



*Scientific Notebook*

*This notebook belongs to:* \_\_\_\_\_

# Mission 1: Seagrass

## Activity 1: Background research

Date: \_\_\_\_\_

Welcome to Shark Bay team members! Seagrasses and the animals that rely on them are in trouble in most of the world. We need to answer some important questions. What makes Shark Bay such an amazing ecosystem? How do the species influence and rely on one another? If we learn this, then we can help protect seagrass ecosystems that are in trouble!

Its almost time to start studying the ecosystem. Seagrasses are the foundation of the Shark Bay ecosystem. Before we start, you need to do some background research on seagrasses. Background research is something that all scientists have to do!

Use the internet or other resources to answer the following questions in your notebook. Then, report back! This is your notebook so draw pictures or maps wherever you think they might help or look good!

**1. What are seagrasses? Are they really grasses?**

**2. How do seagrasses get their energy?**

**3. How do seagrasses spread and reproduce?**



**4. Where do seagrasses live? Draw a map of where they live. Why do they live there?**

**5. What eats seagrasses?**

**6. Why are seagrass beds important?**

**7. What are the threats to seagrass habitats and where are they threatened?**

**8. What do you want to learn about seagrass ecosystems?**

## Activity 2: Observing the ecosystem

Date: \_\_\_\_\_

Making observations is the first step in the scientific method. Before we can study Shark Bay we need to have a look around. You will get to watch the video the field team sent back twice. In the space below take notes on the light levels in each habitat and the amount and types of seagrass you see. Work with your team to draw pictures of the seagrass you see in each habitat!

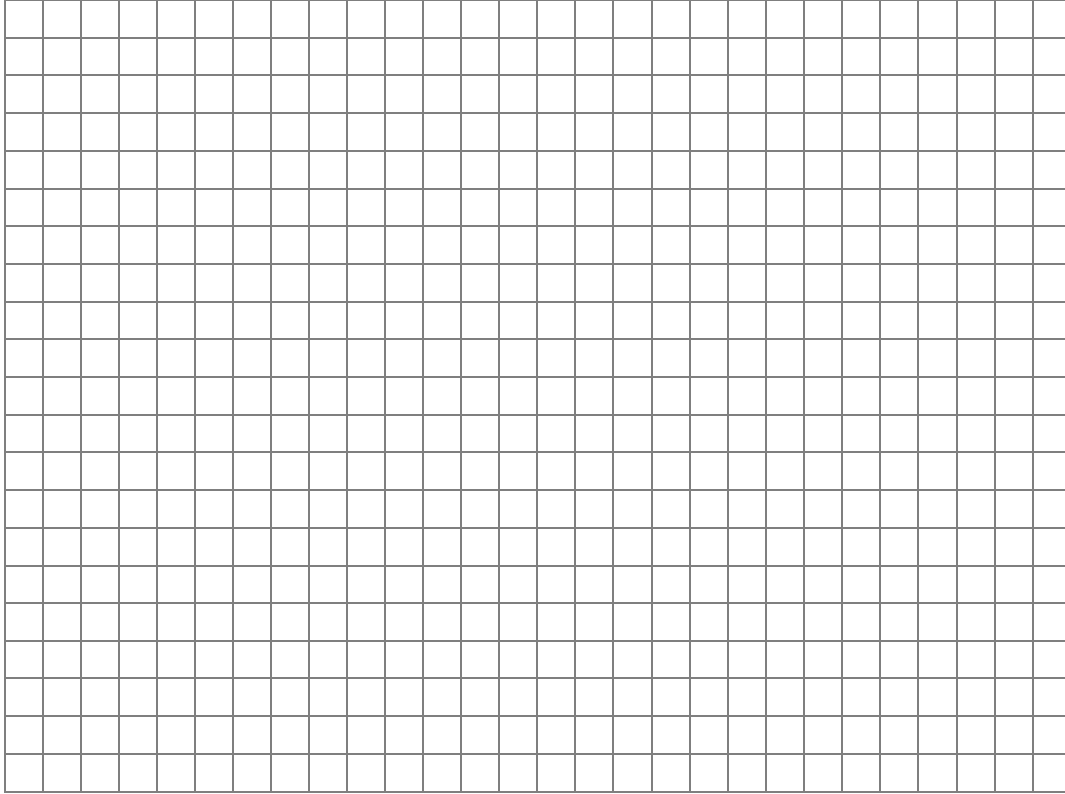
### Shallow Habitats:

### Edge Habitats:

### Deep Habitats:



Use the graph paper below to make a graph of the number of seagrass species that you found in each of the habitats. Be sure to give your graph a title and label the axes.



Use the graph paper below to make a graph of the number of animal species that you found in each of the habitats. Be sure to give your graph a title and label the axes.





Use your observations, tables and graphs to answer the following questions:

**1. Which habitat do you think has the most seagrass? Generate a hypothesis about where there is the most seagrass? Why do you think this is where there will be the most seagrass?**

**2. Were the same types of seagrass in each habitat? What were the differences in the seagrasses of shallow, edge, and deep habitats? Why do you think they differ in this way?**

**3. Where were most of the animals? Why do you think you saw this pattern?**

**4. How would you measure the differences in seagrass communities in the shallow edge and deep habitats?**

### Activity 3: Measuring seagrasses

Just having a look around isn't science! Making observations is just the first step. You need to test your hypotheses about where we should find the most seagrass. You have the information from the field – now its time get to work!

For each quadrat:

1. Identify all the seagrass species present. Write the names of these species on the lines below Table 2.
2. Count the number of boxes each species is found in. Record these numbers in Table 2 below.
3. Record the total number of boxes that have any seagrass in them.

*Example: The quadrat below has two species (A and B). A covers 5 boxes, B covers 2 boxes and the total cover is 6 boxes*

A		B
A	B A	A
		A

**Record the number of quadrats that each species is found in for each quadrat. In the column labeled "Any" record the total number of boxes with any species of seagrass. Once you have recorded your counts for the two quadrats in each habitat calculate the average number of cells covered by each species in each habitat. *Be sure to fill in the names of each species number below the table!***

Table 2: The number of quadrat boxes in each habitat containing different species of seagrass.

	Shallow				Edge				Deep			
	Sp 1	Sp 2	Sp3	Any	Sp 1	Sp 2	Sp3	Any	Sp 1	Sp 2	Sp3	Any
Quadrat 1												
Quadrat 2												
Total												
Average												

Species 1 = \_\_\_\_\_

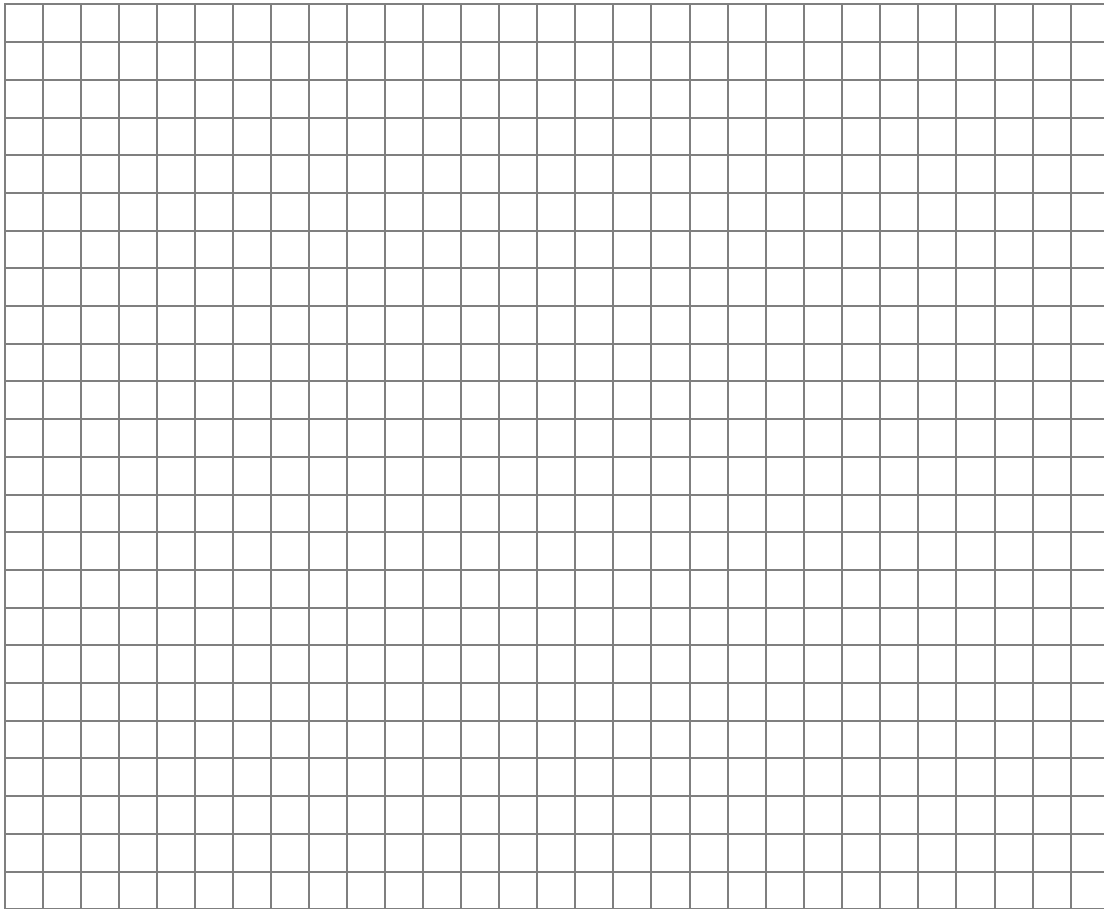
Species 2 = \_\_\_\_\_

Species 3 = \_\_\_\_\_

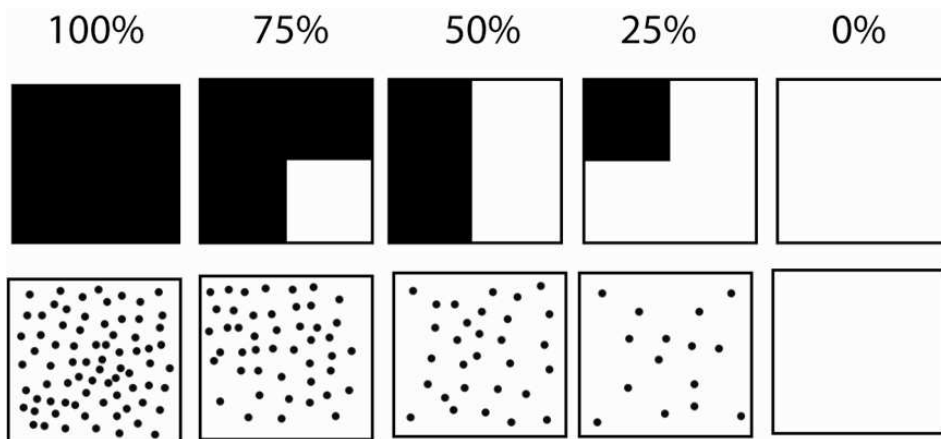




Use the graph paper below to make a graph of the data in Table 2 for the average number of boxes covered by all seagrasses.



Did you notice that sometimes there isn't much seagrass covering the bottom but it is in every box? That could be a problem. Now lets record numbers for the percent of the bottom that each seagrass species covers. Use the chart below to make your estimates. Also make an estimate for all the seagrass species together and record them in your table.



Record the percent of the bottom covered by each species for each quadrat. In the column labeled "Any" record the total area covered by any species of seagrass. Once you made estimates for the two quadrats in each habitat calculate the average percent cover in each habitat for each species. *Be sure to fill in the names of each species number below the table!*

Table 3: The percent cover of seagrass in each habitat.

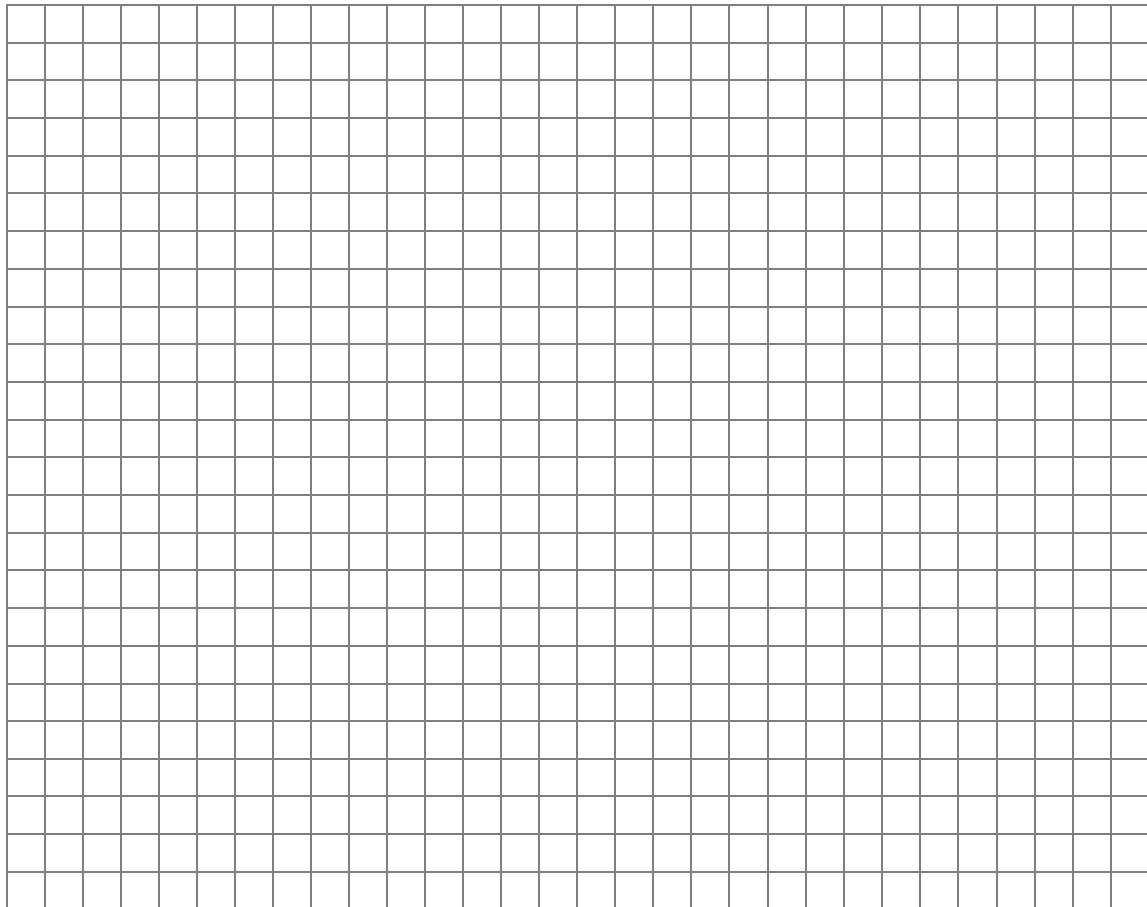
	Shallow				Edge				Deep			
	Sp 1	Sp 2	Sp3	Any	Sp 1	Sp 2	Sp3	Any	Sp 1	Sp 2	Sp3	Any
Quadrat 1												
Quadrat 2												
Total												
Average												

Species 1 = \_\_\_\_\_

Species 2 = \_\_\_\_\_

Species 3 = \_\_\_\_\_

Use the graph paper below to make a graph of the data in your Table 3 for the average percent cover of all seagrasses in each habitat.





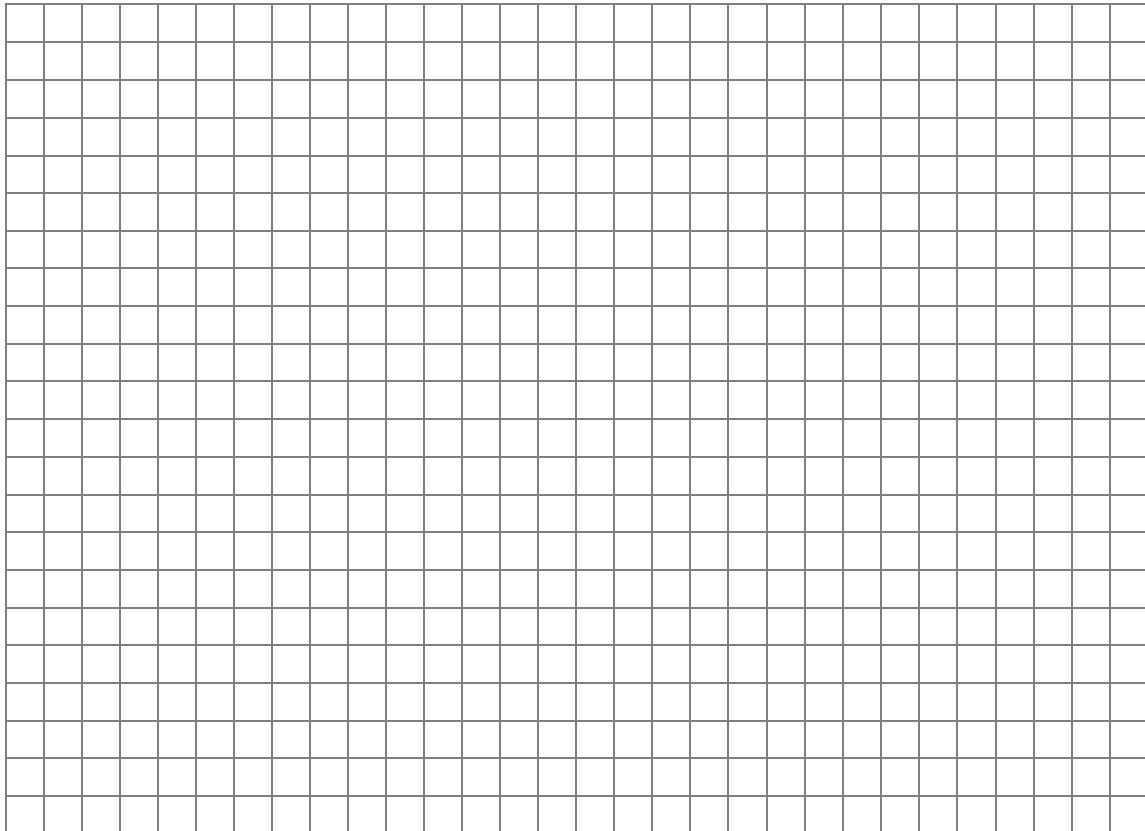
Now we know how much of the bottom the seagrass covers. But is it taller in one of the habitats? Which habitat do you think will have the tallest seagrass? Why?

Let's use the data on seagrass heights in each habitat to test your hypothesis. Calculate the average height of seagrass in these habitats and record the data below. Don't forget to fill in the top row of boxes with the names of the seagrass species you have data for. Your teacher may provide you with the average heights of all seagrass together.

Table 4: Average height of seagrasses in the three habitats of Shark Bay.

	<i>Ampibolis antarctica</i>				All seagrasses
<b>Shallow</b>					
<b>Edge</b>					
<b>Deep</b>					

Use the graph paper below to make a graph of the average heights of the seagrasses in each habitat.



Time to review your graphs and data! Use them to answer the following questions:

- 1. What was the best way to estimate the amount of seagrass covering the bottom? Why?**
- 2. Do your data support your hypothesis of where there is the most seagrass? Why or why not?**
- 3. Look at the graphs that other groups made. Do the graphs made by the other groups in your class also support your hypothesis? Why might the graphs differ?**
- 4. Why is it important to take multiple measurements when you are testing a hypothesis?**
- 5. Did your data support your hypothesis on where seagrasses should be tallest? Why do you think you observed the pattern of heights you graphed?**
- 6. What kind of measurements would you take to determine if human changes were influencing a seagrass ecosystem? How would you design an experiment to test whether people were affecting seagrasses?**



## Mission 2: Fishes

### Activity 4: Generate hypotheses and propose study methods

Date: \_\_\_\_\_

Now that you have completed your study of seagrasses, we need your help to learn about the animals of Shark Bay. Use your previous studies and observations to answer the following questions.

**1. Which habitats do you think will have the most fish? Which will have the fewest fish? Why?**

**2. How would you test your hypothesis about where there should be the most fish and why they are there? Be sure to come up with ideas on how you would measure the number of fish in each area.**





**Tally Sheet: Shallow habitats**      **Circle one: Sand   Seagrass**

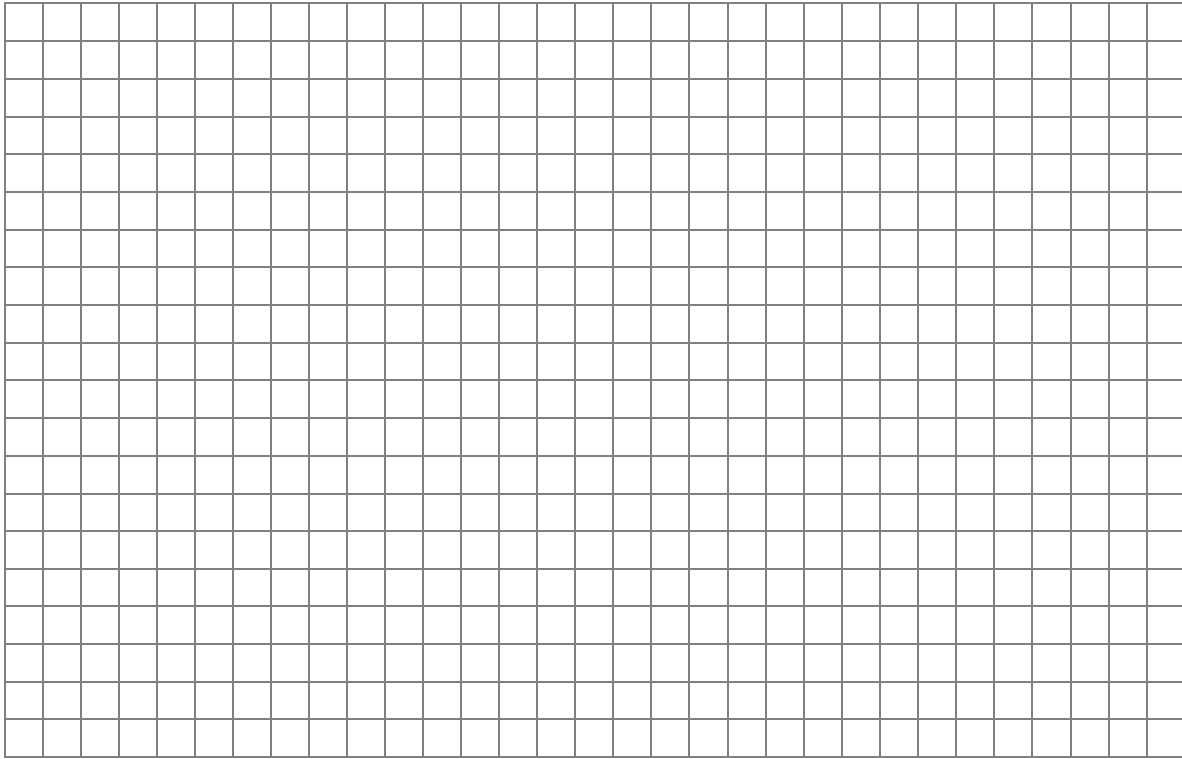
Species	Number	Total
<b>Total number of fish</b>		

**Use your tally sheets to fill out the table below:**

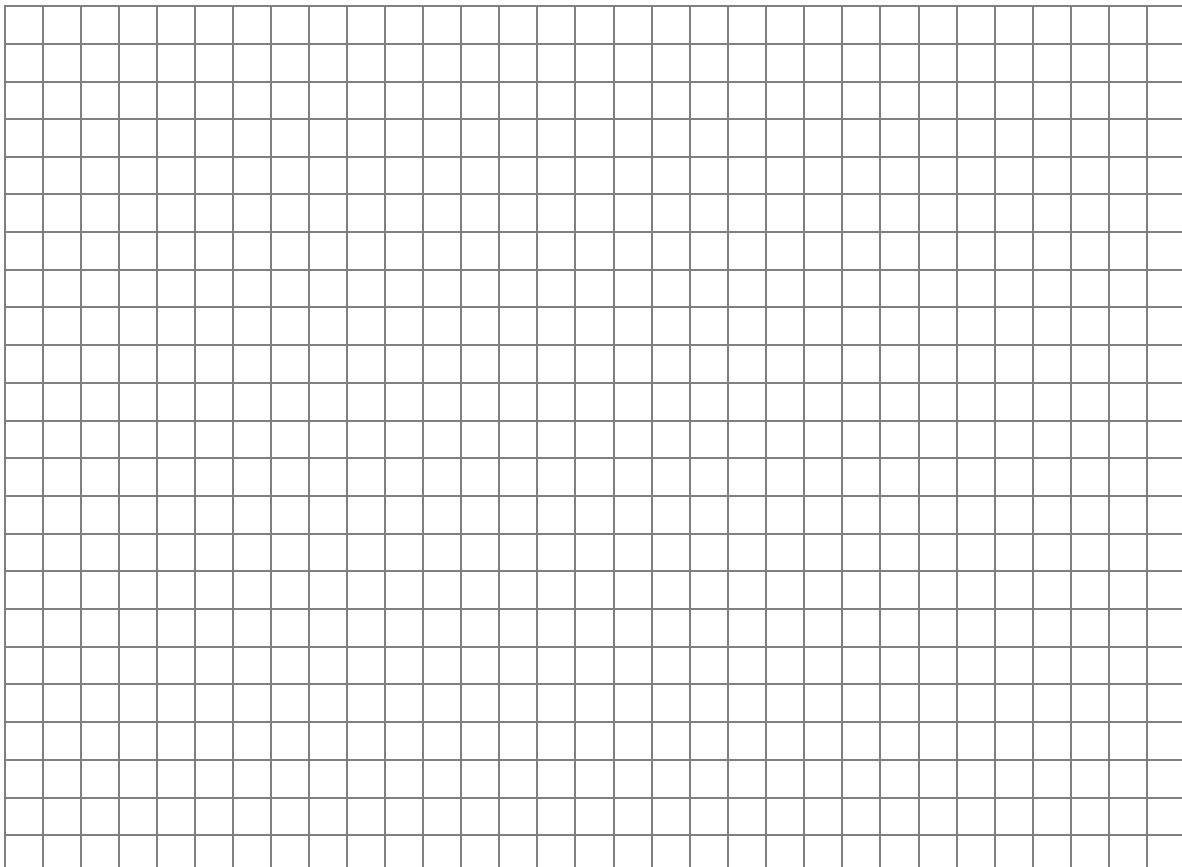
Table 5. Summary table for fish counts

	Shallow	Edge	Deep
Total number of species during counts			
Total number of fish counted			
Number of recording intervals	16	16	16
Average fish per interval			

Use the graph paper below to make a graph of the number of fish species you saw in each habitat during counts.



Use the graph paper below to make a graph of the average number of fish you saw in each habitat per count.







1. Which habitat had the most species of fishes? Why do you think this is the case?

2. Which habitat had the largest number of fishes? Why do you think this is the case?

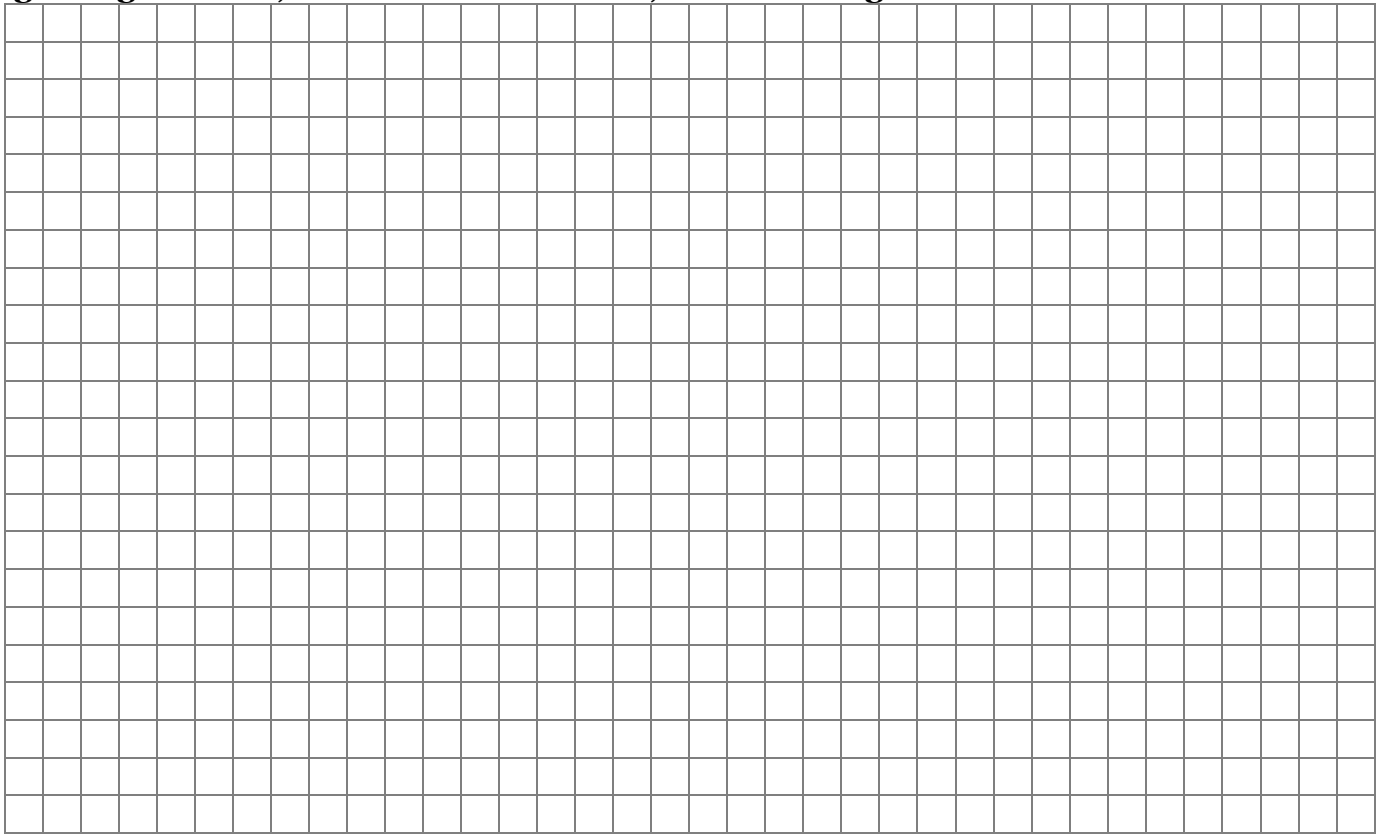
Your teacher will give you data from other schools who have been helping us with our research. Fill out the table below with their data – and yours.

Table 6. Average number of fish during a count in each habitat.

School	Shallow		Edge		Deep	
	Sand	Seagrass	Sand	Seagrass	Sand	Seagrass
My school						
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
<b>Sum</b>						
<b># observations</b>						
<b>Average</b>						

In the space below calculate the average number of fish in each habitat by taking the average of the fish seen in seagrass and sand areas of each habitat.

Use the graph paper below to make a graph of the *average* number of fish per count in each habitat based on the data collected by students at other schools. Make a bar for the following habitat types: Deep Sand Bottom, Deep Seagrass Bed, Edge Sand Bottom, Edge Seagrass Bed, Shallow Sand Bottom, Shallow Seagrass Bed





**Compare the graph on the previous page with the data from your class.**

**1. Did you have enough data to know where the most fish are? Look at the values from each class. Is one day worth of video data going to be enough to answer questions about fish? Why or why not?**

**2. Is habitat depth or the presence of seagrass more important for fish? Why do you think this is?**

**3. Based on what you learned about where there is the most seagrass, what habitats should have the most fish in Shark Bay?**

**4. What do you think would happen to the number of fish in shallow and edge habitats if seagrasses disappeared in Shark Bay? Why?**

## Mission 3: Dolphins and Dugongs

### Activity 6: Understanding habitat use

Date: \_\_\_\_\_

It's time to start learning about some of the big animals in Shark Bay! We want to know what habitats are important to them and why they like these habitats. To learn more about how animals choose where to live, play the game FORAGER! Fill out the data and answer the questions as you play!

**Fill in the table below based on the results of your games.**

Table 7. Distribution of food and foragers between two habitats

Round	Food in Habitat 1	Kids in Habitat 1	Food/Kid in Habitat 1*	Food in Habitat 2	Kids in Habitat 2	Food/Kid in Habitat 2*
<b>1</b>						
<b>2</b>						
<b>3</b>						
<b>4</b>						
<b>5</b>						

\*Enter the number of “food” items each forager got after feeding.

Now answer the following questions:

**1. Describe why you chose the habitat you did when it was your turn to forage. Ask other foragers why they chose their habitat. Were their reasons the same as yours?**



**2. Math is very important to scientists! Determine the following values for us:**

**a. The proportion of food in Habitat 1 for Round 1.**

(hint:  $\frac{\text{Food in Habitat A}}{\text{Food in A} + \text{Food in B}}$ )

**b. The proportion of food in Habitat 2 for Round 1.**

**c. The proportion of foragers in each habitat for Round 1.**

**3. Compare the proportion of foragers in each habitat to the proportion of food in each habitat. Also compare the reward each forager got in each round (look at your Table 7). Are you surprised?**

Great job! It turns out that animals make foraging choices a lot like you did when you played the game! Now we are ready to start studying dolphins and dugongs.

Look at the graph you made on page 17 of your notebook. Compare the amount of fish in shallow seagrass habitats with the average amount in deep habitats overall (the calculation you did at the bottom of page 16). Use these numbers to answer the following questions:

**1. Which habitat do you think will have the most dolphins? Why?**

**2. If there are 100 dolphins in the area, how many dolphins should be in each habitat? Be sure to show your work.**

**3. The amount of fish in each habitat is the same in winter and summer. Should the number of dolphins foraging in these habitats change between winter and summer? Why or why not?**





### Activity 7: Testing dolphin and dugong hypotheses

Date: \_\_\_\_\_

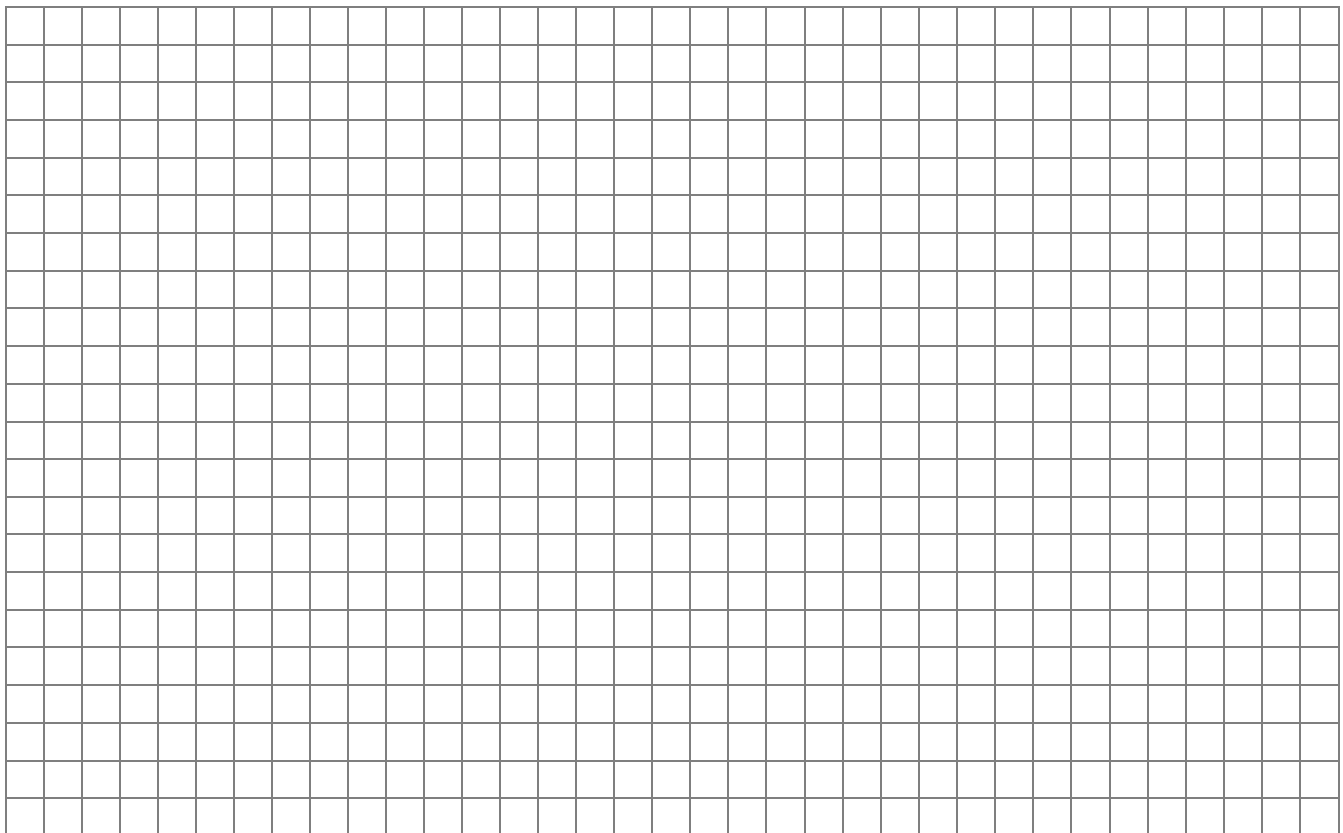
Time to test your hypotheses about where dolphins and dugongs should be! Start with your data from WINTER.

**Calculate the average number of dugongs and dolphins observed on transects in the winter for deep and shallow habitats and place them in the table below.**

Table 8. Average number of dolphins and dugongs observed on transects.

Season	Dugongs		Dolphins	
	Shallow	Deep	Shallow	Deep
Winter				
Summer				

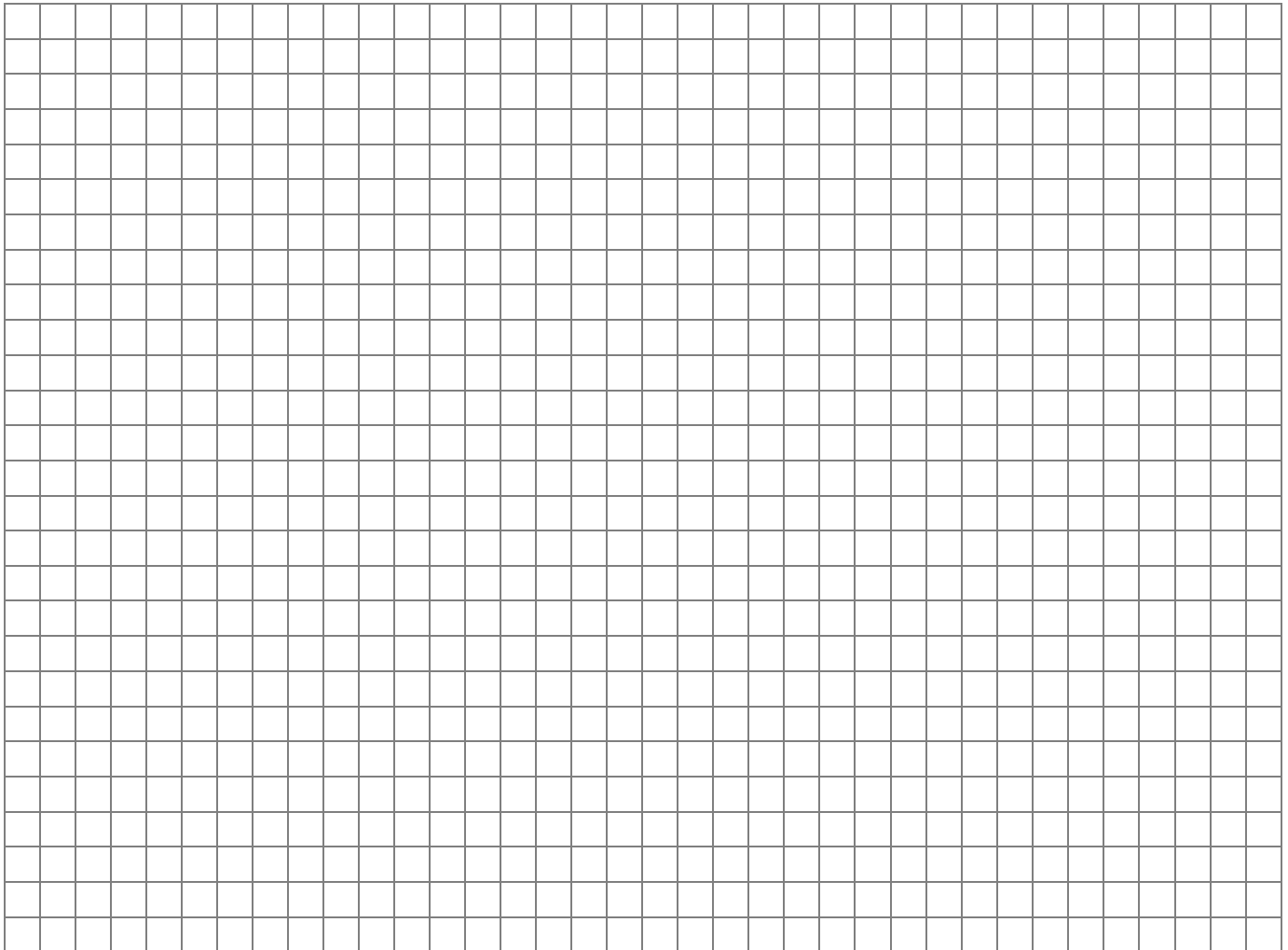
**Use the graph paper below to make a graph of the number of dolphins and dugongs in deep and shallow habitats during WINTER**



**Compare the graph on the previous page to your graphs of seagrass and fish. Were your hypotheses about where dolphins and dugongs would spend their time supported? Explain. Did you prove your hypothesis?**

Ok, lets make sure we are on the right track. Let's see if dolphins and dugongs do the same thing in SUMMER.

**Use the graph paper below to make a graph of the number of dolphins and dugongs in deep and shallow habitats during SUMMER**







**Compare the graph on the previous page to your graphs of seagrass and fish. Were your hypotheses about where dolphins and dugongs would spend their time supported? Explain.**

**Compare your graphs of where dolphins and dugongs were found in WINTER and SUMMER. What did the animals do differently in the two seasons? Why do you think this happened?**

**What do you think the team should do to try to get to learn why dolphins and dugongs are changing what they are doing? Should we just say we are wrong and quit now?**

## Mission 4: Tiger sharks

### Activity 8: Understanding habitat use

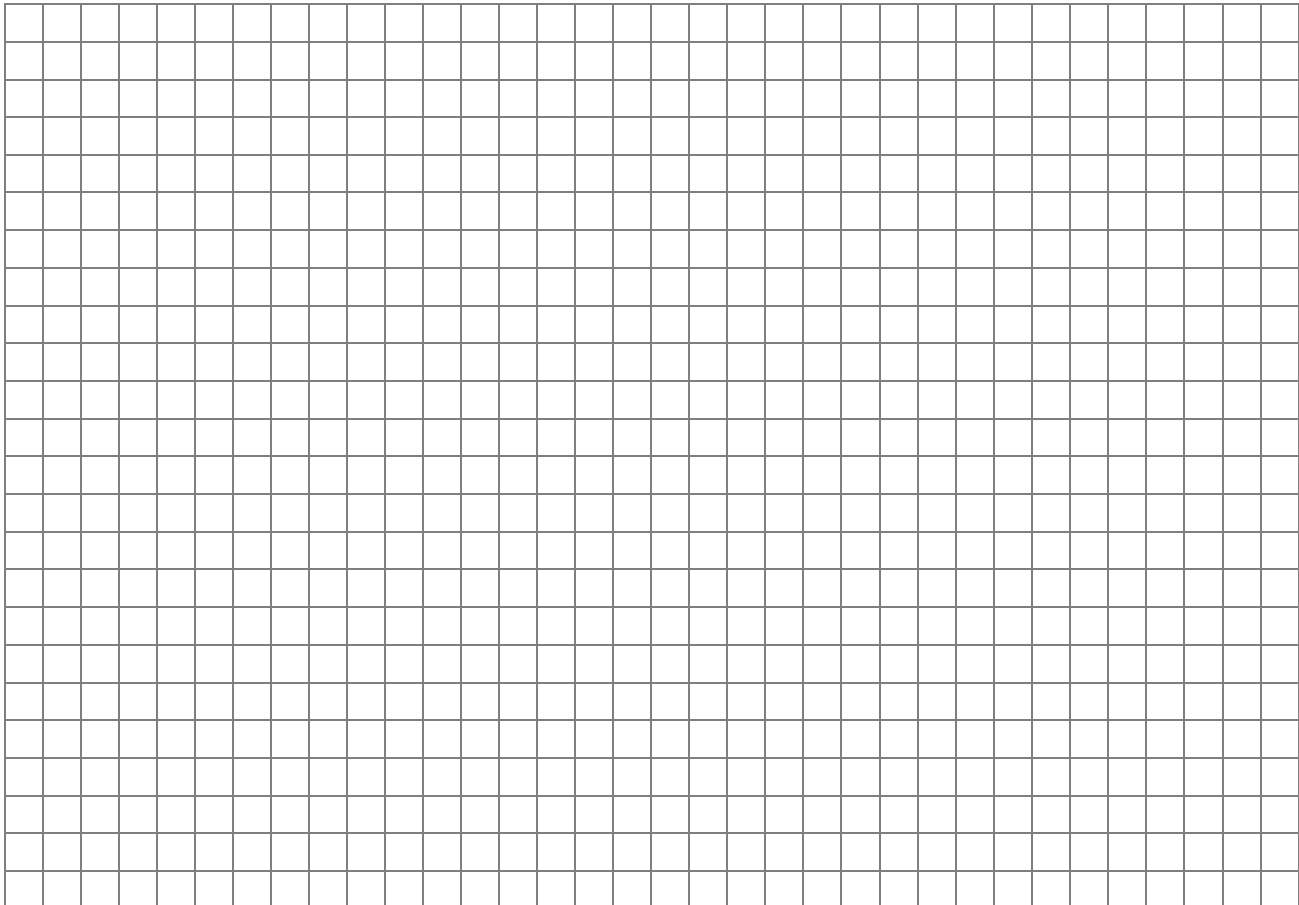
Date: \_\_\_\_\_

Now we've seen a big tiger shark and what sharks can do to dolphins and their other prey like sea turtles and dugongs. Look at your graphs of where the dolphins and dugongs were and the amount of food for each. If tiger sharks are the reason that dugongs and dolphins don't go into the shallow waters in summer, then:

- 1. Do you think tiger sharks are in Shark Bay in both winter and summer? Why or why not?**
- 2. Which habitat do you think tiger sharks will spend the most time in if they are the reason dolphins and dugongs do not go into shallow waters very often in the summer? Why?**

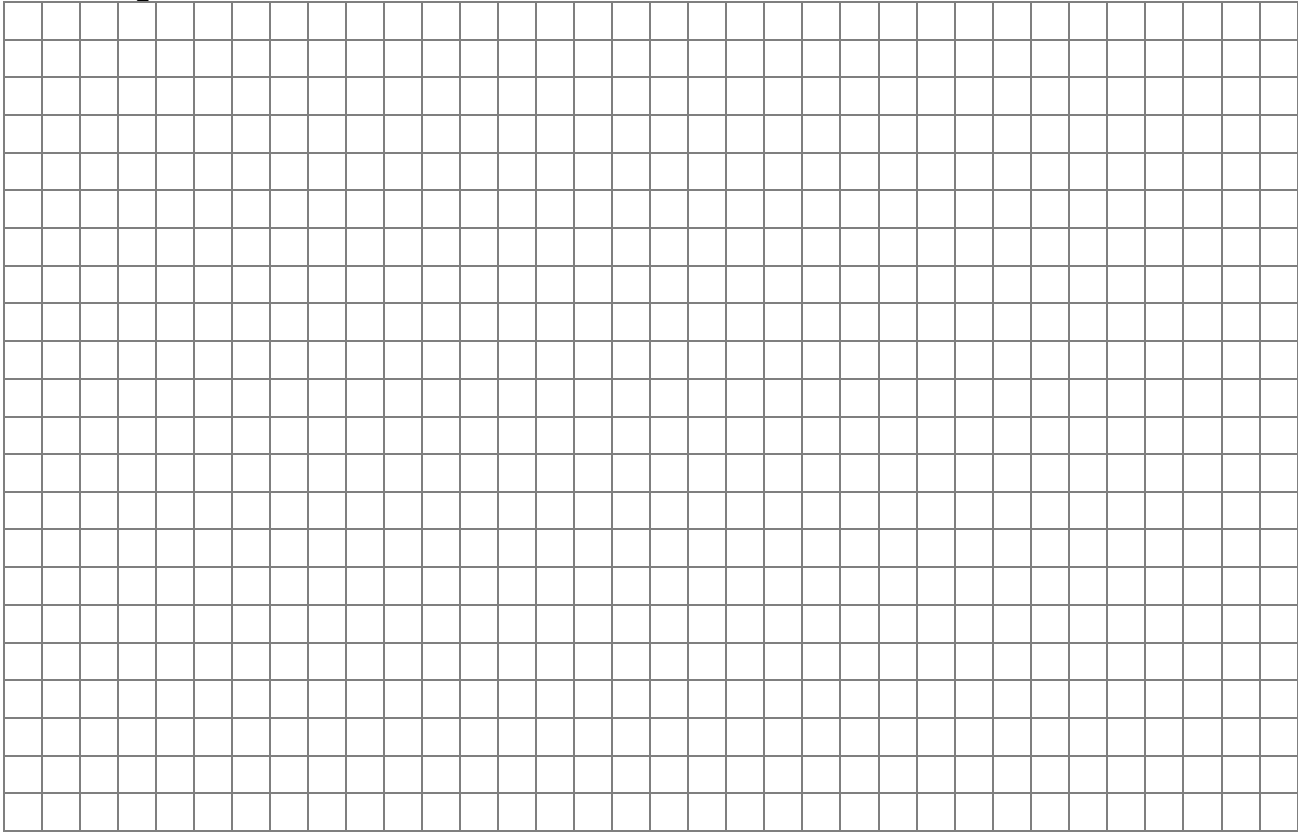
Use the data the field team sent you to make the following graphs to explore your hypotheses.

**Use the graph paper below to make a graph of the number of tiger sharks caught in the winter and in the summer**





Use the graph paper below to make a graph of the average amount of time tiger sharks spend in deep and shallow habitats



- 1. Does your graph of when the tiger sharks are in the bay support your hypothesis? What does this mean for how dolphins, dugongs, and other animals in Shark Bay decide where to spend their time?**
- 2. Does your graph of which habitats tiger sharks use most support your hypothesis? What does this mean for how dolphins, dugongs, and other animals in Shark Bay decide where to spend their time?**
- 3. Why do you think some dolphins and dugongs go into shallow waters in the summer?**
- 4. Do you think tiger sharks might be important to the seagrass ecosystem? How?**

## Mission 5: Effects of predators and grazers

### Activity 9: Dugong effects on seagrass

Date: \_\_\_\_\_

Look at your graphs of dugong numbers in winter and in summer. Use these to answer the following questions:

1. When should dugongs have the biggest effect on seagrasses? Why?
2. In which habitat should dugongs have the biggest influence on seagrasses? Why?
3. What do you think will happen inside the cages in deeper habitats with seagrass compared to those in shallow habitats? Why?

Use the space below to calculate the average cover for *Halodule*, *Amphibolis*, and All Seagrass for data collected by the field team in 1) Shallow Controls, 2) Shallow Exclosures, 3) Deep Controls, and 4) Deep Exclosures. Put these values in Table 10.



Table 10: Average percent cover of seagrass inside exclosures

	<i>Amphibolis</i>	<i>Halodule</i>	All seagrasses
Shallow Control			
Shallow Exclosure			
Deep Control			
Deep Exclosure			

Use the graph paper below to make a graph of the data in your table above for the average values in deep and shallow habitats for all seagrasses. Use the following order for the columns: Deep control, Deep Exclosure, Shallow Control, Shallow Exclosure

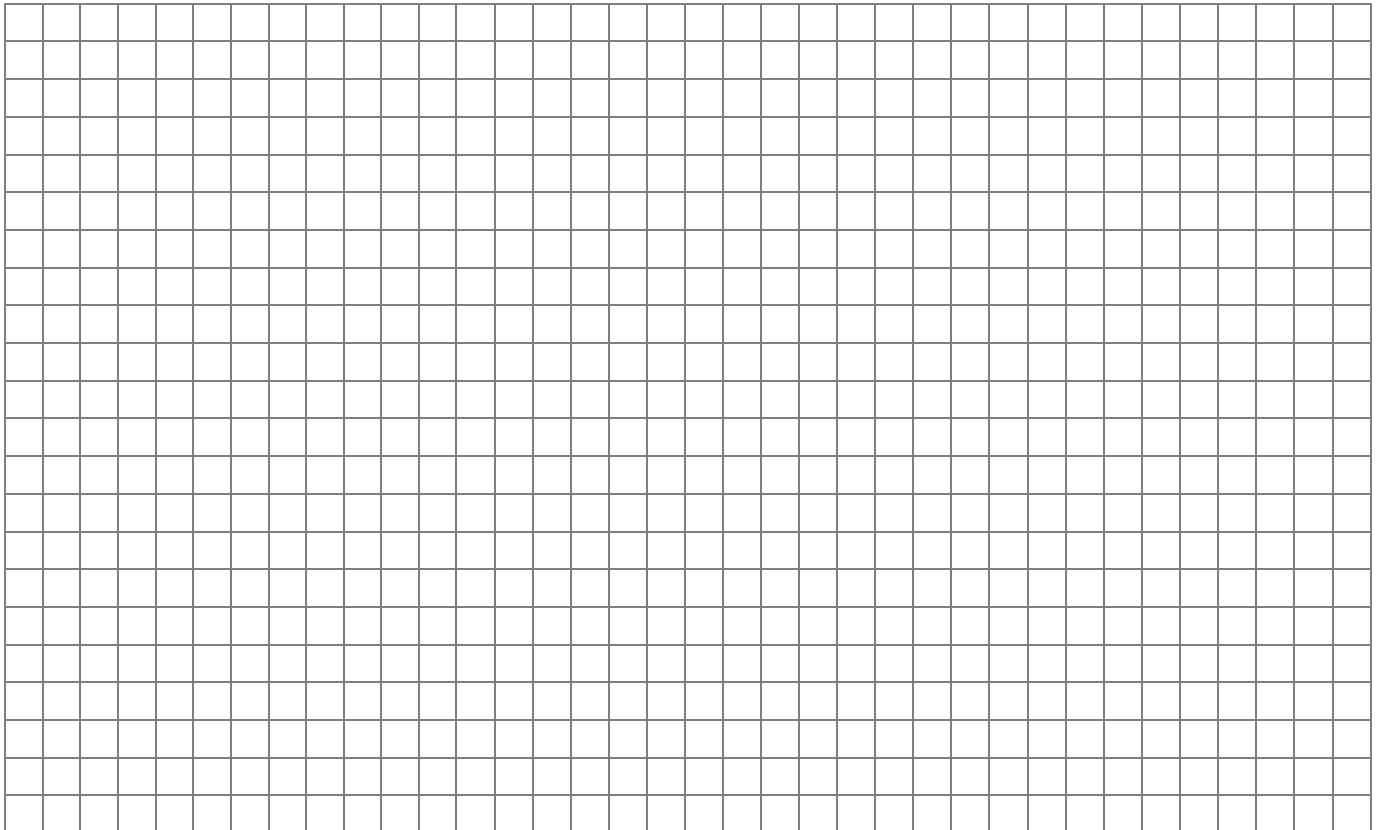


Use the data the field team collected to calculate the average height of the seagrass *Halodule uninervis* in these experimental treatments. Don't forget to fill in the top row of boxes!

Table 11: Average heights of seagrasses

	<i>Average height</i>
Deep Control	
Deep Exclosure	
Shallow Control	
Shallow Exclosure	

Use the graph paper below to make a graph of the data in your table above for the height of seagrass in exclosures and controls of deep and shallow habitats for all seagrasses. Use the following order for the columns: Deep control, Deep Exclosure, Shallow Control, Shallow Exclosure





**1. Based on your graphs and tables of seagrass heights and percent cover, would you say that keeping dugongs from grazing had an effect on seagrasses? Was the effect the same in the two habitats? Explain.**

**2. What do you think would happen to the seagrasses in shallow waters if more dugongs were foraging there in the summer? Why?**

### Activity 10: Putting the ecosystem together

Date: \_\_\_\_\_

**Cut out the pictures of the organisms in the back of your notebook and paste them into the area below to create the Shark Bay Food web in summer. Draw arrows from species that are eaten to the species that eat them.**

Use your food web to answer the questions below. Follow the links in the food web to think about what might happen.

- 1. What is the primary energy source for this food web?**
- 2. What is the producer in this food web?**
- 3. Where do you think dugongs would forage if tiger sharks were to disappear from the Bay in summer? Why?**
- 4. How would the disappearance of tiger sharks influence seagrasses?**
- 5. How would the disappearance of tiger sharks influence all of the other species in your food web? Explain how and why?**
- 6. How would the disappearance of seagrass influence all of the other species in your food web? Explain how and why?**
- 7. Do you think that tiger sharks are good or bad for the Shark Bay ecosystem? Why?**
- 8. What would do you think we should do in areas where sharks are disappearing because of overfishing?**





Go online and do some research on the ecosystem of Yellowstone National Park. Find out what happened when wolves were reintroduced to the park. Use the area below to take notes and draw the Yellowstone food web:

**Do you think tiger sharks in Shark Bay play a similar role in the ecosystem as wolves in Yellowstone? Why or why not?**

Thanks for helping us study Shark Bay! We hope you have had as much fun as we have! Keep on exploring your world – and maybe someday we'll see you out on the water! To see what we are doing and learn about all the research we have done visit us on the web at [www.sberp.org](http://www.sberp.org)!



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