

Reef scientists: lesson 3 of 3

Counting fish and measuring diversity

Belt transects, fish density and Simpson's diversity index



MCP divers on a fish survey. Photo: MCP



The belt transect

1. Lay a 30 m tape along the reef.
2. Swim slowly along it, counting every fish of your target species within a set distance either side.
3. In this practice, the belt is 5 m wide, so it covers $30 \times 5 = 150$ square metres.
4. Record each species separately, and count each fish only once.

Diver rules

Swim at a steady speed.

Never chase fish.

Agree the species list with your buddy before you start.



Why fish counts are tricky

These problems are called observer effects. Training, fixed methods and repeat surveys keep them small.

- Some fish hide when divers arrive, and others swim up to look
- Fish move, so the same fish can be counted twice
- Two divers can count the same fish differently
- Rare species are easy to miss



MCP survey divers. Photo: MCP



Practice: count the fish

Count each species on both belts. Use the key.

 Parrotfish

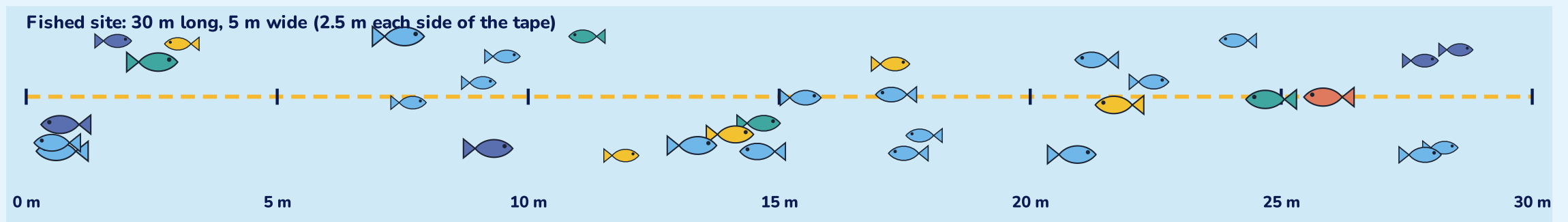
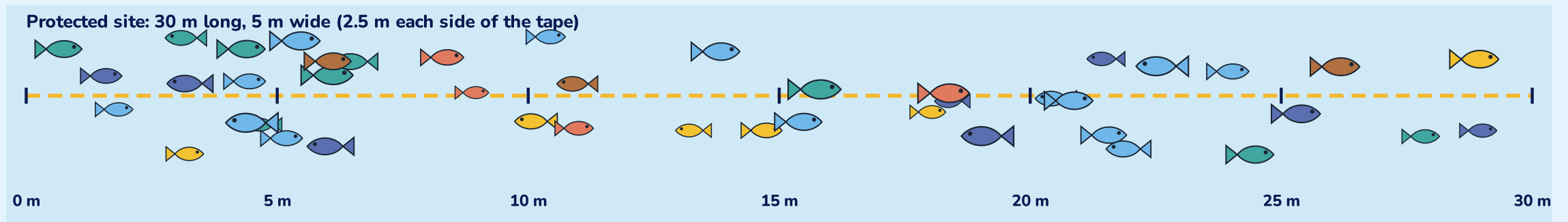
 Surgeonfish

 Butterflyfish

 Damselfish

 Grouper

 Snapper



Fish density

Density lets you compare surveys of different sizes.

$$\text{count} \div 150 \times 100$$

fish per 100 square metres

Work out the total density for each site, and the density of each species.



Simpson's diversity index

Diversity is not just how many species there are. It also depends on how evenly the fish are shared between them.

Simpson's diversity index: $D = 1 - \sum n(n-1) \div N(N-1)$, where n is the number of each species and N is the total number of fish.

D runs from 0 (no diversity) towards 1 (very diverse).

Worked example

3 species with 5, 3 and 2 fish, so $N = 10$

$$\sum n(n-1) = 20 + 6 + 2 = 28$$

$$N(N-1) = 90$$

$$D = 1 - 28 \div 90 = 0.69$$



Compare the sites

Calculate D for both belts. Which species is missing at the fished site?



Simpson's index, protected site



Simpson's index, fished site

Why might that species be missing? Who would want to catch it?



Plan your own survey

1. Choose a question, for example: are there more shore crabs under rocks than on open sand?
2. Write a hypothesis you can test.
3. Choose your method: quadrats, a transect or a belt count. Decide how many replicates.
4. List what you will keep the same, and your safety plan.
5. Collect data, analyse it and present what you found.

Where?

The schoolyard, a school garden, a rocky shore or a seagrass area at low tide, always with an adult.



Talk about it

Which is more useful to a manager: fish density or diversity? Why?

How could observer effects change your results?

What question would you most like to survey near your school?

Well done! You have finished the Reef scientists lessons.



Photos and sources

Photos: survey divers by MCP, Negros Oriental. Fish belts are practice data drawn for this lesson. All illustrations drawn for this lesson by Marine Conservation Philippines.

Sources:

- Marine Conservation Philippines. Marine Monitoring.

Full links are in the teacher reading. Free to use and share for education. Made by Marine Conservation Philippines. More free lessons: marineconservationphilippines.org/resources/teachers-resources/

