov.au/weather/vic/)
- site (GPS co-ordinate or compass bearing to a geological feature on the land)
- transect number
- water visibility if snorkelling or SCUBA diving.

Figure 3.9 S.E.A.L. Diving Services volunteer noting data during *Posidonia australis* seagrass monitoring in Corner Inlet Marine National Park, Victoria. (Image: R. Koss)

3.10 What to do if you think you have found a marine pest

If you suspect you have seen a marine pest, you should report it to the Department of Sustainability and Environment Customer Service Centre on **13 61 86**. It is important that you have all information corresponding to the animal or plant available. This includes a description of the animal or plant and its approximate size, the location where you saw the pest, the date and time of siting and the number of individuals seen. At the bottom of the seagrass monitoring sheet there is room for making notes on any marine pests sited.

3.11 Procedures and what should be done after completing a seagrass monitoring session

- Once all monitoring has been completed, the monitoring group's supervisor must do a head-count to check that all volunteers are present. This is very important, especially if seagrass monitoring requires volunteers to snorkel or SCUBA dive.
- Ensure all equipment has been collected and nothing has been left behind at the monitoring site.
- Once on land, each volunteer must check that their datasheet has been filled in and all numbers are clear and legible. Volunteers must check figures for discrepancies and anomalies (such as shoot length or density outside the normal range) with errors corrected and / or annotations added, if necessary. Ensure that all essential information (*See Number 7 in Section 3.9*) has been completed. Place all datasheets into a folder or envelope, where they will not be lost, which will be the responsibility of the group's monitoring supervisor.
- Once on land, wash transect lines, quadrats and underwater slates in fresh water. This assists in removing any excess sand and mud. Ensure the equipment is dry before placing in storage.
- The group's monitoring supervisor, with assistance from other volunteers, can place new datasheets on the underwater slates and sharpen pencils in preparation for the next seagrass monitoring. This can be done at home or at the car park after the completion of monitoring.
- At home, the group's monitoring supervisor with the assistance from other volunteers, can enter the data into a computer Excel worksheet (*See Section 3.12*) and save the file.

3.12 How to enter seagrass monitoring data into a Microsoft Excel worksheet

After the completion of a seagrass monitoring session there will be an accumulative amount of data which must be entered on to a Microsoft Excel spreadsheet and saved. This ensures that the valuable monitoring information that your group has collected is not lost. The following data entry procedures are relatively simple and the example spreadsheet set up (*The Excel spreadsheet can be downloaded from the Sea Search website www.parkweb.vic.gov.au/seasearch*) will guide you in entering the data. By following the Excel spreadsheet example, it will allow your community group and management authorities to analyse the data without needing to transform the data layout.

- Open a new Microsoft Excel worksheet.
- The first sheet (see the tabs on the bottom of the Excel sheet) is for subquadrat data.
- Type the word ‘Transect’ at the top of the first column.
- Move to the top of the second column and type the word ‘Quadrat’.
- Move to the top of the third column and type the word ‘Subquadrat’.
- Move to the top of the fourth column and type the word ‘Epiphyte Leaf’.
- Move to the top of the fifth column and type the word ‘Epiphyte Quadrat’.
- Move to the top of the sixth column and type the word ‘Length 1’.
- Move to the top of the seventh column and type the word ‘Length 2’.
- Move to the top of the eighth column and type the word ‘Length 3’.
- Move to the top of the ninth column and type the word ‘Density 1’.
- Move to the top of the tenth column and type the word ‘Density 2’.
- Move to the top of the eleventh column and type the word ‘Density 3’.
- Under the transect column, type 1, 2 or 3 in relation to the transect number for the site. For example, monitoring data may be for transect 1, so type number 1.
- Under the quadrat column, type the quadrat number. For example, the monitoring data may correspond to quadrat 5 along transect 1, therefore type the number 5.
- Under the subquadrat column, type each sub-quadrat on a separate line. This ensures there is no data confusion between subquadrats in the final analysis. For example, data should be for transect 1, quadrat 5 and subquadrats 2, 5 and 8.
- Corresponding data for this subquadrat should then be entered under the corresponding columns moving across the datasheet, that is, values for one specific subquadrat should be entered moving across the row.
- On completion of transect 1 monitoring data, continue with the above procedure for transects 2 and 3.
- Once all subquadrat monitoring data has been entered, save this spreadsheet using site name and date. For example, CIMNP120604, which represents seagrass monitoring taken at Corner Inlet Marine National Park on the 12 June 2004. Any MNP, MS or reference site can be abbreviated to the letters of the location. Do not forget what the

abbreviated letters stand for and this can be noted anywhere on the datasheet. At the bottom of the spreadsheet there is a tab named Sheet 2. Click on Sheet 2 to open a new spreadsheet, which is still recognised under the same file name. Sheet 2 is for monitoring data noted for the whole quadrat.

- Type the word ‘Transect’ at the top of the first column.
- Move to the top of the second column and type the word ‘Quadrat’.
- Move to the top of the third column and type the word ‘Cover %’.
- Move to the top of the fourth column and type the words ‘Sessile Invertebrates’.
- Move to the top of the fifth column and type the words ‘Mobile Invertebrates’.
- Under the transect column type the transect number.
- Under the quadrat column type the quadrat number.
- Place monitoring data values under the corresponding columns relevant to the quadrat and transect number.
- Sessile and mobile invertebrate counts should be entered as totals. For example, if there were 2 sea stars and 2 sea urchins, the number 4 should be entered in the mobile invertebrate column.
- Press the Save function often during data entry.

Monitoring data stored in this form can be easily reproduced and used for analysis. Long term monitoring may or may not display trends which can be easily seen by using graphing and statistical applications in the Microsoft Excel software package. A copy of your group’s monitoring data can be saved on to a disk or CD and sent to the Parks Victoria Ranger who assisted your community group seagrass monitoring or a ranger responsible for the management of your MPA (*Ring Parks Victoria on 13 19 63*).

GLOSSARY

Abdomen	A segmented section of the body located behind the thorax
Algae (plural)	A photosynthetic, plant-like single- or multi-cellular organism
Angiosperm	A group of plants where the seed is formed within an ovary
Biodiversity	The number, relative abundance and genetic diversity of organisms on earth
Bivalve	An animal in the mollusc group which has two valves joined at the margin by an elastic ligament and hinge teeth
Chlorophyll	The green pigment of plant cells, which is the receptor of light energy in photosynthesis
Colonisation	The ability for an organism to settle and reproduce in a habitat
Ecology	The interaction between plants, animal and micro-organism communities
Epiphyte	A small plant that grows attached to another plant
Erosion	The loss of soil by the action of wind or water, or both
Estuarine	The area or habitat where fresh water from a river meets the salt water of the ocean
Filter-Feeder	Animals that obtain food by filtering suspended organisms and particles from a volume of water by passing the water over a set of specialised structures
Gonad	The testis or ovary
GPS	Global Positioning System; used to mark locations
Grazer	An animal which feeds on vegetable tissue from herbaceous plants
Herbivore	An animal that feeds exclusively on plant material as a food source
Invertebrate	An animal without a backbone
Photosynthesis	The process by which light energy is used to create chemical bonds with carbon dioxide and water

Physiology	The study of the functions of an organism
Pollination	The transfer of pollen from the male reproductive system (anther) to the female reproductive system (stigma)
Predator	An organism that catches and kills another organism for food
Salinity	A measure of dissolved salt concentration in water
SCUBA	Self-Contained Underwater Breathing Apparatus
Sessile	Attached; not free to move about
Substratum	A base which a sessile animal or plant is fixed
Thorax	The central section of the body consisting of several segments behind the head and in front of the abdomen
Toxin	A poisonous compound
Turbidity	The measure of water column clarity
Visibility	Distance at which objects can be sighted during monitoring

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http://www.deh.gov.au/coasts/publications/somer/annex1/seagrasses.html (Viewed on 18 May 2004)

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APPENDIX 1 – USING A GPS

A complete guide on how to use a GPS can be downloaded FROM the Parks Victoria web site: http://www.parkweb.vic.gov.au/1park_display.cfm?park=256

What is a coordinate system / datum?

In order to translate from the coordinates on a map or chart to a location on the ground using a hand-held GPS, there are several important steps that must be understood.

A coordinate system is a set of infinite lines that divide the earth up into sections for the purpose of map reading. Victoria is divided into two separate zones: zones 54 and 55. These zones relate to the Universal Transverse Mercator projection used by many countries to map the earth.

A datum is a best fit model of the earth's surface. In 2000, the Geocentric Datum of Australia (GDA-94) replaced the Australian Geodetic Datum 1966 (AGD-66) as the standard for all of Australia. It was chosen because it is directly adaptable to the World Geodetic System 1984 (WGS-84) which is used world-wide for GPS receivers. Prior to this, AGD-66 was widely used, and provided a best fit model for Australia *only*. Although GDA-94 in current industry standard have maps / charts made prior to 2000, they list coordinates relative to AGD-66.

There are two coordinate systems used in Australia to match these datums. They include MGA-94 (Map Grid of Australia) for the GDA-94 datum and AMG-66 (Australian Map Grid 1966) for AGD-66 datum.

Latitudes and Longitudes can be displayed in a variety of formats. The most widely adopted for general maps, are Degrees, Minutes and Seconds. The best way to understand this system is to simply considerate it like a clock. The world is broken up into 360 degrees and each degree can be thought of as an hour. Each degree is broken up into 60 minutes and each minute is broken up into 60 seconds.

Latitudes and Longitudes can also be expressed in Degrees, Minutes and Decimal Minutes. This is generally only used in Victoria for nautical charts. The difference between this and the previous method, is that each degree is still broken into 60 minutes, however, each minute, instead of being divided into sixty seconds is divided up into hundredths. In order to correctly chart Marine National Park coordinates onto a nautical chart this needs to be understood. All GPS receivers will convert between these two display formats.

In order to find your ground location on a map using a GPS receiver, it is important to understand to which datum your GPS receiver is set, what projection your map is, and in which format your coordinates are expressed. If it is set incorrectly, position differences of up to several hundred metres will occur.

How to find Victorian Marine National Parks and Sanctuaries using your GPS receiver

It is important to familiarise yourself with your GPS receiver and more importantly, the accuracies attainable. Being able to switch between coordinates systems and datums is also useful, as not all maps or coordinates give positions in the same format. Latitude and Longitude are usually provided in the geodetic datum on which GPS is based (WGS-84).

GPS is not precise. The design of the system ensures that the average member of the public can achieve a reasonable accuracy with their GPS receiver, without locating a definitive 'X marks the spot' position.

It is, however, still possible to reduce the error of the position to less than 10-15 metres by ensuring that:

- the coordinate system and datum in the receiver are correct
- the GPS receiver is in Differential mode.

Differential GPS uses a known position on the earth and makes corrections to the GPS coordinates for that same position. These corrections are then applied to your GPS receiver, guaranteeing that the error in your position is minimised.

APPENDIX 2 – SEAGRASS ABUNDANCE COVER SHEET

Seagrass abundance cover. This sheet can be laminated and used at the monitoring site.

Very Dense (VD)

Dense (D)

Medium (M)

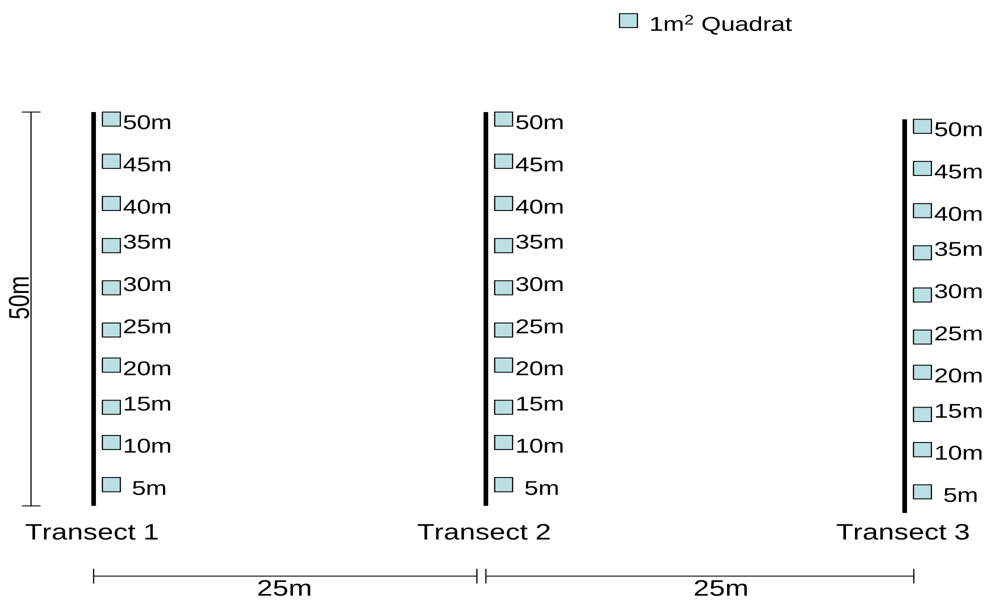
Sparse (S)

APPENDIX 3 – RANDOM SUBQUADRAT ALLOCATION

Numbers 1 to 8 for random sub-quadrat allocation in Section 3.7. Cut all numbers into equal-size pieces.

1	**2**
3	**4**
5	**6**
7	**8**

APPENDIX 4 – SEAGRASS MONITORING FIELD SHEET



At a single site, monitor three transect lines that are 25 m apart. Use a GPS or compass to record transect positions at the start and end position of each transect.

Record data every 5 m with a 1 m^2 quadrat (divided into 8 subquadrats)

Data Recording

- Animals – Count the number of mobile and sessile animals in the whole quadrat.
- Define substrate composition: fine sand, coarse sand, mud, fine silt, shell grit and gravel.
- Seagrass cover abundance for the whole 1 m^2 quadrat: sparse, medium, dense, very dense.
- Epiphyte percentage cover in three subquadrats: first estimate leaf cover then the whole sub-quadrat.
- Seagrass shoot length in three subquadrats: measure three shoot lengths in each subquadrat.
- Seagrass density in three subquadrats: measure the number of shoots in each subquadrat for every second quadrat along the transect line.
- Essential information should be noted (e.g. volunteer name, date, site, time, etc)

APPENDIX 5 – PERSONAL/SCIENTIFIC EQUIPMENT SHEET

Personal and Scientific Equipment Summary Sheet to be checked by the supervisor of the monitoring group as outlined in section 3.1

PERSONAL EQUIPMENT	Tick	SCIENTIFIC EQUIPMENT	Tick
Each volunteer has protective shoes with a solid sole or dive boots.		3 x 50 m measuring tapes	
Each volunteer has a wetsuit, snorkel, mask, fins if snorkelling.		3 x 1 m^2 quadrats	
Each volunteer has current and certified SCUBA equipment (if required) as outlined in Parks Victoria Operations Manual. This can be obtained from your local Parks Victoria Ranger. Each volunteer has a certified dive certificate as outlined in the Parks Victoria Operations Manual.		6 tent pegs	
Each volunteer has a hat, sunscreen and sunglasses.		Dive buoys with sinker	
Each volunteer has a water bottle with water.		GPS or compass	
Each volunteer has wet-weather gear if rain predicted.		Waterproof datasheets, underwater slates, pencils, rulers and rubber bands.	
Each volunteer has adequate clothing to protect against the elements.		Map of site (if available)	
A current First Aid Kit for the		Field summary sheet and	

whole group.		seagrass density photos.	
Operable mobile phone or marine radio if using a boat.			

Parks Victoria is responsible for managing the Victorian protected area network, which ranges from wilderness areas to metropolitan parks and includes both marine and terrestrial components.

Our role is to protect the natural and cultural values of the parks and other assets we manage, while providing a great range of outdoor opportunities for all Victorians and visitors.

A broad range of environmental research and monitoring activities supported by Parks Victoria provides information to enhance park management decisions. This Technical Series highlights some of the environmental research and monitoring activities done within Victoria's protected area network.

Healthy Parks Healthy People

For more information contact the **Parks Victoria Information Centre** on **13 1963**, or visit **www.parkweb.vic.gov.au**