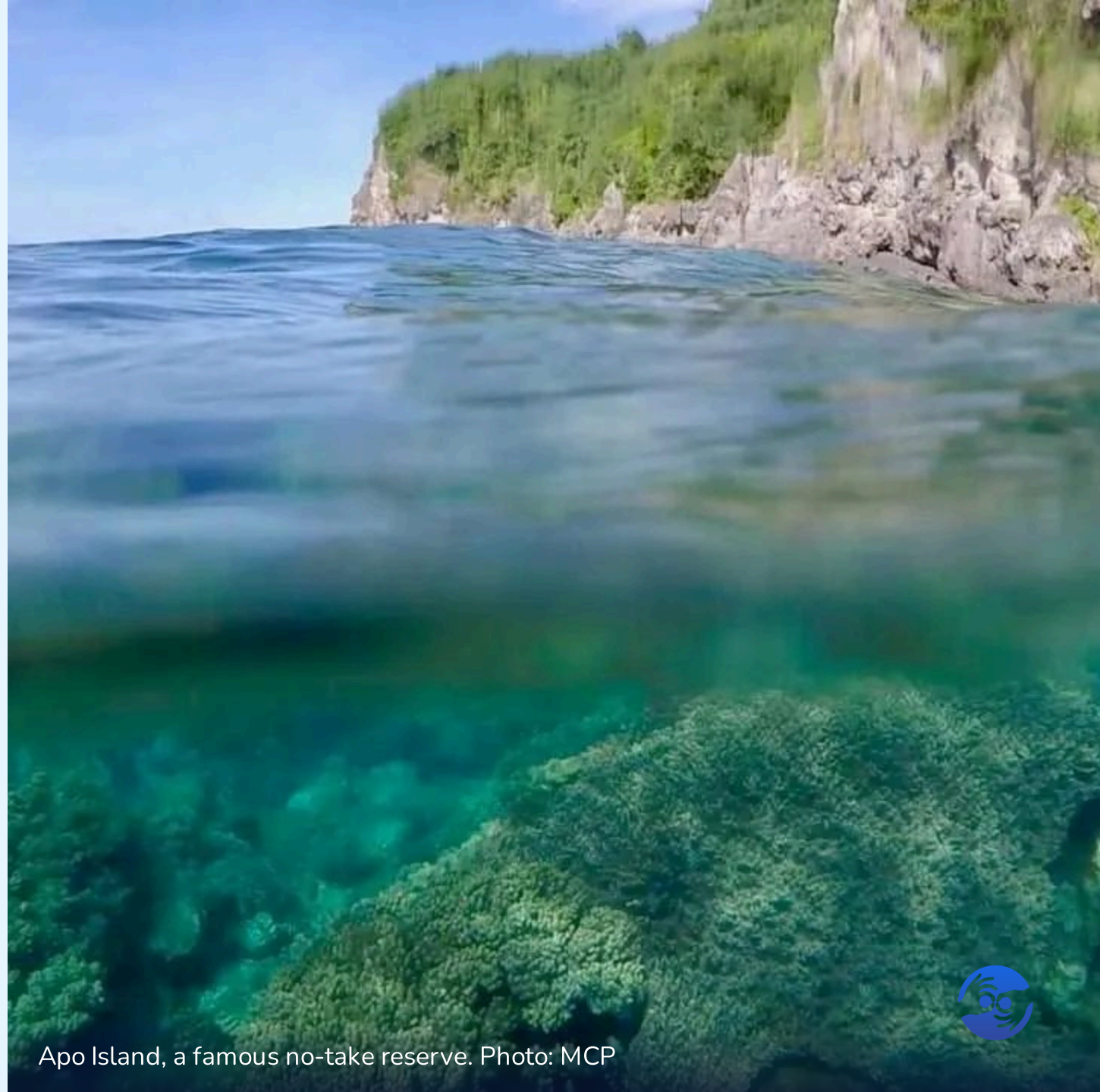


Reef data lab: lesson 2 of 4

Protected or not?

Do marine reserves have
more fish, and why do some
work better than others?



Apo Island, a famous no-take reserve. Photo: MCP



The question

Eight of our eleven sites are marine reserves, where fishing is not allowed. Three are open reefs, where fishing goes on.

Use the cleaned fish data to test: do reserves hold more fish than open reefs?

Write your prediction first. Which measure would you expect to differ most?



Choose your measure

Which measure best shows the effect of fishing? Why?

Fish biomass

The total weight of fish.
Scientists' favourite measure
of a healthy fish community.

Total fish

Includes lots of small fish
that nobody catches.

Fished groups

Parrotfish, groupers and
snappers, which fishers
target.

Large fish

Big fish of any kind, 30 cm
or longer.



Your analysis

1. Leave out the surveys you flagged in lesson 1, including S217's.
2. For each measure, work out the mean and the median per survey, for reserves and for open reefs.
3. Why are the mean and median so different for biomass? Look at the spread.
4. Draw a bar chart of the means.

Formula help

=AVERAGEIFS(biomass column,
protected column, "yes")

Or use a pivot table with protected as rows.



Fish biomass

23.1 kg

average per survey in reserves

8.7 kg

average per survey on open reefs

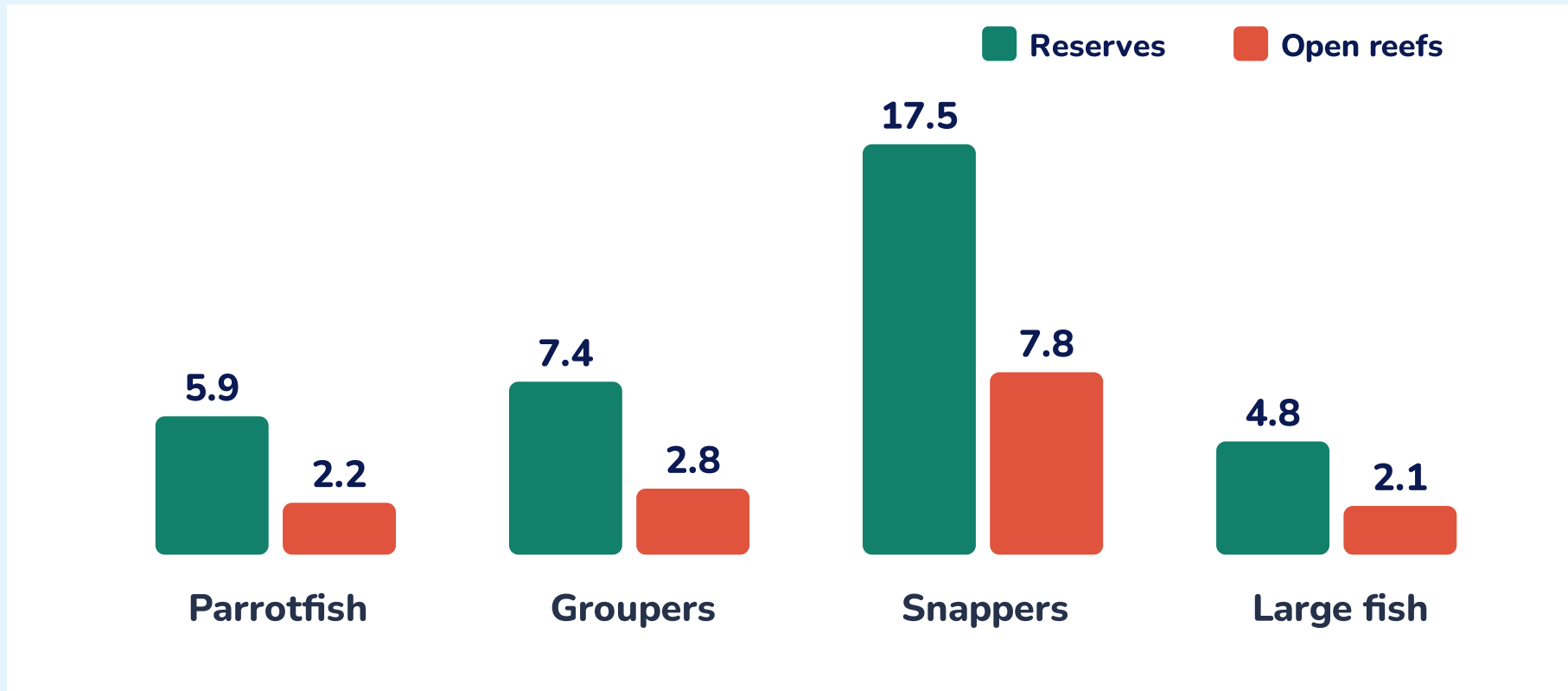
About 3 times more fish by weight in reserves. The medians (12.2 and 4.6 kg) are lower, because a few surveys with big schools pull the mean up.

How we know: Teaching dataset based on MCP survey records, adjusted for learning



The fished groups

Average number per survey. The fish that people catch show the biggest difference.

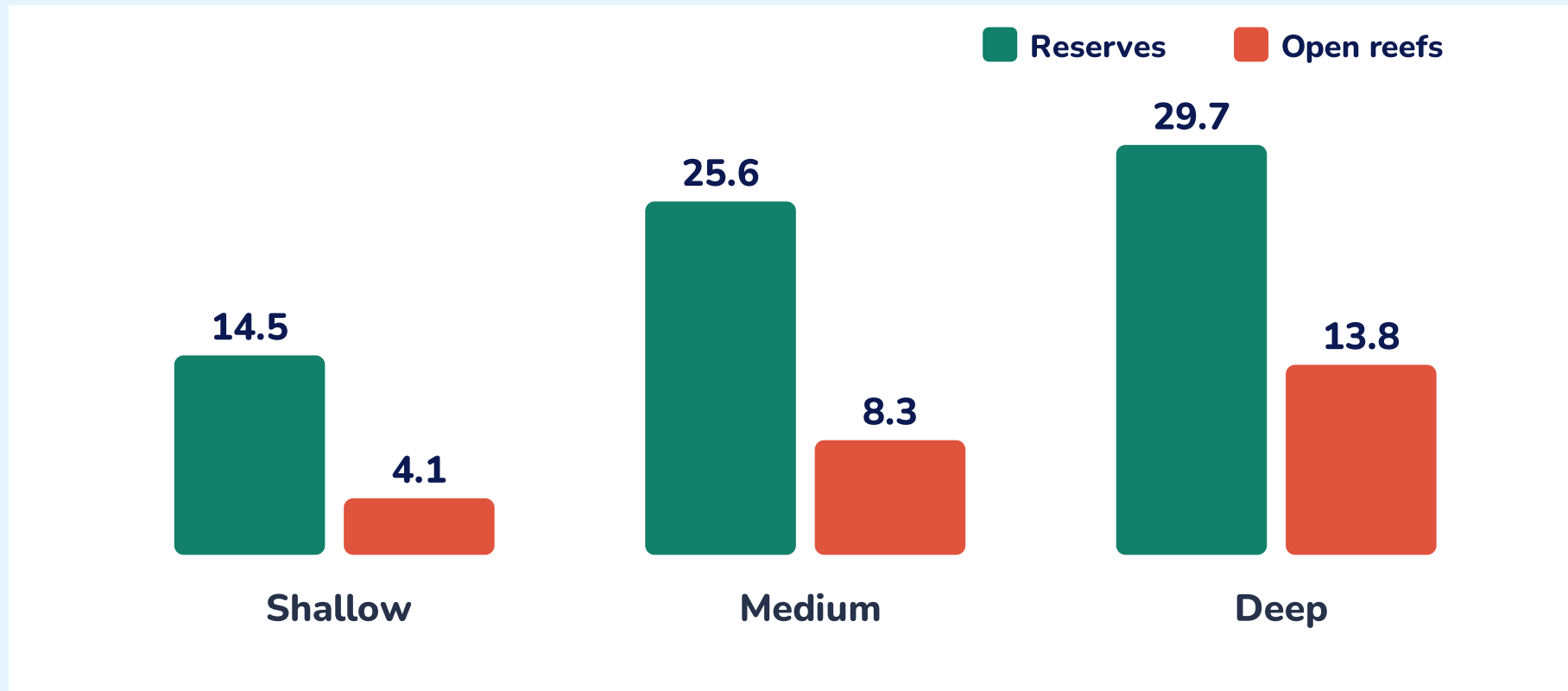


How we know: Teaching dataset based on MCP survey records, adjusted for learning



Does it hold at every depth?

Fish biomass (kg per survey) at each depth. Comparing like with like makes the evidence stronger.



How we know: Teaching dataset based on MCP survey records, adjusted for learning



Not all reserves are equal

1. Open the Sites sheet. Each reserve has an enforcement level: Strong, Moderate or Weak.
2. Add an enforcement column to the fish data with a lookup: `=INDEX(Sites enforcement, MATCH(site, Sites site, 0))`.
3. Work out mean biomass for each enforcement level, and for the open reefs.
4. What do you notice about the weakly enforced reserves?



Enforcement makes the difference

Average fish biomass per survey by enforcement level.



How we know: Teaching dataset based on MCP survey records, adjusted for learning

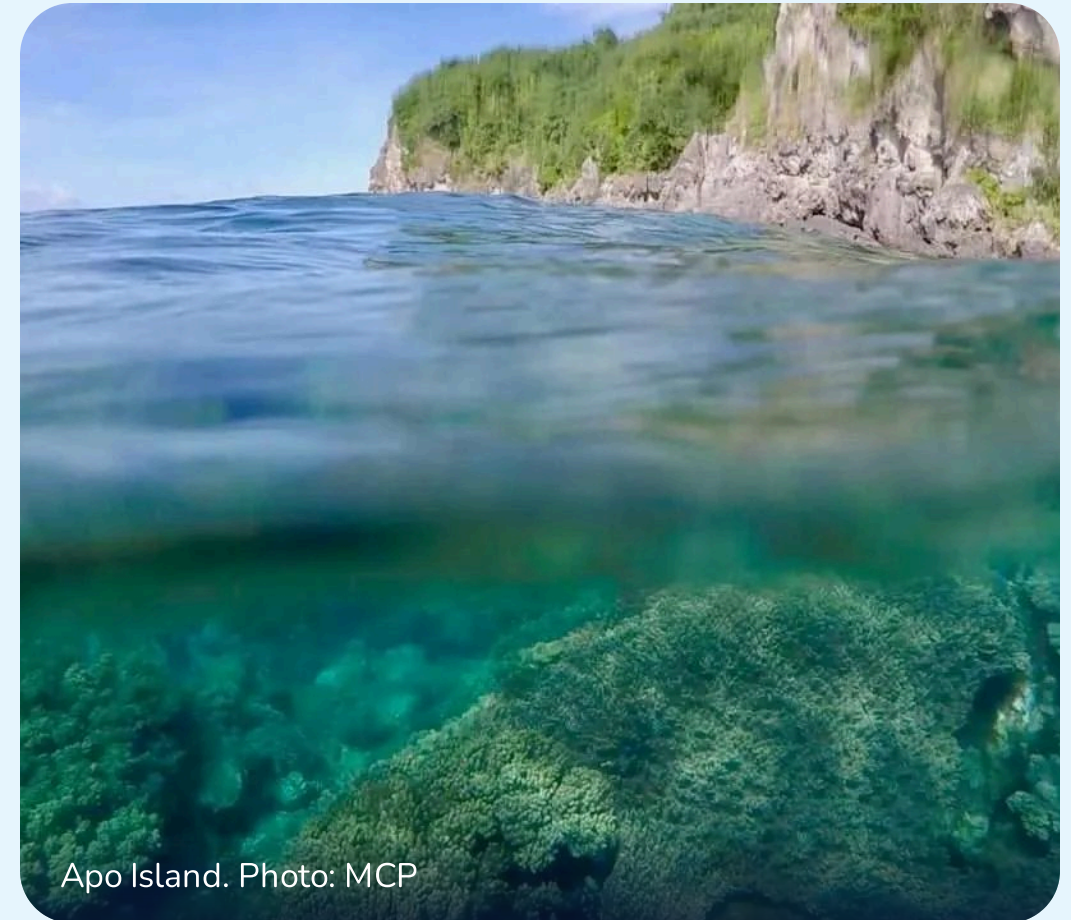


Why enforcement matters most

A reserve on paper does nothing if people keep fishing in it. Weakly enforced reserves in this data hold barely more fish than open reefs.

Where reserves are placed is often decided by local politics and community agreement rather than science. What happens after, patrols, wardens and community support, decides whether the fish come back.

- Studies around the world agree: well-enforced reserves do far better
- It is one of the five NEOLI features in the Fish, fishers and no-take zones module



Apo Island. Photo: MCP



Is the difference real?

1,905

reserve surveys

769

open reef surveys

With this many surveys, a threefold difference is very unlikely to be chance. Grades 11 and 12: test it with `=T.TEST()`, and ask whether the data fits the test's assumptions.



Talk about it

Which measure showed the biggest difference? Why that one?

Why might a reserve fail even though fishing is banned?

If you were a mayor with a small budget, what would you spend it on to make a reserve work?

Next time: a reef through a heatwave



Photos and sources

Photos: Apo Island by MCP. All illustrations drawn for this lesson by Marine Conservation Philippines.

Sources:

- Teaching dataset based on MCP survey records, 2022 to 2026, adjusted for learning.
- Edgar, G.J. and others (2014). Nature.

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/

