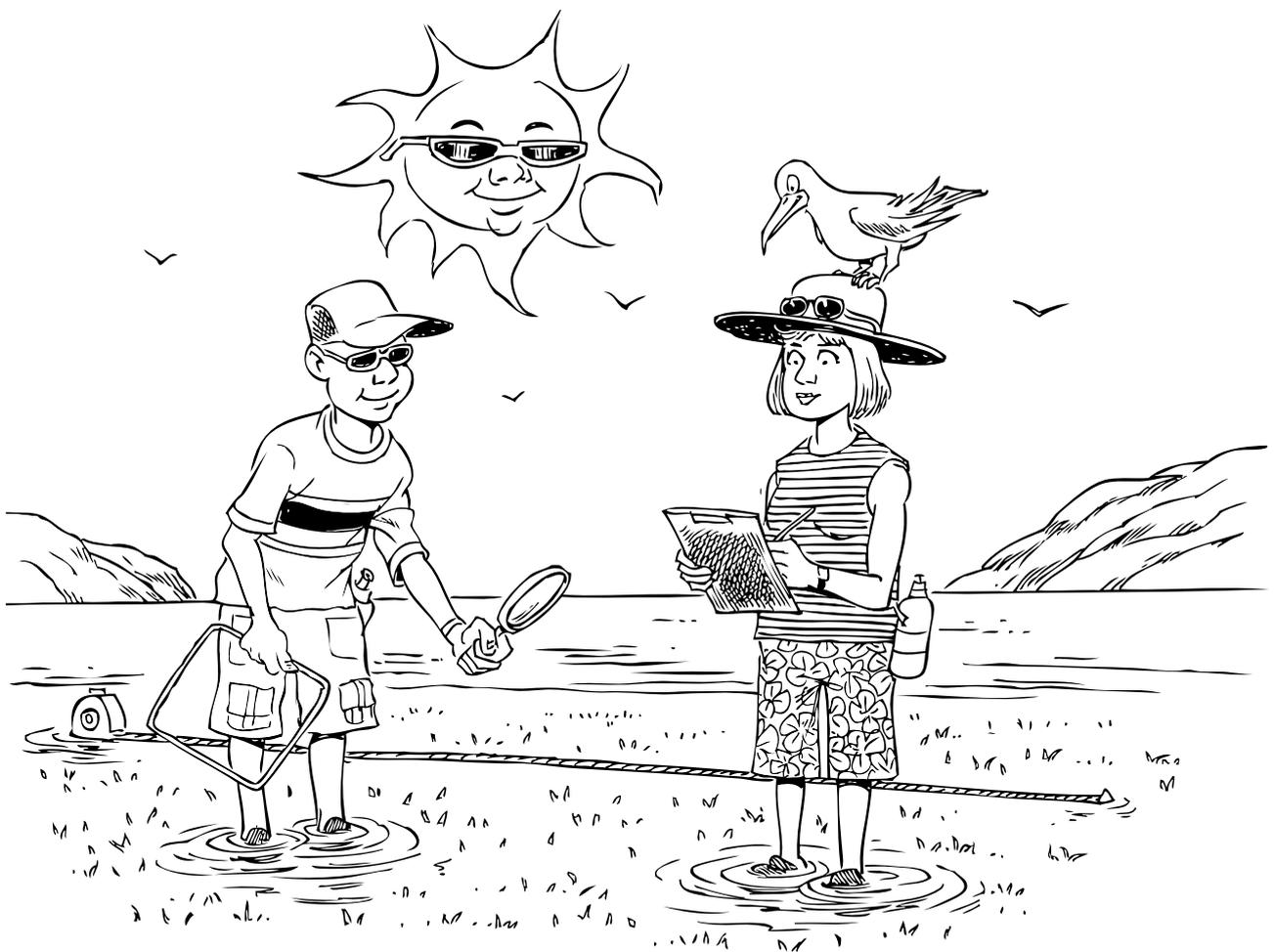


Seagrass-Watch

Activity Book



Sensational Seagrass

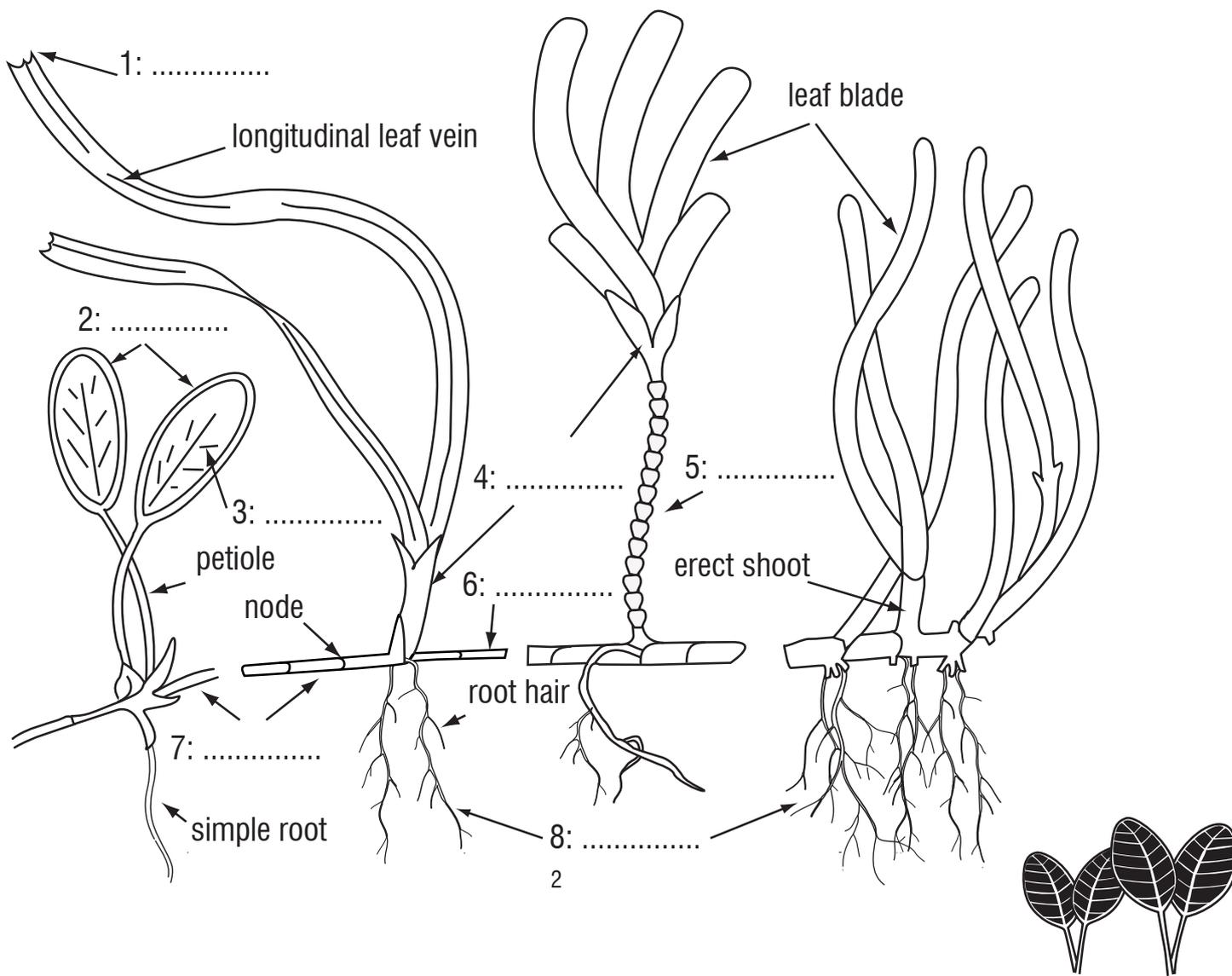
Seagrass is one of the most important plants on earth. Seagrass is the only marine flowering plant. Seagrass is found in oceans throughout the world and is the basis for many important marine ecosystems. Seagrass meadows are commonly found along coastlines, on reef tops and in estuaries.

Seagrass plants have roots, rhizomes and leaves. The roots and rhizomes are buried in the substrate and anchor the plant. Roots can be simple or branching, and have fine hairs to help absorb nutrients. Rhizomes form in segments, with shoots rising from the joints, which are called nodes or scars.

Shoots are the part of the plant above the substrate. They grow out of the sediment and have leaves. Leaves can rise directly from the rhizome, or can be attached by a stem. Sometimes the leaves are on a stalk, called a petiole. Seagrass have veins and air channels in their leaves, so they can carry water, food and gases. Veins can be across the leaf blade or run parallel (longitudinal) to the leaf edge. At the base of a leaf is a sheath, which protects young leaves. At the other end of a leaf is the tip.

Can you label the missing plant parts below from the following list?

cross vein, oval leaf blade, rhizome, branching roots, stem, internode, leaf sheath, leaf tip



A special kind of grass

They are called ‘seagrass’ because most have flat, ribbon-like, grassy leaves. But they are not a true grass. There are around 60 different species of seagrass world-wide, and some do not look like grass at all.

Seagrass range from the size of your fingernail to shoots as long as 7 metres. Leaves of different seagrass species can be shaped like a flattened ribbon, look like a fern, a clover, or even like spaghetti. No matter what the shape, seagrass leaves rely on light to convert carbon dioxide and water into oxygen and sugar (photosynthesis). The sugar and oxygen are then available for use by other living organisms, making seagrass an important link in the food web.

Can you identify the three seagrass species below from the following list?

HD (*Halophila decipiens*)

- oval shaped leaves
- fine hairs on leaf blade
- leaf edges jagged/saw-like
- able to live in low light

HO (*Halophila ovalis*)

- oval shaped leaves in pairs
- leaf edges & blade smooth
- can live on intertidal mud flats

HS (*Halophila spinulosa*)

- oblong leaves arranged like a fern
- leaf edges jagged/saw-like
- able to live in low light

CS (*Cymodocea serrulata*)

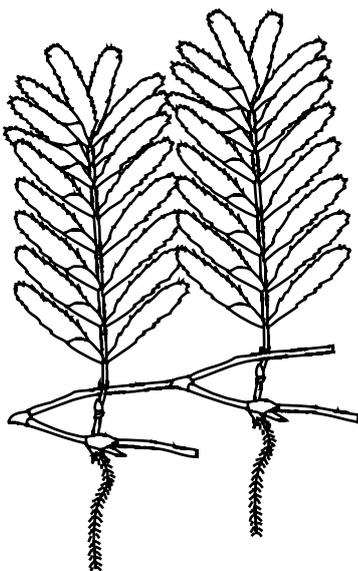
- wide strap-like leaves
- leaf tip rounded with jagged edge
- plants live in shallow water, not exposed at low tide

HU (*Halodule uninervis*)

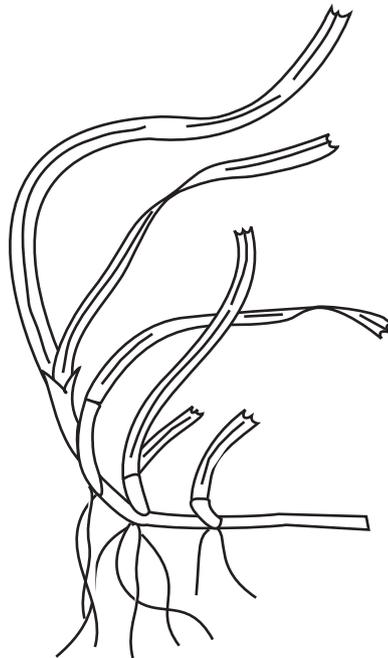
- strap-like leaves
- leaf tip has three points
- prominent single vein along middle of leaf

SI (*Syringodium isoetifolium*)

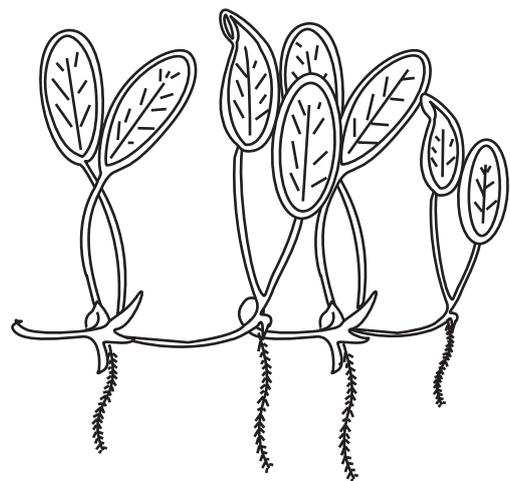
- leaves spaghetti shaped
- leaf tip with single point
- plants live in shallow water, not exposed at low tide



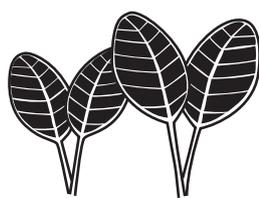
Species A:



Species B:

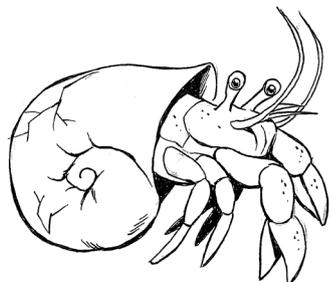


Species C:

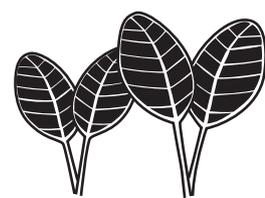
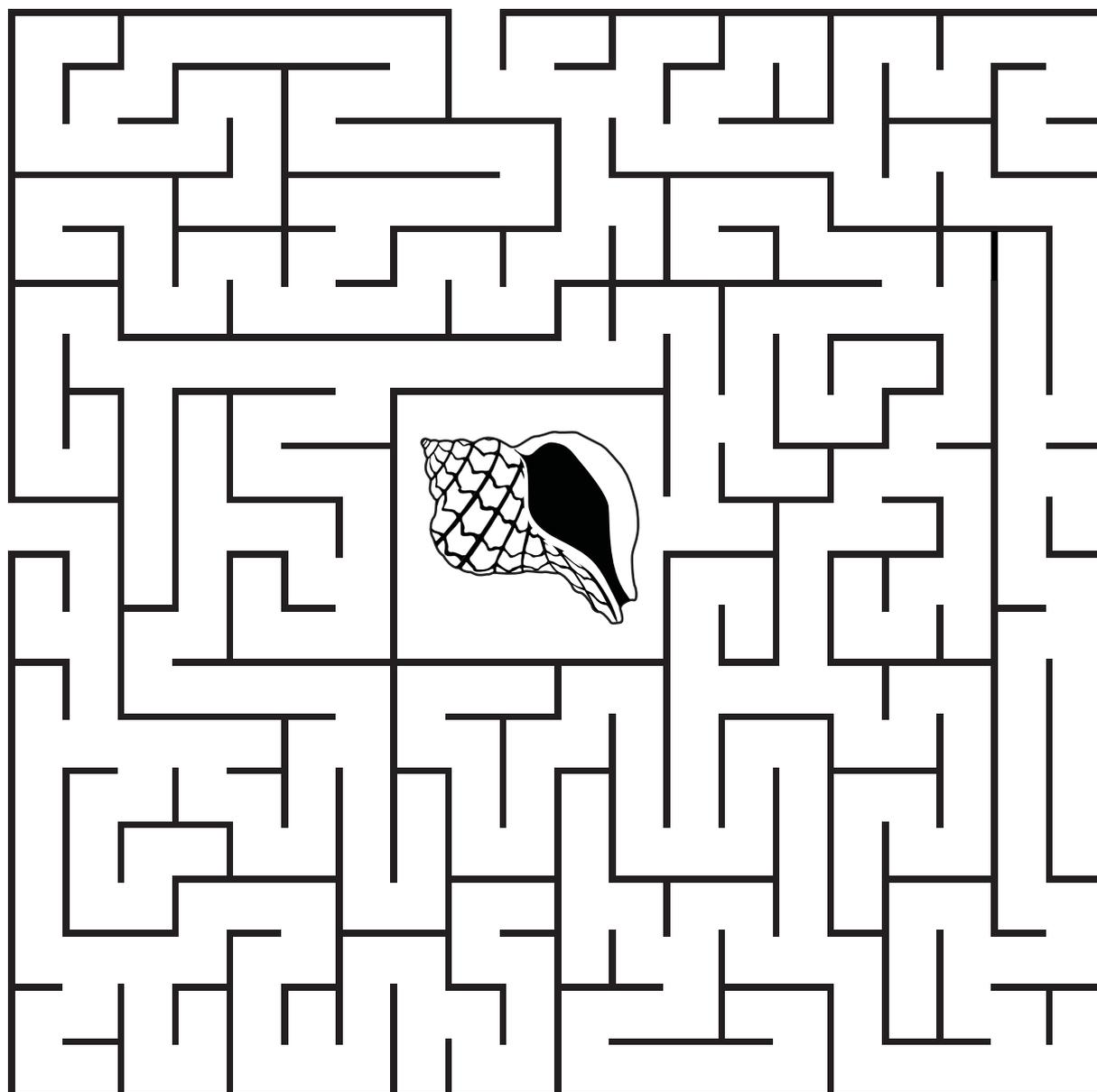


Food and shelter

Seagrass is important because it is food and provides shelter for marine life. Within seagrass meadows, you can find animals such as prawns, crabs, starfish, marine slugs and seahorses. Hermit crabs are also common in seagrass meadows.



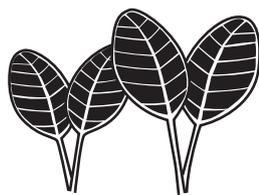
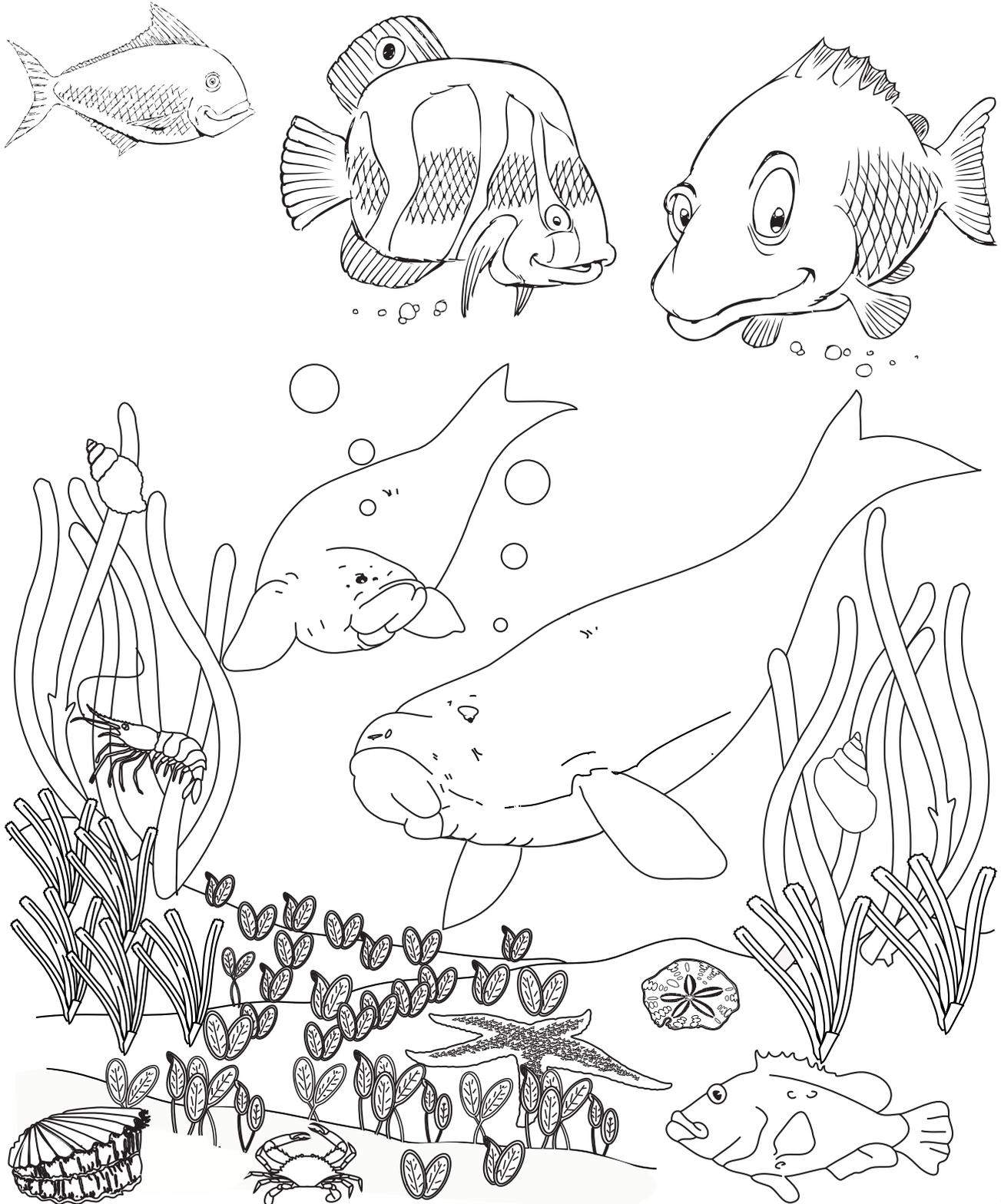
Help the Hermit Crab find a new home



Biodiversity

Seagrass meadows are very biodiverse. That means they include lots of different life forms (species). Seagrass meadows also have lots of animals living within them. About 40 times more animals occur in seagrass meadows than on bare sand.

How many different animal and plant species can you count in the picture below?



Fisheries

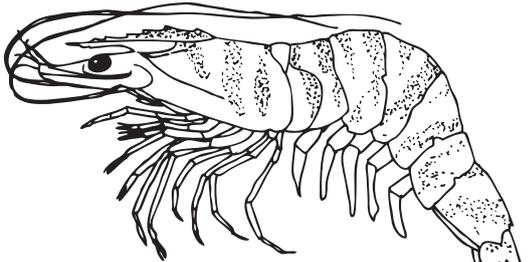
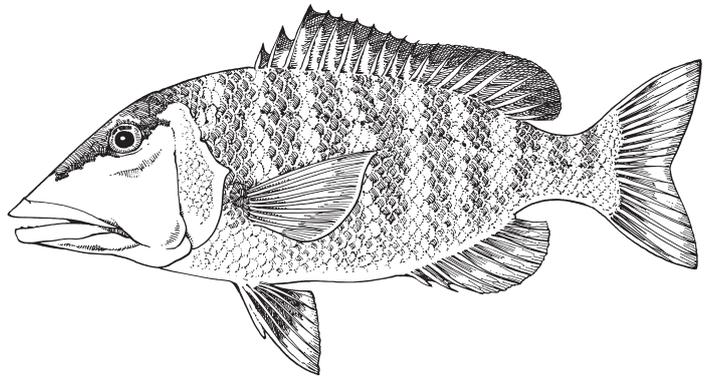
One of the important roles of seagrass is providing a nursery and shelter area for fish and prawns which are valuable to recreational, commercial and indigenous fisheries. Juveniles of some important species which depend on seagrass meadows include fish such as perch, mullet, whiting, tailor, luderick, bream, flathead, snappers, emperors and sweetlips. Tiger prawns, king prawns and tropical rock lobsters also live in seagrass meadows as juveniles. Shellfish such as some oysters and pearl shell may be more likely to settle and survive where there is seagrass.

What do all these animals have in common besides being valuable to fisheries?.....

.....

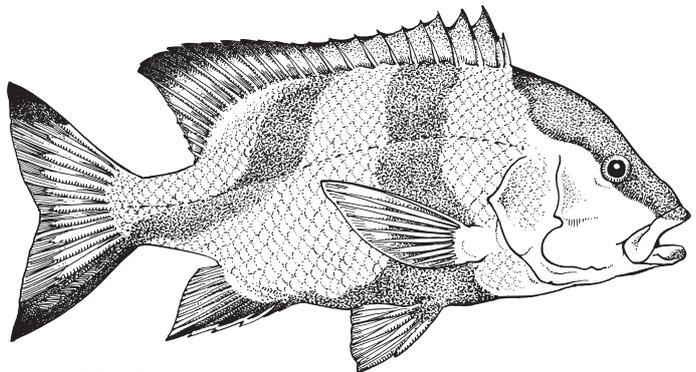
Red throat emperor / sweetlip

- adults live on coral reefs and lagoon areas
- are bottom feeders, mainly eating crabs, sea urchins, sand dollars and fish
- juveniles live in shallow water seagrass meadows, moving offshore as they grow
- change from female to male as they grow



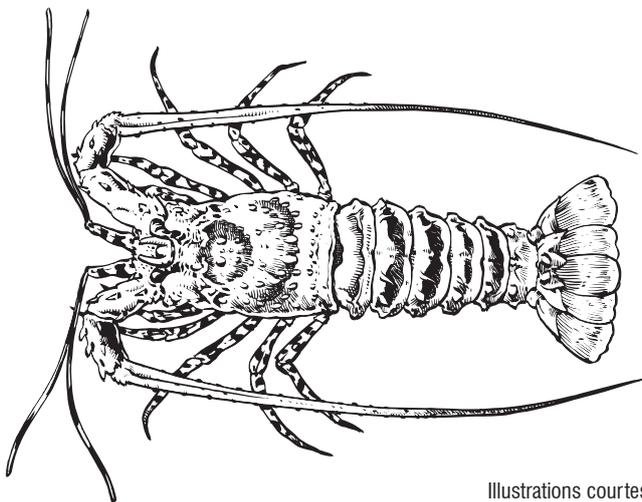
Tiger prawn

- adults live and spawn offshore on muddy or sandy bottoms
- mainly feed at night on molluscs, crustaceans and polychaete worms
- young prawns settle into and live in seagrass meadows
- estuarine fish are major predators of juveniles prawns



Red emperor

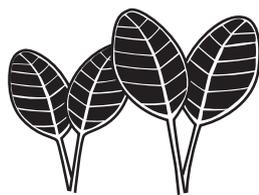
- are part of the family of tropical snappers and sea perches
- adults live on coral reefs and sand flats.
- juveniles live in nearshore mangrove and seagrass habitats
- are predators which mainly feed at night



Ornate tropical rock lobster

- adults live on coral or rocky reefs
- in spring mature adults congregate and migrate to deepwater spawning grounds
- adults spawn in summer
- in winter the postlarvae settle into seagrass meadows
- juveniles shelter and feed in seagrass meadows

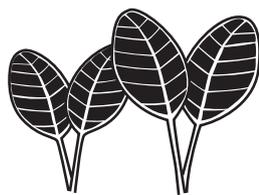
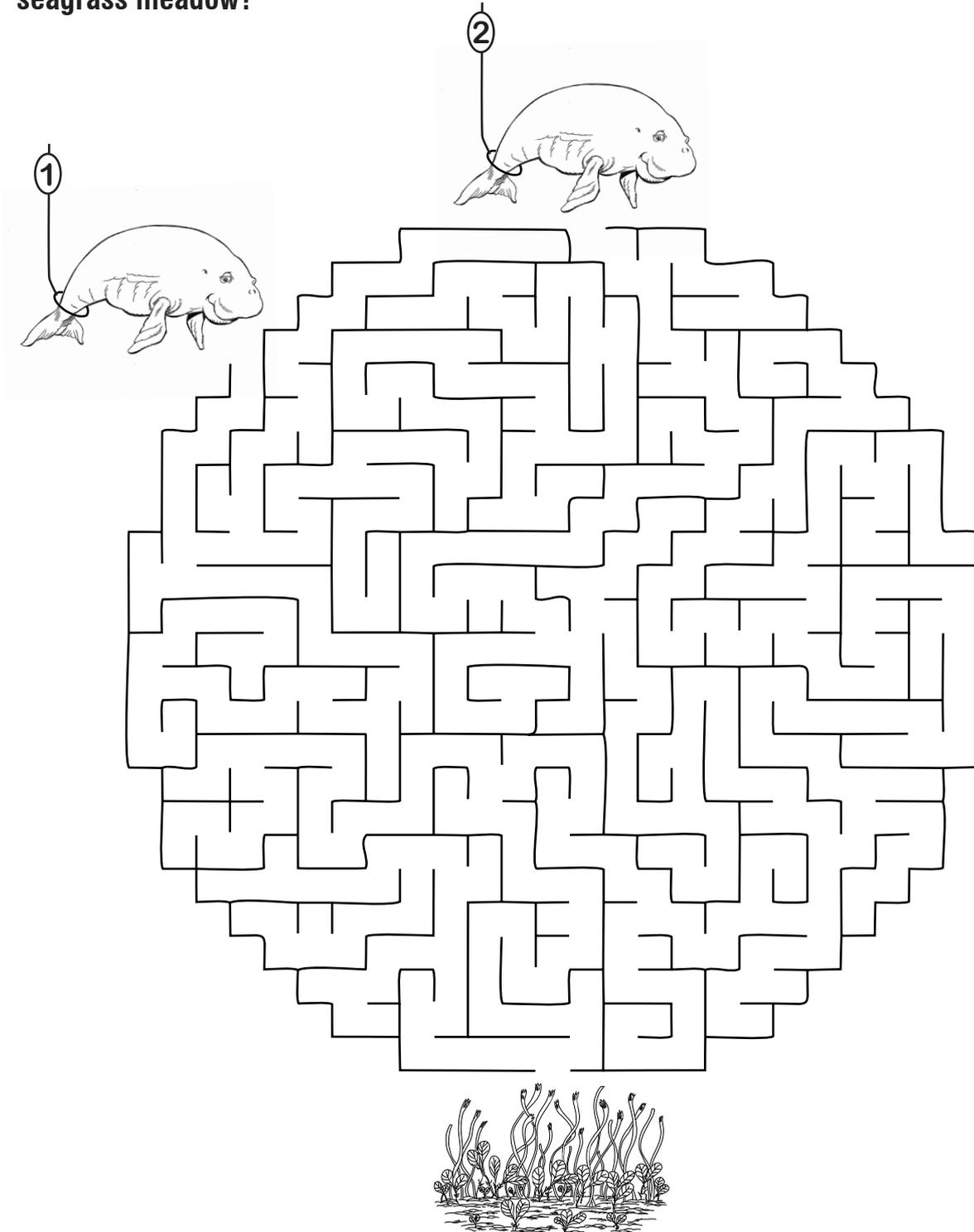
Illustrations courtesy Paul Lennon



Dugongs

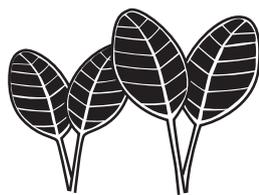
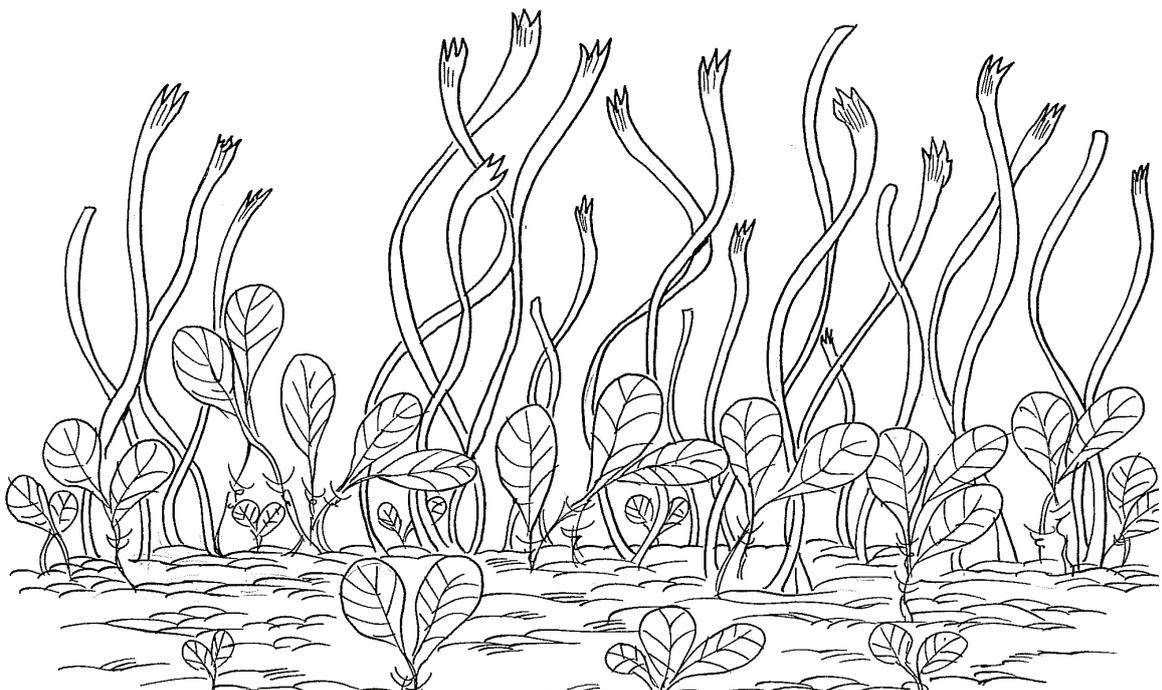
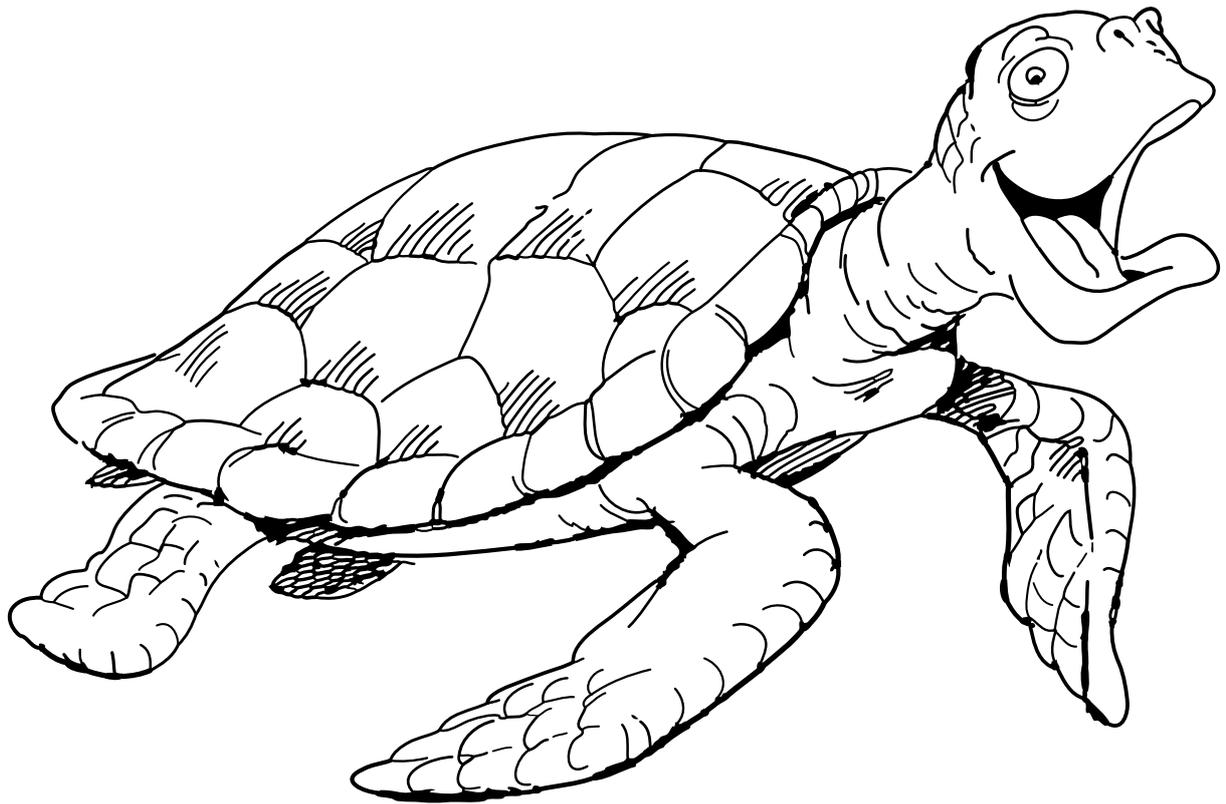
The dugong is a marine mammal which eats seagrass. Dugong can eat up to 40 kilograms of seagrass per day. When a dugong eats, it digs its snout into the sea-bed to uproot the seagrass, leaving a trail in the meadow where they have fed. Dugong can travel for great distances searching for food. They have a good memory and satellite tracking has shown that they can return hundreds of kilometres to a specific place.

Two dugong have been tagged with satellite transmitters, which one will reach the seagrass meadow?



Sea Turtles

Green sea turtles are marine reptiles that mainly feed on seagrass. They eat (crop) the leaves of the strap-like seagrass species. An adult green turtle eats about two kilograms of seagrass a day.



Word-Find

Find the hidden words in the puzzle below. From the unused letters in the puzzle, reveal the name of the *areas of the sea bottom on which marine flowering plants are present*.

Compass

Crab

Dredging

Dugong

Fishery

Habitat

Halodule

Halophila

Intertidal

Nursery

Quadrat

Subtidal

Transect

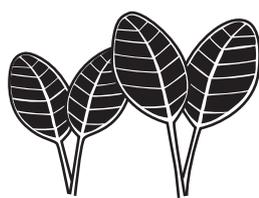
Turtle

Volunteer

Water Quality

Zostera

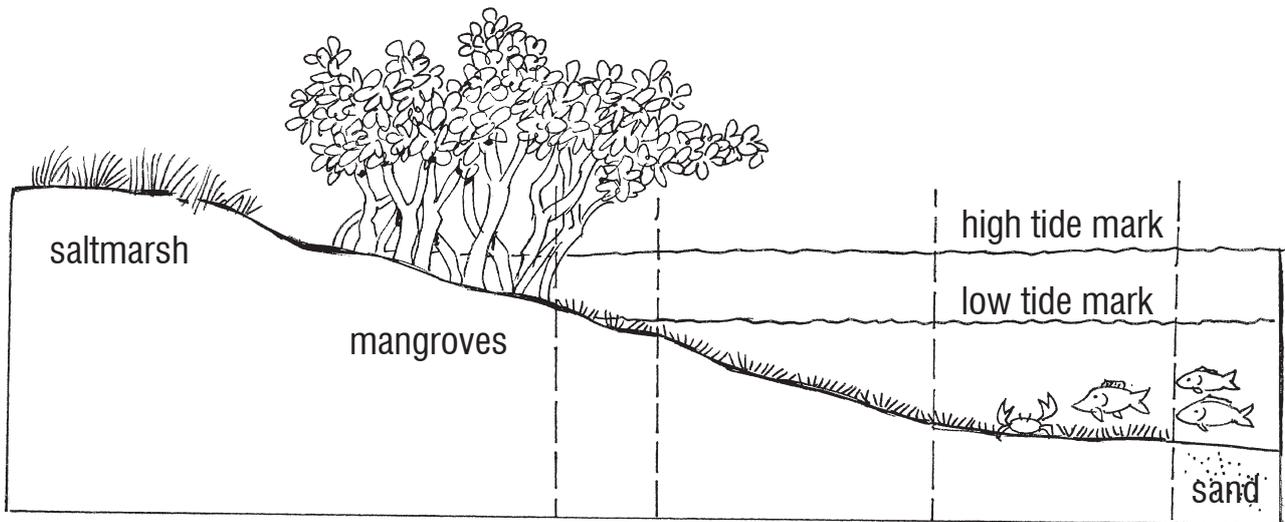
W T U R T L E H T D S E
A Y A G R I A A R R S H
T R S S Y N S L A E A A
E E H U R T S O N D R L
R S A B E E A P S G E O
Q R B T H R P H E I T D
U U I I S T M I C N S U
A N T D I I O L T G O L
L B A A F D C A M E Z E
I A T L A A D U G O N G
T R D V O L U N T E E R
Y C Q U A D R A T O W S



Seagrass Habitats

Seagrasses need plenty of sun and clean water to grow. Seagrasses also live in locations sheltered from wave action. Species of seagrass are adapted to live in a variety of coastal marine habitats. Seagrasses are usually found growing in mud or sand, in subtidal areas (areas that are covered with salt water all the time). Subtidal areas can include very deep water (more than 15m depth). Some seagrass species can also be found in the intertidal region (covered by water during high tide and uncovered during low tide).

Place the letter of each of the six seagrass species below in the correct box where you generally find that species. Hint: information on some species can be found on page 3.



Intertidal		Shallow subtidal		Deep-water (>15m)	
<input type="text"/>					

a.



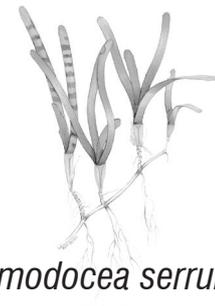
Halophila spinulosa

b.



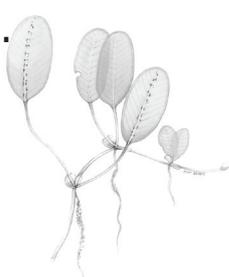
Halophila decipiens

c.



Cymodocea serrulata

d.



Halophila ovalis

e.

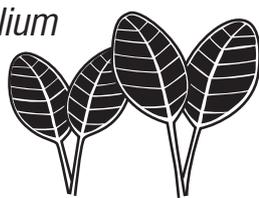


Zostera muelleri

f.

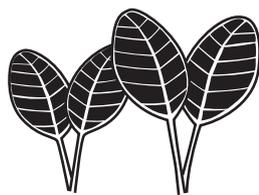
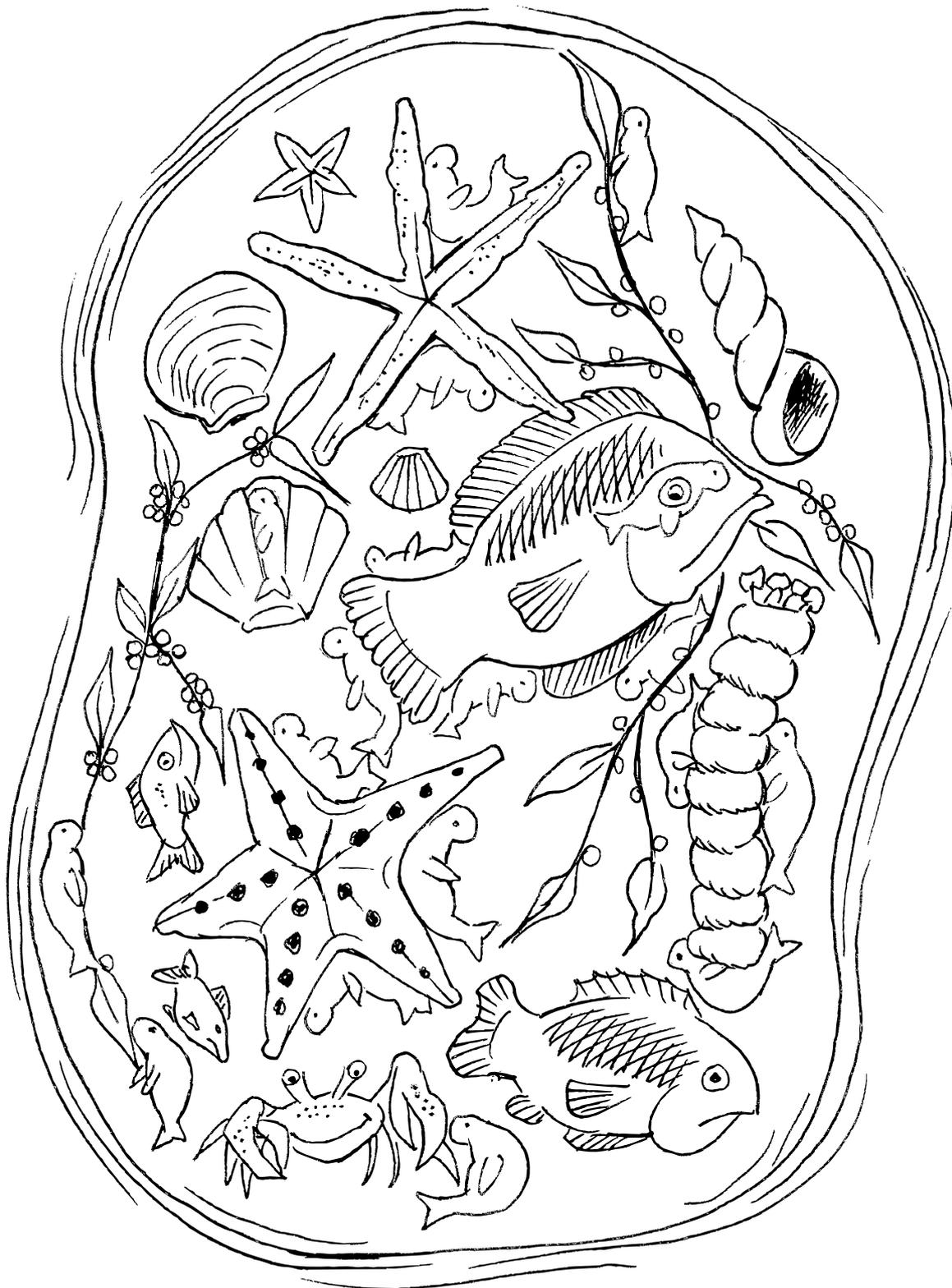


Syringodium isoetifolium



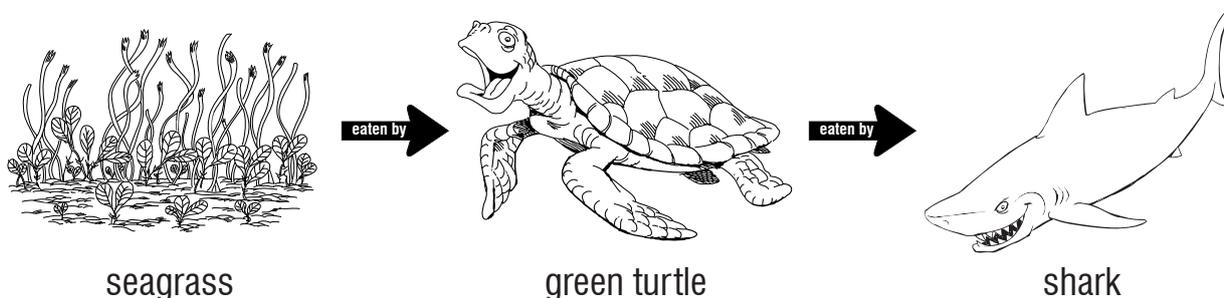
Seagrass Tidal Search

To live in intertidal regions (uncovered during low tide), seagrass must put up with getting too dry, too hot and too much sunlight. When the tide goes out, little pools of water are often left behind. Sometimes, small plants and animals get left behind too. Occasionally animals like dugongs can be stranded when the tide drops quickly. How many dugongs can you find hidden in this picture?



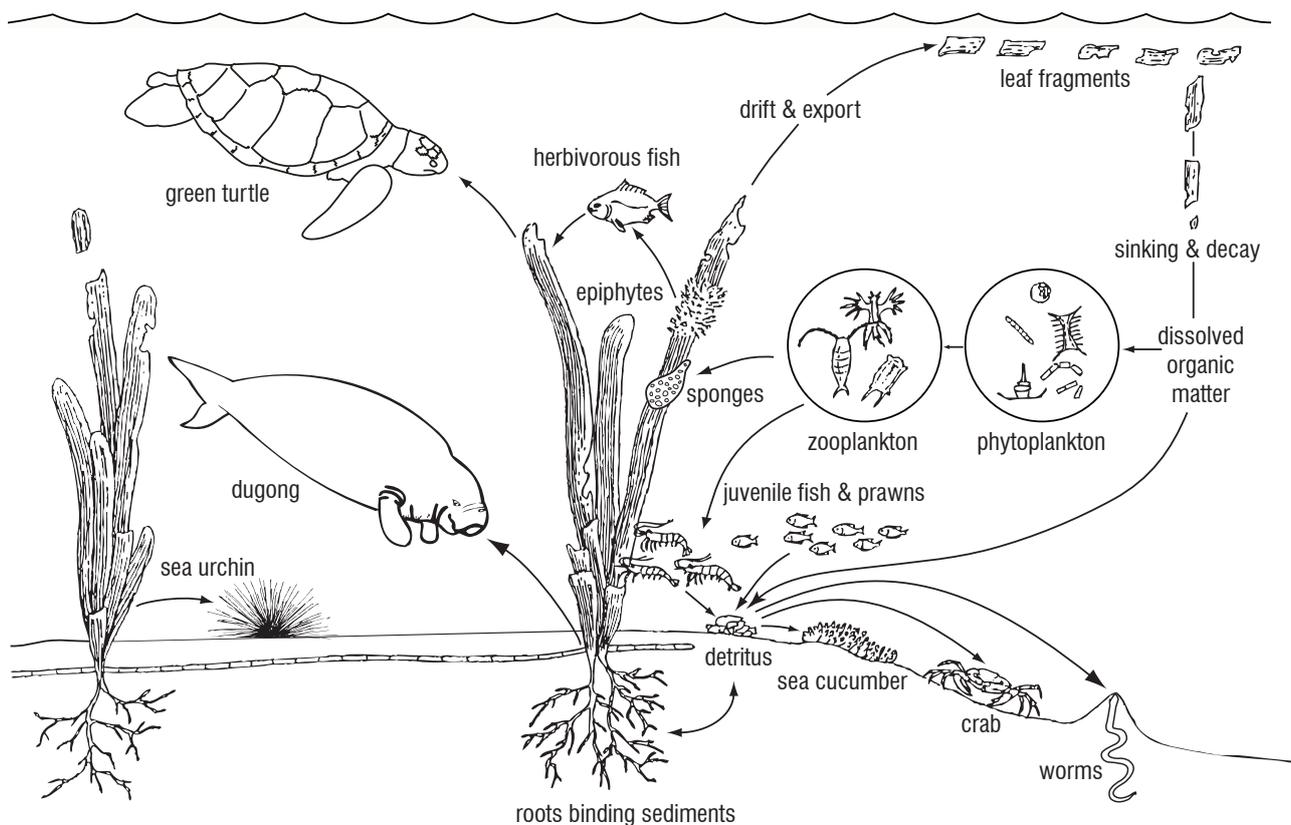
Seagrass Food Webs

In a seagrass meadow as elsewhere, all the living things are connected to each other. Lets look at an example. In a reef lagoon green turtles eat seagrass, and sharks eat the green turtles. This is called a food chain.

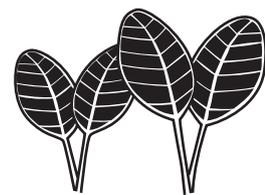


Energy

Energy in a food chain moves from the plant to the first animal, and on to the second animal. At each stage energy is used by many things. Seagrass uses some of it's energy to flower and make seeds. The dugong uses energy to breed and move about.



Food chains tell us about one feeding relationship. In a place like a seagrass meadow there are many different feeding relationships which are connected together to form a food web. Food webs are not fixed because feeding relationships can change. In the food web above many of the plants and animals depend on each other.



Seagrass Food Webs

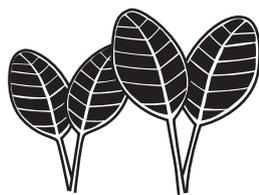
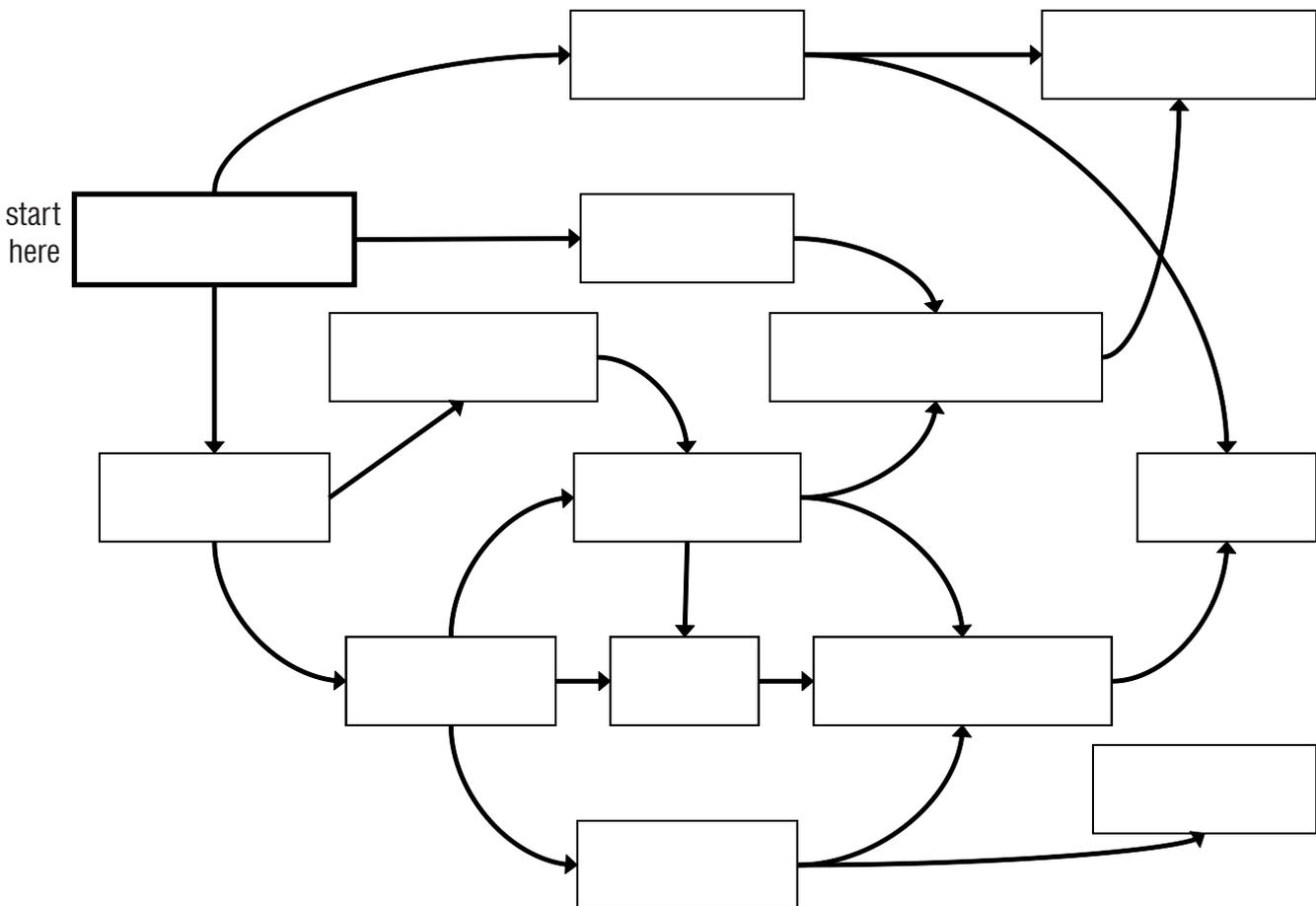
Can you construct a food web? Use the structure below and write the name of each plant or animal group in its correct location in the food web.

Facts to help you:

- arrows show the movement of energy
- food chains start with a plant
- giant perch are large predators that are found in tidal waters where they feed on prawns and surface fish such as garfish
- dugong are marine mammals that graze on seagrass
- garfish eat plants
- molluscs and worms eat seagrass detritus
- whiting are a fish that forage for burrowing benthic animals such as worms
- sea birds such as pelicans prey on whiting
- sharks prey on large fish, such as sea perch, and marine mammals
- crocodiles prey on large fish, such as giant perch, and marine mammals
- prawns feed primarily at night, on benthic animals such as molluscs and polychaete worms
- crabs are scavengers, eating worms and prawns
- detritus includes the organic material from decomposing plants
- sea perch consume mainly crabs, followed by prawns and benthic fish

Tick off the groups when you have used them:

- | | |
|--------------------------------------|------------------------------------|
| <input type="checkbox"/> crab | <input type="checkbox"/> pelican |
| <input type="checkbox"/> crocodile | <input type="checkbox"/> prawns |
| <input type="checkbox"/> detritus | <input type="checkbox"/> sea perch |
| <input type="checkbox"/> dugong | <input type="checkbox"/> seagrass |
| <input type="checkbox"/> garfish | <input type="checkbox"/> shark |
| <input type="checkbox"/> giant perch | <input type="checkbox"/> whiting |
| <input type="checkbox"/> molluscs | <input type="checkbox"/> worms |



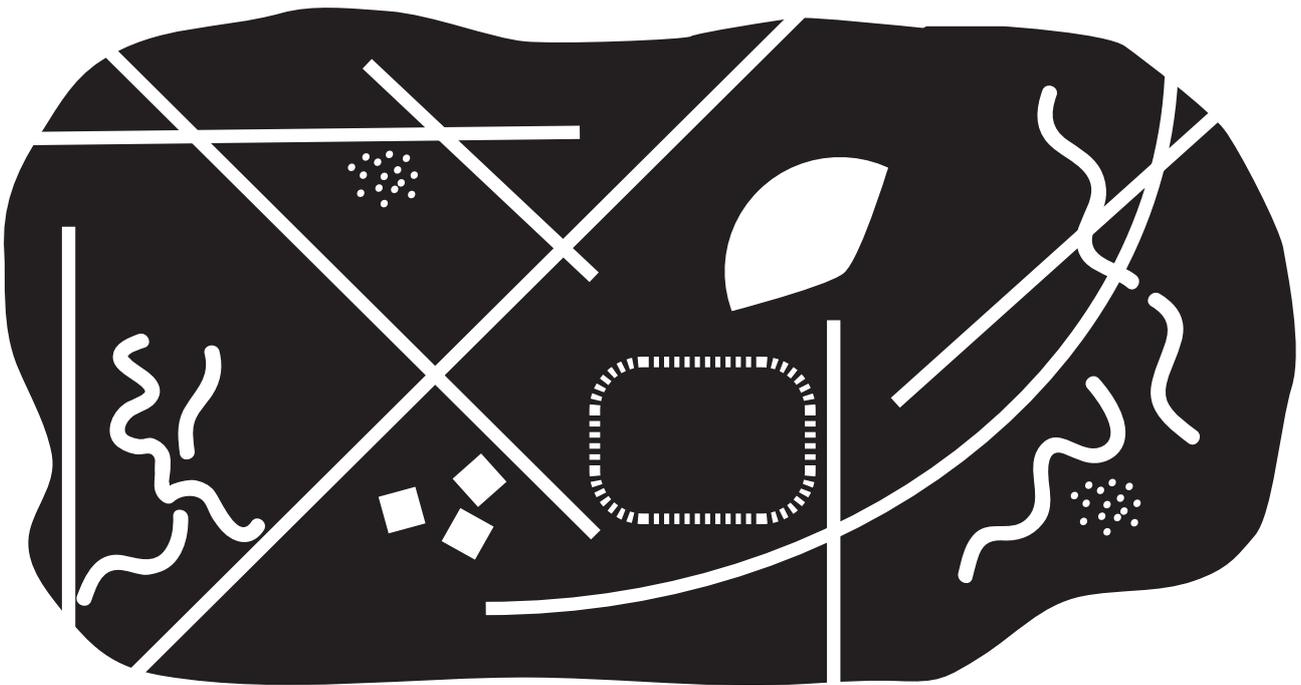
Damaging seagrass

Seagrass meadows are fragile ecosystems. Worldwide there is concern that seagrass meadows are being lost due to the activities of people. People can damage or destroy seagrass by pollution (sewage, oil spills and coastal runoff) and physical destruction (dredging, boat propellers and anchors/moorings).

Physical damage can cause scars within a seagrass meadow. Damage can be both natural or by people. Below is a birds eye view of an intertidal seagrass meadow. Can you identify what caused the damage (scars) to the meadow?

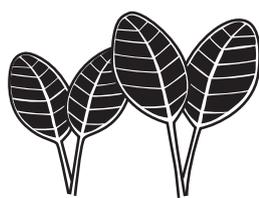
How many scars have been caused by:

- dugongs feeding
- shorebirds feeding
- boat propellers
- boat anchors
- boats swinging on moorings
- digging for bait worms



Help stop the damage

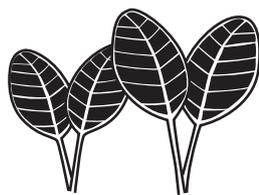
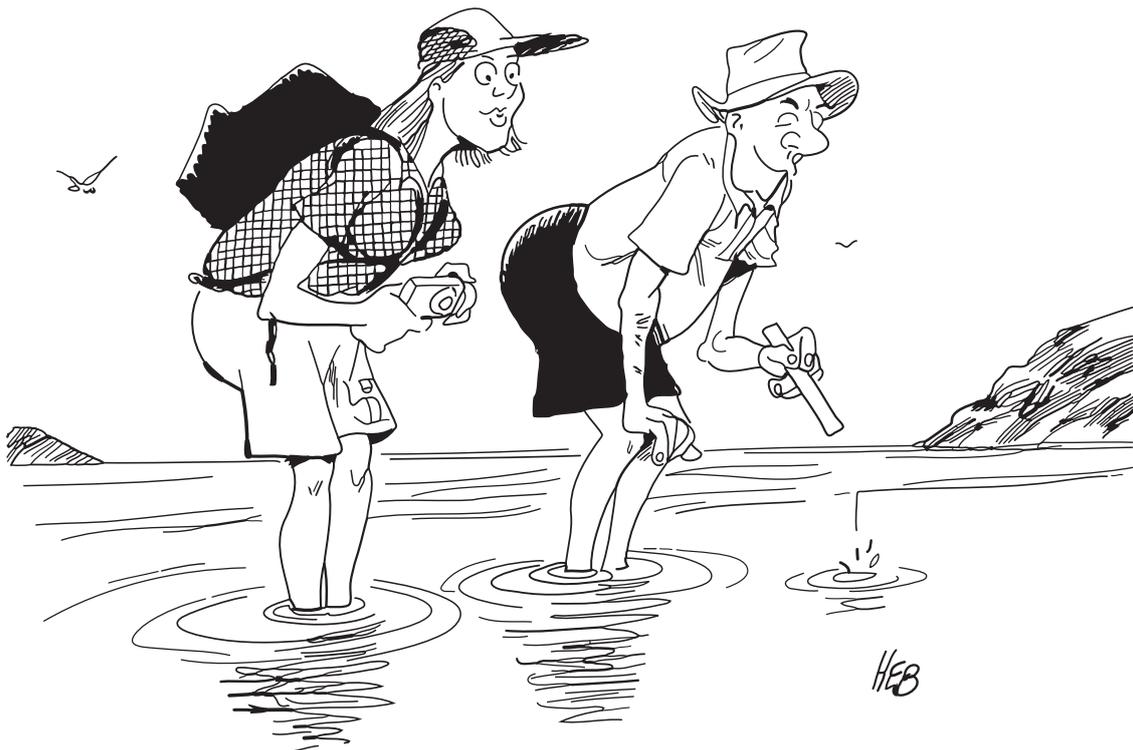
There are many ways you can help stop damage to seagrass meadows: don't litter; be aware when applying fertilizers and pesticides, as excess amounts can wash down gutters and drains to the sea; when boating, slow down and avoid shallow areas; support marine conservation program; learn about these special marine habitats and volunteer to monitor their health by joining Seagrass-Watch.



Seagrass Monitoring: Spot the difference

We can see if seagrass meadows are healthy by watching them over time – this is called monitoring. Seagrass-Watch is a global seagrass observing network which monitors seagrass health and makes us aware of any damage or loss.

How observant are you? Can you spot the ten things different between the two pictures below?



Seagrass Monitoring

One way we can monitor seagrass is to measure the amount or cover of seagrass within a square frame (quadrat) and compare this over time. In each of the quadrats below, measure the percentage of each seagrass species (*Halophila* and *Zostera*) and add them together to make up the total cover. Each grid is equal to 1%.

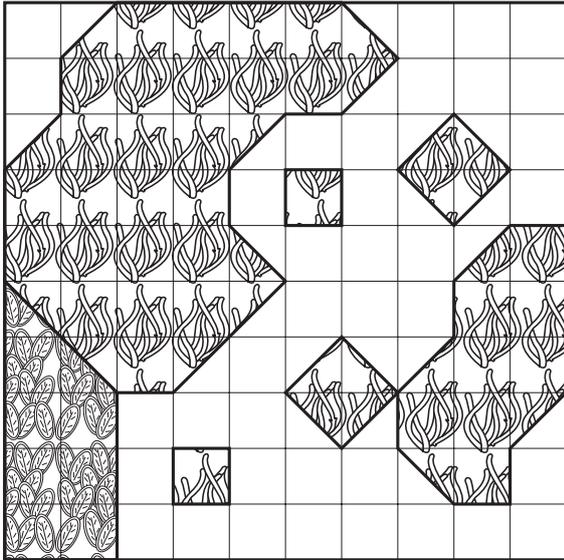
Legend



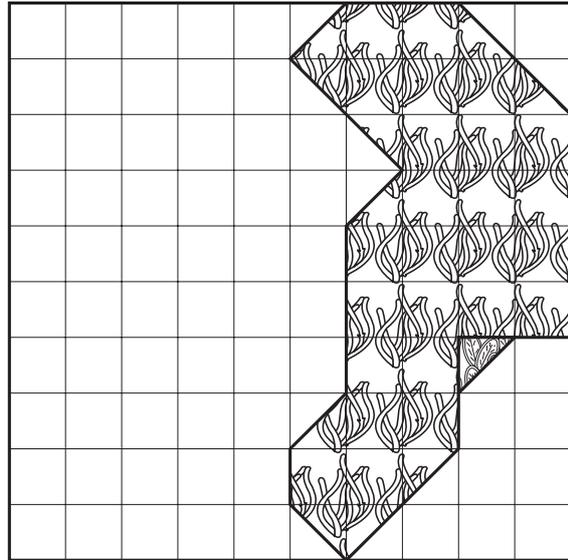
Halophila



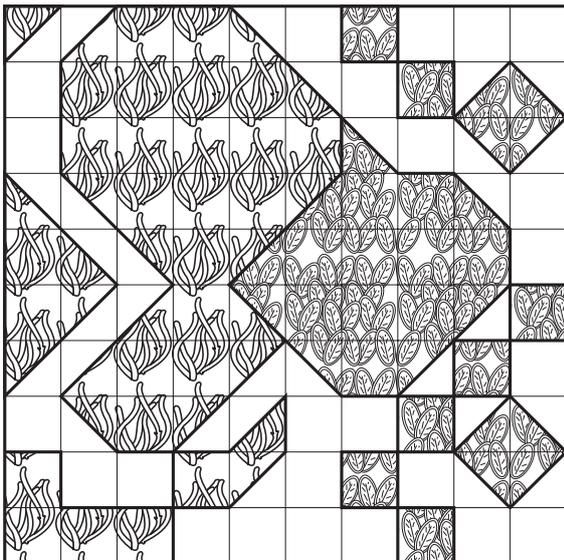
Zostera



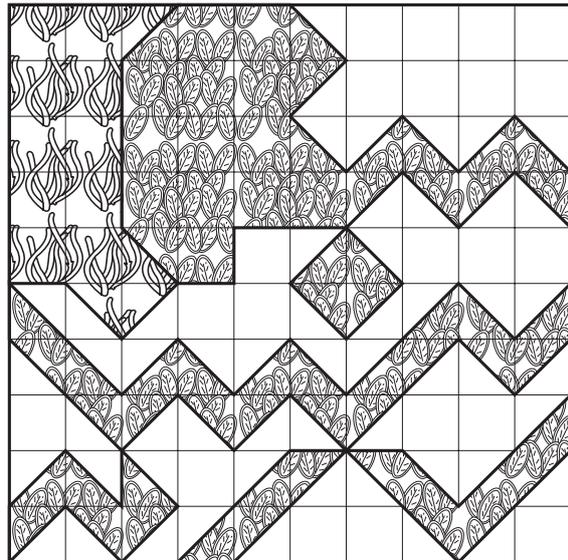
Q1. % *Halophila* = _____
 % *Zostera* = _____
 TOTAL COVER = _____



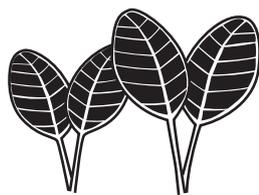
Q2. % *Halophila* = _____
 % *Zostera* = _____
 TOTAL COVER = _____



Q3. % *Halophila* = _____
 % *Zostera* = _____
 TOTAL COVER = _____



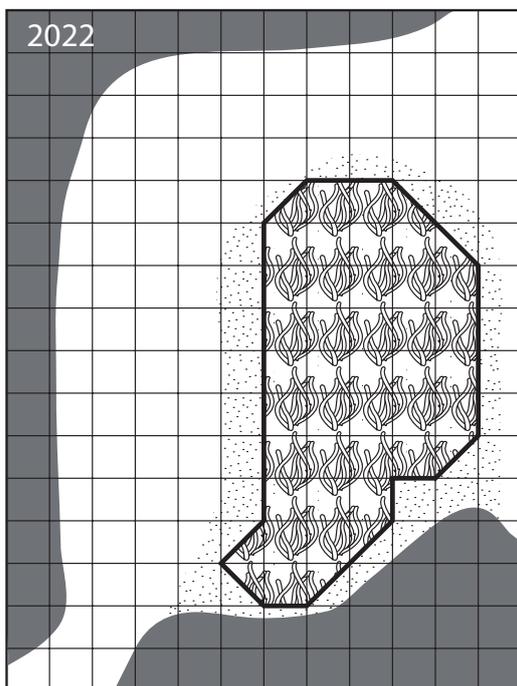
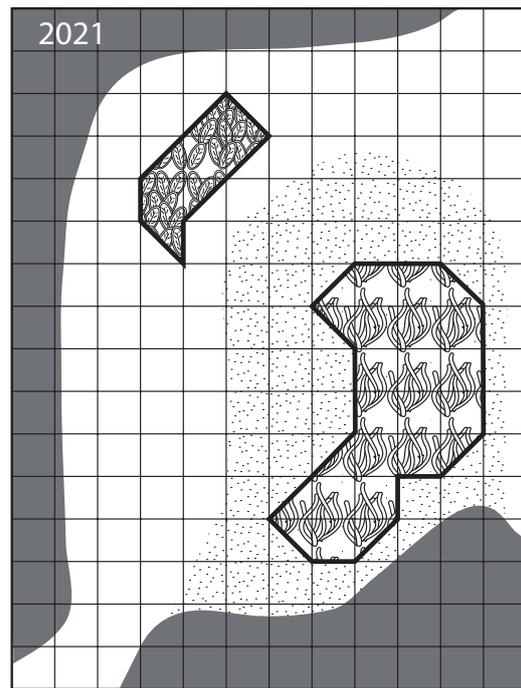
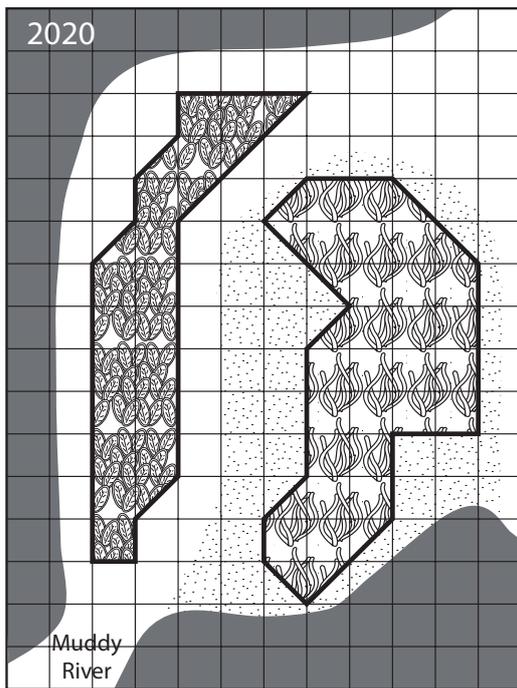
Q4. % *Halophila* = _____
 % *Zostera* = _____
 TOTAL COVER = _____



Seagrass Mapping

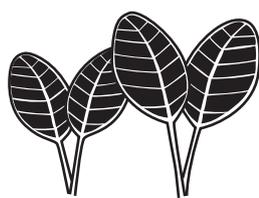
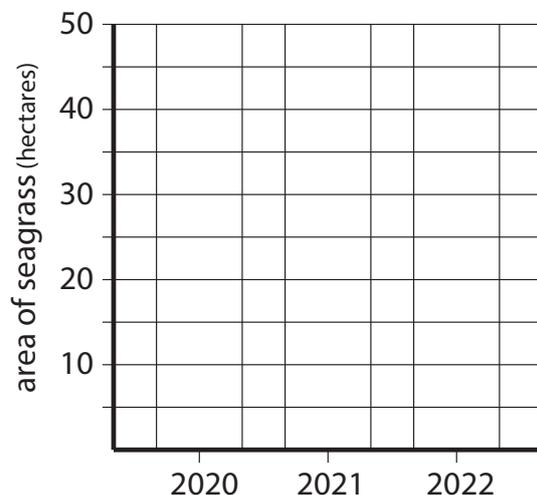
Seagrasses can form extensive meadows, similar to grasslands. These meadows occur along our coastlines, particularly in sheltered, shallow waters of estuaries, bays and lagoons, as well as on reef tops and on the sheltered sides of many off- shore islands. One way to monitor seagrass meadows is to map them over time.

From the three maps below, calculate the area of each seagrass meadow for each year and plot the results in a stacked bar graph below. Each grid equals 1 hectare. Why do you think meadows would change between years?



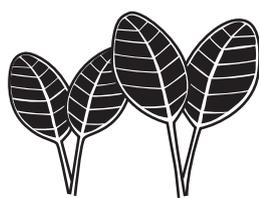
Legend

-  *Halophila* meadow
-  *Zostera* meadow
-  mudbank
-  land

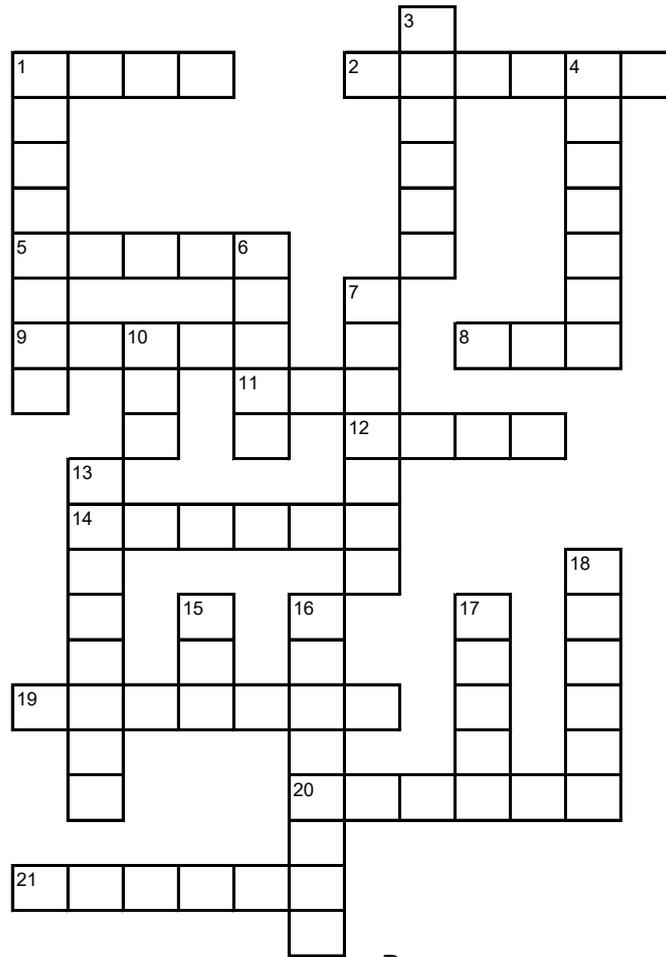


Word Scramble

1. ANDS _ _ _ _
2. PHAILOHAL _ _ _ _ _ _ _ _
3. ITMORNO _ _ _ _ _ _
4. MSACOCP _ _ _ _ _ _
5. EMALPS _ _ _ _ _
6. TEUVELONR _ _ _ _ _ _ _ _
7. CBRA _ _ _ _
8. HLULODAE _ _ _ _ _ _ _
9. ZRTAEOS _ _ _ _ _ _
10. DOOF _ _ _ _
11. DRSGNIMIOYU _ _ _ _ _ _ _ _ _
12. DTAARQU _ _ _ _ _ _
13. TADAEHTSE _ _ _ _ _ _ _ _
14. TECNASRT _ _ _ _ _ _
15. TULRET _ _ _ _ _
16. IBTATAH _ _ _ _ _ _
17. AOESSHER _ _ _ _ _ _
18. HPATES _ _ _ _ _ _
19. OGGUND _ _ _ _ _
20. MYEOCCAD _ _ _ _ _ _
21. SGRASSAE _ _ _ _ _ _
22. RANPW _ _ _ _



Crossword 1

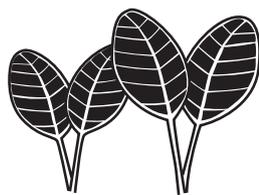


Across

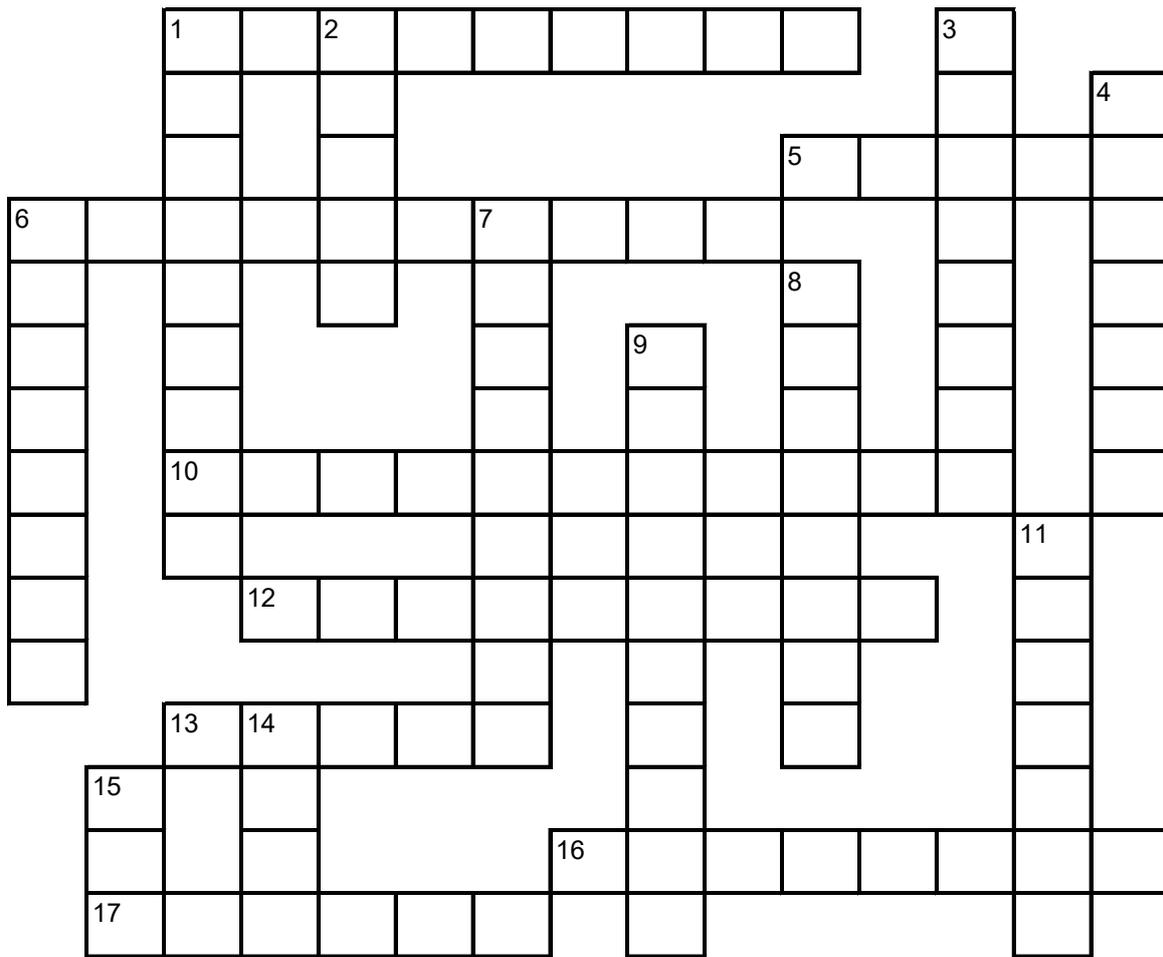
1. Sampling intertidal seagrass meadows is best done at low _____
2. This marine mammal eats seagrass
5. Seagrass fruits contain _____
8. A set of information used to identify seagrass (or a device to lock a door)
9. The hollow tube used to collect seagrass seeds is a _____
11. Global Positioning System (initials)
12. A transect is set up using a 50m _____ measure
14. Device that holds a boat in place at sea
19. A square frame that the seagrass percent covers are estimated within
20. You use them to measure canopy height
21. Image taken as a permanent record of percent covers within a quadrat.

Down

1. Quadrats are placed along a 50m _____
3. This marine reptile eats seagrass
4. Seagrass meadows act as _____ areas for baby prawns and fish
6. During a cyclone, be prepared for a tidal _____
7. Seagrass species with many cross veins and rounded leaf tip (ZC)
10. Fish eggs
13. Seagrass with 3 pointed leaf tip
15. A group of whales
16. A marine flowering plant
17. Used for sifting sediment to find seeds
18. A crustacean that uses seagrass meadows as a nursery area



Crossword 2



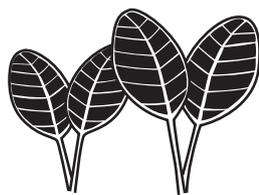
Across

1. Species of *Cymodocea* with a distinctly jagged leaf tip
5. number of points on the leaf tip of *Halodule uninervis*
6. Repeated observation of a site to detect change
10. Genus of seagrass whos leaves are round in cross-section (spaghetti like)
12. A paper form used to record field data in a set format
13. Self-Contained Underwater Breathing Apparatus
16. Beneath the low watermark
17. Structure which encloses the growing end of a stem and protects young leaves

Down

1. Species of *Halophila* which has a lateral shoot bearing 10-20 pairs of opposite leaflets (fern-like)
2. Seagrass structures used to anchor the plant and absorb nutrients
3. Growing tip of a seagrass
4. Stalk of *Halophila ovalis* leaves
6. Open expanses of intertidal mud
7. Species of *Cymodocea* with rounded leaf tip
8. Soil/matter that settles to the bottom of a water body
9. Single leaf structure arising immediately from the horizontal rhizome unique to the genus *Zostera*
11. A fixed unit, usually square, used for sampling
14. A cylindrical sample of benthos and substratum obtained by the use of a hollow tube
15. Satellite-based navigation system

Hint: you can find information on seagrass identification by visiting www.seagrasswatch.org



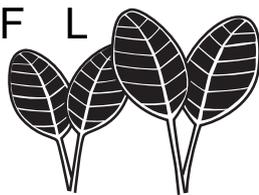
Local Eyes: Global Wise

Seagrass-Watch is a global scientific seagrass assessment and monitoring program.

Which of the following Seagrass-Watch regions or countries is missing?

Australia	Gladstone	Madang	Philippines
Bali	Gold Coast	Malaysia	Pohnpei
Bangladesh	Great Sandy Strait	Manado	Rotuma
Bowen	Hervey Bay	Micronesia	Sabah
Broome	India	Mission Beach	Shoalwater Bay
Cairns	Indonesia	Moreton bay	Singapore
China	Japan	Mornington Island	Solomon Islands
Cooktown	Karimunjawa	Napranum	Thailand
Eritrea	Kavieng	New Caledonia	Torres Strait
Fiji	Komodo	Noosa	Townsville
Fitzroy	Kosrae	Ovalau	Viet Nam
Flores	Lau	Palau	Viti Levu
Gizo	Mackay	Papua New Guinea	Whitsundays

H Z K O S R A E N O T S D A L G O V G M
 T C B T J M T M A C K A Y O R Z T I F U
 J P A P U A N E W G U I N E A W N S I N
 D D N E Q D E H N E W C A L E D O N I A
 V N G Y B A P A L A U T B G I Z O R E R
 O A L S I N D O N E S I A A B A L I P P
 V L A I Y G O J P A I L A R T S U A N A
 A S D N A L S I N O M O L O S K B C H N
 L I E G B S U D S D N A L I A H T D O I
 A N S A R P Y A I S E N O R C I M N P H
 U O H P E S Y A P H I L I P P I N E S C
 V T R O T U M A D E V M L J X D D W U Y
 E G N R A S Z N B N U I J I F N O O S A
 L N A E W J A P A N U H E R V E Y B A Y
 I I E K L D E O J A O S S T E S Y F S F
 T N R O A M N A C Q R T T T N M N J E S
 I R T M O E W X E D G N E I V A K W R K
 V O I O H A I S Y A L A M R H Z M Z O Q
 B M R D S A B A H C O O K T O W N D L T
 K B E O D A N A M B S J G L A M X T F L



Solutions

Sensational Seagrass: 1=leaf tip; 2=oval leaf blade; 3=cross vein; 4=leaf sheath; 5=stem; 6=internode; 7=rhizome; 8=branching roots

A special kind of grass: species A = HS, species B = HU, species C = HO

Biodiversity: 15 (4 fish, 3 seagrass, 1 crab, 1 scallop, 2 snails, 1 prawn, 1 marine mammal, 1 starfish, 1 sand dollar)

Fisheries: adults live offshore, juveniles live in nearshore seagrass meadows

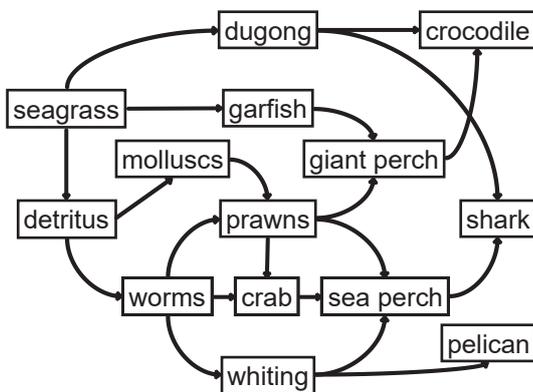
Dugong maze: tagged dugong number 2

Word find: seagrass meadows

Habitats: intertidal = d & e; shallow subtidal = c & f; deep-water = a & b

Tide Pool Search: 18

Food web:



Damaging scars:

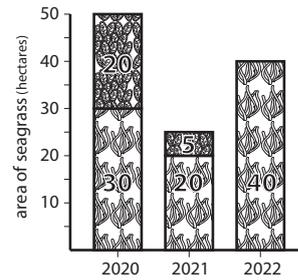
6 dugongs feeding trails (wavy lines); 2 bird feeding areas (groups of dots); 8 boat propellers (straight lines or arcs); 3 boat anchors (squares); 1 boat swinging on its mooring (semi-circle); 1 bait worm digging area (dashed rectangle).

Spot the difference: Flying bird missing, ruler shorter, mans tongue not poking out, less wrinkles on back of mans shirt, no hair on mans legs, no flash on camera, pocket missing from ladies shorts, pocket missing from backpack, ripple missing from around ladies legs, island in background smaller

Monitoring:

- Q1, *Halophila* = 8, *Zostera* = 45, TOTAL = 53
- Q2, *Halophila* = 0.5, *Zostera* = 30, TOTAL = 30.5
- Q3, *Halophila* = 25, *Zostera* = 36, TOTAL = 61
- Q4, *Halophila* = 40, *Zostera* = 12, TOTAL = 52

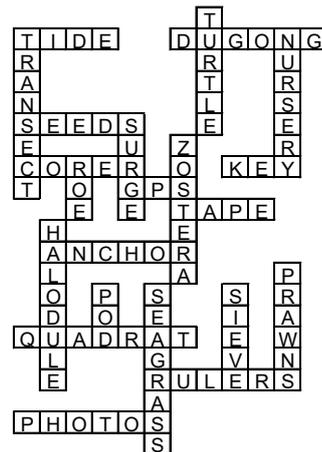
Mapping:



The change in meadows between years may be due to: runoff (poor water quality) from Muddy River. Increased turbidity could cause the loss of *Halophila* meadow and some of intertidal *Zostera* meadow (in 1999). Increased nutrients could aid expansion of intertidal *Zostera* in 2000.

Word scramble: 1. sand, 2. *Halophila*, 3. monitor, 4. compass, 5. sample, 6. volunteer, 7. crab, 8. *Halodule*, 9. *Zostera*, 10. food, 11. *Syringodium*, 12. quadrat, 13. datasheet, 14. transect, 15. turtle, 16. habitat, 17. seahorse, 18. gastropod, 19. dugong, 20. *Cymodocea*, 21. seagrass, 22. prawn

Crossword 1:



Crossword 2:

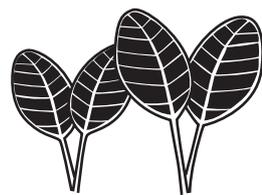


Local Eyes: Global Wise: missing region is Torres Strait

scan for more information



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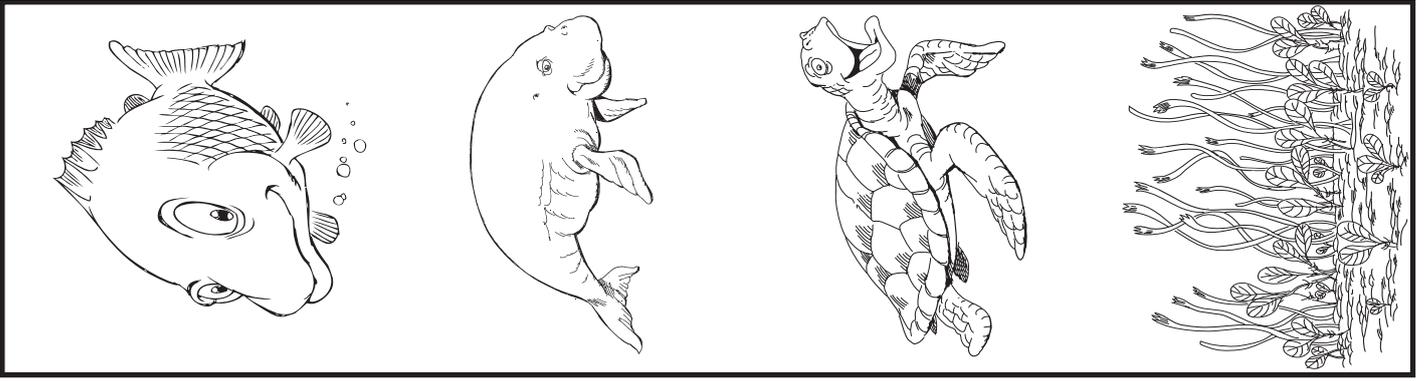
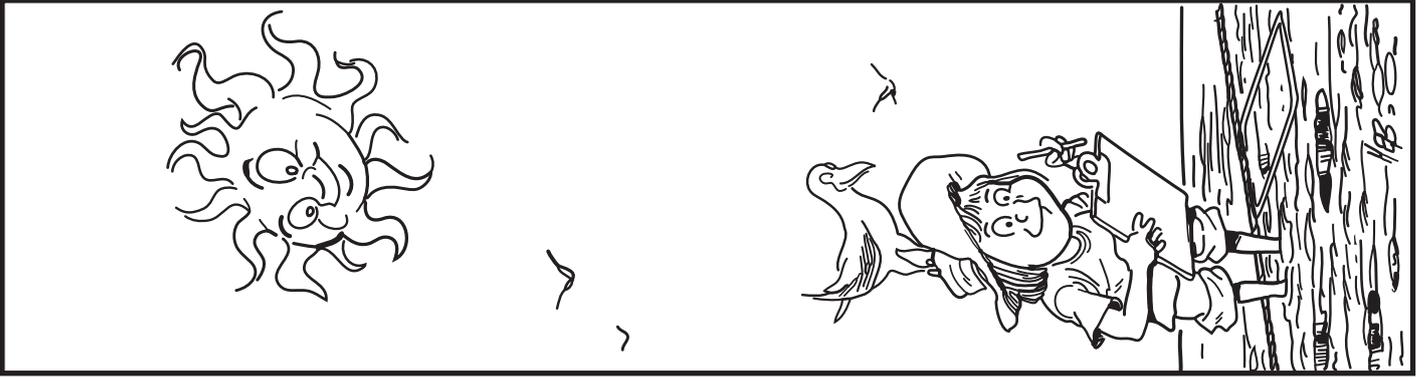
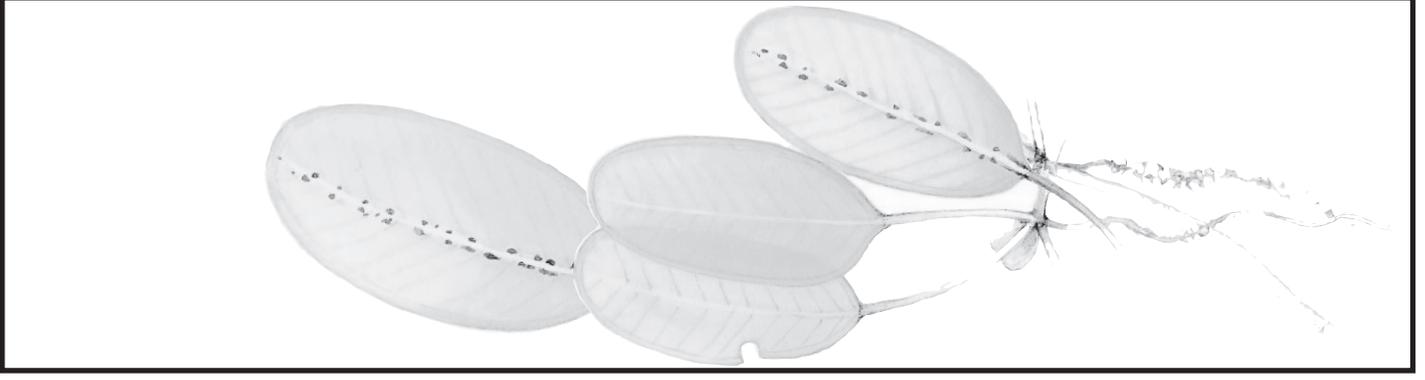
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