4-25-2024

Seagrass Conservation and Restoration to Mitigate Ocean Acidification and Climate Change

Tori Benson
College of Saint Benedict/Saint John's University

Emi Wagner
College of Saint Benedict/Saint John's University

Jaeger Reed
College of Saint Benedict/Saint John's University

Seagrass Conservation and Restoration to Mitigate Ocean Acidification and Climate Change

Tori Benson, Emi Wagner, Jaeger Reed

College of Saint Benedict/Saint John's University, Biology Department, Collegeville, MN 56321

Introduction

- Climate change and ocean acidification are increasingly important global concerns influenced by rising atmospheric carbon dioxide levels.
- Human activities, like burning fossil fuels, trawling, and seismic testing, are just a few of the many significant contributions to greenhouse gas emissions, magnifying climate change.
- Elevated CO2 levels lead to ocean acidification, threatening marine ecosystems and biodiversity by reducing ocean pH levels.
- Seagrass ecosystems have emerged as vital allies in combating climate change and ocean acidification through their capacity for carbon sequestration. These interconnections are essential for effective global management and conservation efforts.

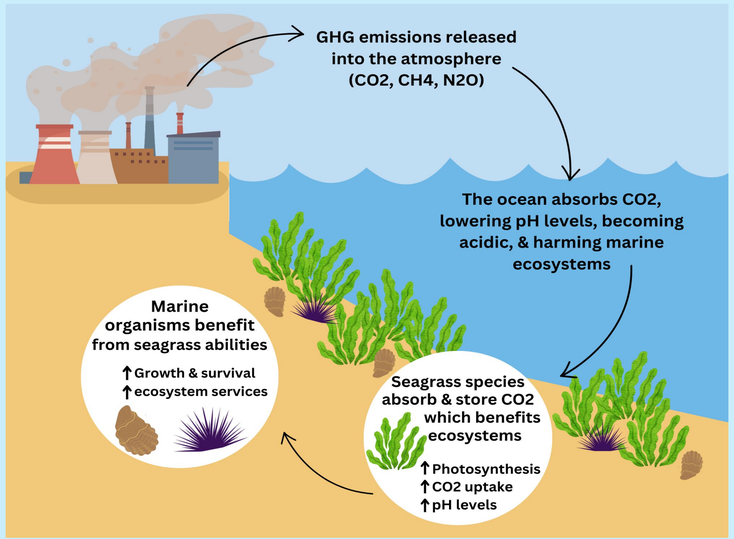

Figure 1. Relationship between climate change, ocean acidification, seagrass ecosystems, and other organisms like oysters and sea urchin.

Climate Change & Ocean Acidification

- **Climate change** is a long-term shift in global temperature, including weather patterns, and results from a variety of greenhouse gas (GHG) emissions like carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), which can trap heat in the atmosphere through the greenhouse effect.
- **Ocean acidification** is also a long-term process, where there is a decline in the pH levels of the ocean, and it is directly caused by elevated CO2 levels. When CO2 is absorbed by ocean water, it reacts to form carbonic acid (H2CO3) and this process decreases pH levels, making the ocean more acidic.
- A potential solution to these issues is conserving and restoring seagrass ecosystems. They are made up of diverse aquatic flowering plants, are found globally, can provide support a wide variety of marine life, and play a crucial role in removing carbon from the environment through sequestration (Xu et al., 2024).

Presentation of Research

- Seagrass decline has been observed since 1880, with a 19.1% decrease in meadow area (Dunic et al., 2021).
- Early conservation efforts utilized artificial seagrasses to aid in restoration because it mimics natural functions, enhancing sediment-light function, and stabilizing sediment composition for successful transplantation.
- Some seagrass species show resilience to environmental changes, including adaption to increased CO2 levels, which enhances shoot density and biomass, contributing to carbon sequestration efforts and showcasing their ability to survive (Russell et al., 2013).
- Seagrasses thrive in shallow coastal waters with clear visibility since these conditions facilitate photosynthesis to produce energy, supporting their growth and resilience to environmental stressors (Krause-Jensen et al., 2021).

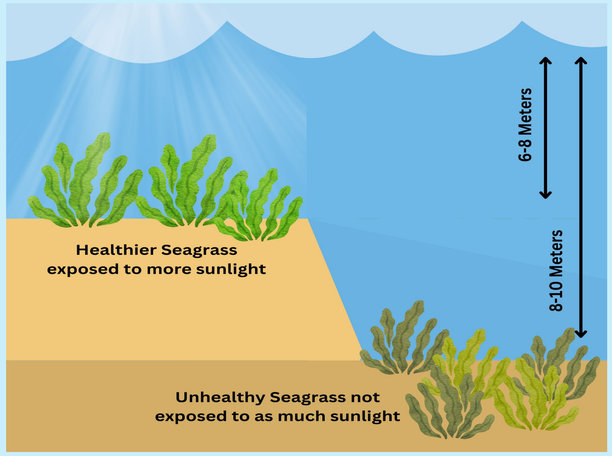

Figure 2. Diagram illustrating the influence of water depth and clarity on seagrass health and photosynthesis.

- Some seagrass species demonstrate increased carbon storage capacity with age with rises in shoot density, and denser meadows trap organic matter in sediment, enhancing carbon burial rates.
- In seed germination, research indicates that warmer temperatures and lower salinity levels favor higher germination rates (Yue et al., 2019). In other seed-based restoration experiments, an effective method involved injecting seeds into sediment with controlled seed storage during winter (Govers et al., 2022).
- Seagrass acts as natural buffers against environmental stresses for other organisms like oysters and sea urchin by increasing pH levels through photosynthesis.
- Technological advancements, like lacunarity analysis, demonstrate how landscape configurations influence seagrass community diversity and stability while adapting to environmental change including natural disasters (Enwright et al., 2022).

Human Influence

- Some management actions and restoration efforts have increased to combat seagrass declines with some success, but challenges persist due to human activities like trawling and eutrophication, hindering the full recovery of seagrass ecosystems.
- Despite restoration efforts, seismic testing poses significant threats to seagrass ecosystems by disrupting sediment stability and releasing sequestered carbon compounds (Macreadie et al., 2015).

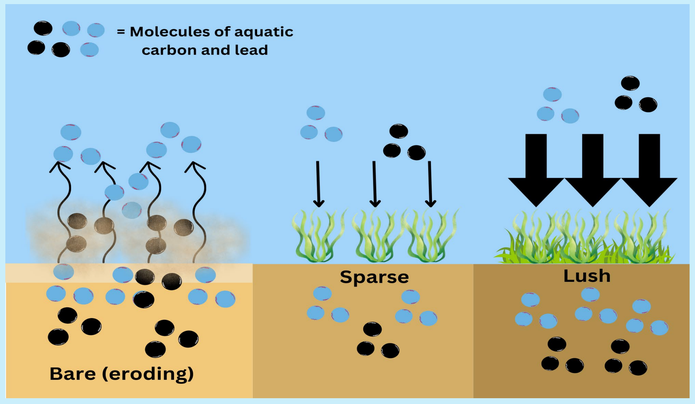

Figure 3. Diagram illustrating the rough sequestration or erosion patterns of lush, sparse, and bare regions of ocean floor. Molecules shown are oceanic carbon and lead.

Conclusions & Recommendations

- Climate Change and ocean acidification pose significant threats to global ecosystems, highlighting the importance of seagrass meadow recovery.
- Understanding the relationships between seagrass ecosystems, climate change, and ocean acidification is vital for conservation
- Seagrasses play a vital role in stabilizing ocean acidification, but they face threats from human activities and natural disasters, necessitating urgent conservation measures.
- Intensified conservation practices should include policies to reduce human disturbances such as pollution and anchor damage, and promoting nutrient regulation to facilitate meadow recovery.
- Successes in areas like Chesapeake Bay and Tampa Bay demonstrate the effectiveness of nutrient regulation in promoting seagrass meadow recovery.
- Continued research into seagrass ecology and restoration techniques, including identifying resilient species and understanding their adaptation to changing conditions, is essential.
- International collaboration and public engagement are essential for developing global cooperation and prepare communities to address climate change, preserve seagrass ecosystems, and ensure the success of conservation efforts worldwide.
- Sources available upon request.

COLLEGE OF Saint Benedict Saint John's UNIVERSITY