

NOVEMBER 2017

OCEAN ACIDIFICATION

- As carbon dioxide (CO_2) dissolves in sea water, it forms carbonic acid, decreasing the ocean's pH, a process collectively known as ocean acidification.
- Present ocean acidification occurs approximately ten times faster than anything experienced during the last 300 million years, jeopardising the ability of ocean systems to adapt to changes in ocean chemistry due to CO_2 .
- Ocean acidification has the potential to change marine ecosystems and impact many ocean-related benefits to society such as coastal protection or provision of food and income.
- Increased ocean temperatures and oxygen loss act concurrently with ocean acidification and constitute the 'deadly trio' of climate change pressures on the marine environment.
- To combat the worst effects of the deadly trio, CO_2 emissions need to be cut significantly and immediately at the source.
- Sustainable management, conservation, restoration and strong, permanent protection of at least 30% of the ocean are urgently needed.

What is the issue?

Ocean acidification is a direct consequence of increased human-induced carbon dioxide (CO_2) concentrations in the atmosphere. The ocean absorbs over 25% of all anthropogenic emissions from the atmosphere each year. As CO_2 dissolves in sea water it forms carbonic acid, thereby decreasing the ocean's pH, leading to a suite of changes collectively known as ocean acidification. Ocean acidification is happening in parallel with other climate-related stressors, including ocean warming and deoxygenation. This completes the set of climate change pressures on the marine environment – heat, acidity and oxygen loss – often referred to as the 'deadly trio'. Interaction between these stressors is often cumulative or even multiplicative, resulting in combined effects that are more severe than the sum of their individual impacts.

Why is this important?

Present ocean acidity change is unprecedented in magnitude, occurring at a rate approximately ten times faster than anything experienced during the last 300 million years. This rapid timeline is jeopardising the ability of ocean systems to adapt to changes in CO_2 – a process that naturally occurs over millennia. Changes in ocean pH levels will persist as long as concentrations of atmospheric CO_2 continue to rise. To avoid significant harm, atmospheric concentrations of CO_2 need to get back to at least the 320-350 ppm range of CO_2 in the atmosphere.

Compared to other similar events in Earth's history, ocean acidification, over hundreds of years, has been happening very fast. However, its recovery has been

very slow due to the inherent time lags in the carbon and ocean cycles.

Oceans are acidifying fast



From: Laffoley, D. d'A. and Baxter, J.M. (eds) (2010) *Ocean Acidification: Questions Answered*.

Ocean acidification has the potential to change marine ecosystems and impact many ocean-related benefits to society such as coastal protection or provision of food and income. Although more knowledge on the impacts of ocean acidification on marine life is needed, changes in many ecosystems and the services they provide to society can be extrapolated from current understanding. Some of the strongest evidence of the potential effects of ocean acidification on marine ecosystems stems from experiments on calcifying organisms.

Increased sea water acidity has been demonstrated to affect the formation and dissolution of calcium carbonate shells and skeletons in a range of marine species, including corals, molluscs such as oysters and mussels, and many phytoplankton and zooplankton species that form the base of marine food webs.

Changes in species growth and reproduction, as well as structural and functional alterations in ecosystems, will threaten food security, harm

Ocean Acidification Research Paper

B Lingard



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Table of Contents Ocean Acidification Research Paper

1. Understanding the eBook Ocean Acidification Research Paper
 - The Rise of Digital Reading Ocean Acidification Research Paper
 - Advantages of eBooks Over Traditional Books
2. Identifying Ocean Acidification Research Paper
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Ocean Acidification Research Paper
 - User-Friendly Interface
4. Exploring eBook Recommendations from Ocean Acidification Research Paper
 - Personalized Recommendations
 - Ocean Acidification Research Paper User Reviews and Ratings
 - Ocean Acidification Research Paper and Bestseller Lists
5. Accessing Ocean Acidification Research Paper Free and Paid eBooks
 - Ocean Acidification Research Paper Public Domain eBooks
 - Ocean Acidification Research Paper eBook Subscription Services
 - Ocean Acidification Research Paper Budget-Friendly Options

6. Navigating Ocean Acidification Research Paper eBook Formats
 - ePub, PDF, MOBI, and More
 - Ocean Acidification Research Paper Compatibility with Devices
 - Ocean Acidification Research Paper Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Ocean Acidification Research Paper
 - Highlighting and Note-Taking Ocean Acidification Research Paper
 - Interactive Elements Ocean Acidification Research Paper
8. Staying Engaged with Ocean Acidification Research Paper
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Ocean Acidification Research Paper
9. Balancing eBooks and Physical Books Ocean Acidification Research Paper
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Ocean Acidification Research Paper
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Ocean Acidification Research Paper
 - Setting Reading Goals Ocean Acidification Research Paper
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Ocean Acidification Research Paper
 - Fact-Checking eBook Content of Ocean Acidification Research Paper
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

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