



PART 3

Read the text below and answer questions 27–40.

NAVIGATING AN ACIDIC FUTURE: RESPONSES AND SOLUTIONS

Ocean acidification is driven by a simple mechanism—rising atmospheric carbon dioxide increases dissolved CO_2 in seawater—but responding to it is a policy and engineering puzzle that resists simple slogans. Because acidification is a global chemical trend with highly local biological expression, the same intervention can look “effective” in one bay and irrelevant in the open ocean. Decision-makers therefore increasingly talk about a mitigation hierarchy: first prevent the driver, then reduce exposure where possible, then build resilience, and only finally consider high-risk interventions that attempt to counteract chemistry directly. The hardest part is not listing options, but comparing them honestly—especially when some measures mainly shift risks in space, time, or across communities.

Mitigation sits at the top of that hierarchy because cutting CO_2 emissions slows the flow of carbon into the ocean everywhere at once. From a chemical standpoint, reducing atmospheric concentration addresses the cause rather than treating symptoms, and it also limits the co-travellers of acidification such as warming and deoxygenation. Yet mitigation operates on political, economic, and infrastructural timelines that can lag behind ecological thresholds. That gap fuels demand for near-term actions, but it also creates a moral hazard: if local fixes are framed as substitutes, they can reduce pressure for emissions cuts. A credible portfolio must therefore treat local measures as conditional and time-limited, designed to protect the most vulnerable while broader decarbonisation catches up.

In aquaculture, adaptation is often tangible because the relevant water passes through pipes, tanks, and intake systems. Hatcheries can monitor carbonate chemistry and shift intake timing to avoid brief windows of low pH, especially during upwelling events or heavy runoff. Some facilities raise alkalinity in rearing tanks with buffering substances, an approach that can stabilise larval conditions and improve survival. However, this is an ex-situ conservation tactic: exporting it to open coastal waters is impractical, and careless chemical additions could generate downstream effects. Selective breeding and broodstock management can also increase tolerance, but gains may be incremental and sometimes involve trade-offs with growth rate, disease resistance, or product quality. Even when effective, these tools protect production systems more readily than they protect surrounding ecosystems.

On coral reefs and other habitat-forming systems, “adaptation” often means reducing non-chemical stressors so organisms have more physiological margin. Limiting overfishing



can stabilise food webs; reducing sediment and nutrient pollution can improve light and reduce disease pressure. These steps do not reverse acidification, but they can raise the probability that corals and associated species persist long enough for mitigation to matter. Restoration adds another layer, from transplanting fragments to assisted gene flow and the cultivation of heat-tolerant strains. Yet restoration can collide with a chemical constraint: if the reef framework cannot accrete calcium carbonate fast enough to offset erosion, the habitat may simplify even if living tissue survives. In that sense, rebuilding biology without improving chemistry can deliver partial, fragile wins.

Nature-based approaches are sometimes described as “blue carbon” solutions because they store carbon and can, under certain conditions, alter local chemistry. Seagrass meadows, kelp forests, and some macroalgae draw down CO_2 during daylight, which can raise pH in nearby water and create short-lived refuges for sensitive life stages. But the effect is variable: currents mix water masses, seasonal growth changes uptake, and nighttime respiration can reverse the daytime signal. These blue carbon limitations matter for planning, because benefits are often spatially confined and temporally intermittent. In sheltered bays, pairing vegetation restoration with careful siting of aquaculture may reduce exposure, but it is not a scalable substitute for global mitigation on open coastlines.

More controversial proposals attempt to change seawater chemistry directly through ocean alkalinity enhancement (OAE) or related forms of enhanced weathering. The idea is to add alkaline minerals so the ocean can absorb more CO_2 while maintaining higher pH and carbonate availability. Proponents argue that, in principle, OAE could address both climate and acidification, but the proposal raises governance and scientific uncertainties. The upstream footprint of mining and energy use can be substantial; the downstream ecological side effects are hard to forecast; and the monitoring, reporting, and verification of outcomes is technically demanding in dynamic coastal waters. Small deployment errors could create local hotspots of altered chemistry, and the distribution of risks and benefits may be uneven, intensifying debates about consent and environmental justice.

Because so many interventions hinge on local conditions, measurement becomes both a scientific tool and a policy safeguard. Modern programs increasingly track multiple variables—pH, alkalinity, temperature, oxygen, and biological indicators—to identify when systems approach thresholds. Data can support early-warning services for aquaculture and inform the design of protected areas by mapping refuges and high-variability zones. Yet long-term observing networks are expensive, and many regions with high dependence on marine resources have limited capacity to maintain sensors, laboratories, and trained



staff. Without equitable investment, the places most exposed to acidification may also be the least able to document harm or to evaluate interventions.

A realistic strategy therefore combines strong mitigation with targeted, evidence-based adaptation, while treating geoengineering-style approaches as experimental and conditional rather than routine. Each option should be judged by measurable outcomes and explicit trade-offs, including who pays, who benefits, and what risks are displaced. Overpromising local fixes can erode public trust and delay emissions cuts; underinvesting in resilience can leave communities exposed while global agreements move slowly. Navigating an acidic future ultimately requires chemistry literacy and social realism: the willingness to act on what is knowable, to admit uncertainty, and to design policies that remain honest under pressure.

Questions 27–31

Choose **TRUE** if the statement agrees with the information given in the text, choose **FALSE** if the statement contradicts the information, or choose **NOT GIVEN** if there is no information on this.

27 The passage warns that presenting local fixes as substitutes for emission cuts may weaken pressure for broader mitigation.

28 The passage suggests that adding buffering substances is a practical way to reduce acidity in open coastal waters.

29 The passage suggests that seagrass and kelp can raise local pH only under certain conditions and that the effect may be short-lived.

30 The passage states that ocean alkalinity enhancement will be commercially standardised within the next decade.

31 The passage suggests that the expense of long-term monitoring creates difficulties for regions with limited resources.

Questions 32–36

Select the correct answer.

32 What does the passage identify as the chief strength of mitigation?

A It addresses the driver of acidification rather than treating local symptoms.

B It can protect vulnerable habitats quickly enough to match ecological change.

C It avoids political trade-offs by relying mainly on technical fixes.

D It reduces the need for accountability because outcomes are self-evident.



33 Which hatchery strategy is mentioned as a way to reduce exposure during low-pH periods?

- A** Moving production permanently to offshore sites where chemistry is more stable
- B** Replacing monitoring with standardised intake rules across seasons
- C** Changing intake timing based on chemistry measurements
- D** Adding alkaline minerals directly to surrounding coastal waters

34 Why might reef restoration have limits, according to the passage?

- A** Local stressors cannot be influenced by management action.
- B** Reef frameworks may not accrete calcium carbonate fast enough to offset erosion.
- C** Planting coral fragments typically increases sediment runoff and nutrient pollution.
- D** Erosion becomes irrelevant once coral fragments are introduced.

35 Why are some nature-based measures described as variable?

- A** They raise pH uniformly along open coastlines once implemented.
- B** They work only at night, when respiration is strongest.
- C** They depend mainly on changes in international carbon markets.
- D** Their effects are influenced by factors such as currents and season.

36 Which concern is associated with ocean alkalinity enhancement in the passage?

- A** Uncertain ecological side effects and the difficulty of measuring outcomes.
- B** The inability of added minerals to alter seawater alkalinity at all.
- C** Proof that small deployment errors cannot affect local ecosystems.
- D** A lack of scientific interest in testing the idea.

Questions 37–40

Complete the summary below. Choose **ONE WORD ONLY** from the text for each answer.

Building a realistic response to ocean acidification

Monitoring data can support early-warning services for **37** and help identify threshold conditions. However, many exposed regions struggle to sustain observing networks because local **38** is limited. The passage argues that options should be compared using explicit **39** rather than comforting promises. It concludes that effective action requires chemistry literacy and social **40**

Answer Key

27. TRUE



28. FALSE

29. TRUE

30. NOT GIVEN

31. TRUE

32. A

33. C

34. B

35. D

36. A

37. aquaculture

38. capacity

39. trade-offs

40. realism