



PART 2

Read the text below and answer questions 14–26.

OCEAN ACIDIFICATION: THE OTHER CARBON DIOXIDE PROBLEM

A

When carbon dioxide (CO_2) is discussed, public attention usually focuses on its heat-trapping role in the atmosphere. Yet a substantial share of human-produced CO_2 is absorbed by the oceans. This uptake slows the pace of atmospheric warming, but it triggers a second, less visible consequence: a long-term shift in seawater chemistry known as ocean acidification. Some researchers have called it the “evil twin” of global warming because it is driven by the same emissions yet threatens marine life through a different pathway. In policy terms, acidification is not simply a side-effect of temperature rise; it is a major CO_2 -related risk in its own right, with implications for ecosystems and coastal economies.

B

The underlying chemistry is straightforward, but its implications are profound. When CO_2 dissolves in seawater, it reacts with water to form carbonic acid. Carbonic acid partly dissociates, releasing hydrogen ions. Because the **pH** scale is logarithmic, even a small numerical drop represents a significant increase in acidity. More hydrogen ions mean lower pH, but the story does not end there: hydrogen ions also combine with carbonate ions, reducing the bio-availability of carbonate in seawater. This matters because carbonate is an essential building block for calcium carbonate structures. In effect, the ocean becomes chemically more “corrosive” for organisms that need carbonate to build and maintain shells or skeletons, even if the water is not acidic in the everyday sense.

C

Many of the most immediate biological concerns involve calcifying organisms, especially those that rely on aragonite, a form of calcium carbonate that is relatively soluble. Scientists often describe conditions using the aragonite saturation state: when saturation is high, forming aragonite is energetically easier; when saturation falls, organisms must expend more energy to build, and existing structures can dissolve more readily. Corals, oysters, mussels, and certain plankton are therefore frequently highlighted. One striking example is the pteropod, sometimes called a “sea butterfly,” a small planktonic snail whose thin aragonite shell can be vulnerable in low-saturation waters. Because such organisms can sit near the base of food webs, stress on them may contribute to broader ecological change.



D

However, ecosystem outcomes are not uniform, and acidification does not create only “losers.” Laboratory and field studies show varied responses across species and life stages. Some organisms show reduced growth or altered behaviour; others exhibit partial resilience, especially when they can regulate internal chemistry or adapt over generations. In certain circumstances, seagrasses and some algae may benefit from higher dissolved CO_2 because it can enhance photosynthesis, at least where nutrients and light are sufficient. Yet these potential “winners” do not cancel the risks, because the net result depends on interacting stressors such as warming, low oxygen, and pollution. Acidification can therefore contribute to complex shifts in community structure, and in some settings it may help trigger a trophic cascade—an indirect chain of effects moving through food webs.

E

The human and economic dimensions are already visible in some regions. A frequently discussed case involves the oyster industry in the Pacific Northwest of the United States, where hatcheries experienced major failures when larvae encountered episodes of low-pH, low-saturation seawater drawn into coastal facilities. The problem was not merely theoretical: larval oysters struggled to form shells at the very stage when rapid calcification is essential. In response, some producers invested in monitoring equipment and altered operations, for example by adjusting the timing of seawater intake to avoid corrosive periods. These adaptations reduced losses, but they also increased costs and required technical capacity that may not be available to all coastal communities.

F

Detecting acidification trends requires careful measurement because the ocean naturally varies from season to season and from place to place. Cold waters absorb more CO_2 than warm waters, so higher-latitude regions can experience chemical shifts earlier. Upwelling zones add further complexity: deep waters can be naturally rich in dissolved CO_2 , and when they rise to the surface, local pH can already be lower than average. This means that additional anthropogenic CO_2 can push conditions beyond historical ranges. To separate long-term, human-driven change from natural variability, scientists track multiple indicators, including pH, carbonate chemistry, and aragonite saturation, using long time series rather than isolated measurements.

G

Because acidification is fundamentally driven by CO_2 , the most direct mitigation is reducing emissions. Local measures can provide limited buffering in specific settings. Reducing nutrient runoff can lessen coastal acidification linked to respiration and decomposition, while protecting habitats such as seagrass meadows may improve local



chemistry during periods of strong photosynthesis. Yet these strategies are partial and context-dependent; they cannot substitute for global decarbonisation. Ocean acidification is therefore a reminder that the ocean is not merely a passive sink: by absorbing CO₂ it offers climatic benefits, but it pays a chemical price that societies must factor into climate and conservation policy.

Questions 14–18

Which paragraph contains the following information?

- 14** A comparison that frames acidification as a distinct CO₂ threat alongside global warming.
- 15** A description of why carbonate becomes less available for shell-building after CO₂ dissolves.
- 16** A reference to a specific vulnerable organism sometimes called a “sea butterfly”.
- 17** An account of an industry crisis that led to monitoring and changes in water intake timing.
- 18** The point that local buffering actions cannot replace global emissions cuts.

Questions 19–22

Complete the summary below. Choose **NO MORE THAN TWO WORDS** from the text for each answer.

How carbon dioxide changes seawater chemistry

Once absorbed by seawater, CO₂ produces **19** As this substance breaks apart, it releases **20**, causing a decline in **21** Shell-forming organisms may then struggle because carbonate becomes less available; one comparatively soluble form of calcium carbonate is **22**

Questions 23–26

Select the correct answer.

- 23** What is identified as the key chemical chain triggered by CO₂ uptake?
- A** Dissolved CO₂ raises seawater pH while increasing the carbonate available for shell formation.
 - B** More hydrogen ions reduce the availability of carbonate needed for calcification.
 - C** Carbonic acid converts hydrogen ions into stable aragonite structures.
 - D** Lower carbonate levels cause seawater to absorb less CO₂ and become warmer.



24 Why does the passage emphasise aragonite saturation?

- A** It distinguishes low-pH events caused by upwelling from those caused by human emissions.
- B** It measures an organism's ability to regulate its internal chemistry under stress.
- C** It indicates how easy or difficult it is for organisms to form aragonite structures.
- D** It predicts which marine species will become resilient over successive generations.

25 What does the passage suggest about biological outcomes overall?

- A** Responses differ, and the effects may be intensified by other environmental pressures.
- B** Benefits to some photosynthetic organisms are likely to compensate for harm to calcifying species.
- C** Life stage is important, but warming, low oxygen and pollution have little influence on outcomes.
- D** Resilience is restricted to organisms capable of adapting within a single generation.

26 What is the writer's overall view on solutions?

- A** Adaptation by coastal industries should take priority because global chemical change cannot be slowed.
- B** Emissions reductions should wait until scientists can completely separate human influence from natural variation.
- C** Measures such as limiting runoff and protecting seagrass can provide the same protection as global decarbonisation.
- D** Reducing CO₂ emissions is essential, while local actions can offer only limited protection.

Answer Key

14. A

15. B

16. C

17. E

18. G

19. carbonic acid

20. hydrogen ions

21. pH



22. aragonite

23. B

24. C

25. A

26. D