Climate Changes’ Toll on British Columbia's Marine Ecosystems

Climate change is causing devastating change in waters of the Pacific Coast off British Columbia and the plants and animals losing their lives and habitats need our help. The impact of climate change on marine ecosystems has become increasingly evident, one example being the massive death of sea stars attributed to Sea Star Wasting Disease. Sea star populations are decreasing at rapid rates, having a disastrous negative ripple effect on broader ecological imbalances, particularly concerning the health of kelp forests and the marine ecosystems the kelp supports. We must understand the ramifications of sea star decline, the essential role of kelp ecosystems, proposed solutions such as human-made kelp farms, and the urgent need for enhanced research and conservation efforts in the face of climate-induced marine crises.

Sea Star Wasting Disease is an epizootic causing widespread mass death among sea stars. A study from [Proceedings of the National Academy of Sciences](https://www-pnas-org.ezproxy.library.uvic.ca/doi/pdf/10.1073/pnas.1416625111) (PNAS) explains that an epizootic is a disease among animals that is equivalent to an epidemic among humans. Sea Star Wasting Disease is the largest known marine wildlife epizootic to date with a [Smithsonian article](https://www.smithsonianmag.com/smart-news/these-sea-stars-are-literally-wasting-away-but-they-may-soon-receive-protection-180981848/#:~:text=Beyond%20the%20threat%20to%20the%20species%20itself%2C%20its,%E2%80%9Curchin%20barrens%E2%80%9D%20where%20kelp%20forests%20used%20to%20be.) stating that “90 percent of the animal's population was wiped out between 2013 and 2017,” critically endangering the species and calling for urgent protection as an endangered species. [PNAS](https://www-pnas-org.ezproxy.library.uvic.ca/doi/pdf/10.1073/pnas.1416625111)’s study explains that the cause of the disease remains unknown, but it most likely has to do with abnormalities in climate and weather due to climate change, and rising ocean temperatures are proven to drastically speed up the death rate and increase the numbers of dead sea stars. It is not known why the warmer waters are making sea stars more susceptible to disease, but the heat potentially weakens their immune systems and ability to fight off the disease. An article from [Science Advances](https://www.science.org/doi/10.1126/sciadv.aau7042) provides evidence that changing water temperature is “a key facilitator of the disease-related declines in the shallow nearshore waters.” While the sea stars die much faster in warm waters, the disease is still an issue in colder waters, and more research is needed to fully understand the disease.

[Smithsonian’s](https://www.smithsonianmag.com/smart-news/these-sea-stars-are-literally-wasting-away-but-they-may-soon-receive-protection-180981848/#:~:text=Beyond%20the%20threat%20to%20the%20species%20itself%2C%20its,%E2%80%9Curchin%20barrens%E2%80%9D%20where%20kelp%20forests%20used%20to%20be.) article describes the disastrous effect of sea star population decline on the ecosystem. The deaths of Sunflower sea stars are particularly an issue, as they are the main predators of sea urchins. Without proper Sunflower sea star populations to eat them, the urchin population has exploded. Sea urchins' main food is kelp and with the increased number of them large urchin barriers have formed as they destroy thriving kelp forests. These barriers of urchins are almost completely devoid of other life and are no longer suitable habitats for a multitude of animals and plants. Not only is the kelp being attacked by the urchins, but the kelp has been unable to survive ocean heat waves, contributing to its disappearance at alarming rates. There are many examples of kelp being destroyed due to warming water in other areas such as in Australia and Norway. One such example is from an article from [YaleEnviornment360](https://e360.yale.edu/features/as-oceans-warm-the-worlds-giant-kelp-forests-begin-to-disappear) stating that where waters have become too warm for kelp to survive they have been replaced with mats of turf algae which further prevents the kelp from growing back.

Kelp dying is detrimental to the wider ecosystem as a healthy kelp forest is essential to the survival of many fish, marine mammals, and birds. The kelp forests provide essential shelter and food and according to an article from the [National Ocean Service](https://oceanservice.noaa.gov/facts/kelp.html#:~:text=These%20underwater%20towers%20of%20kelp%20provide%20food%20and,their%20young%20from%20predators%20or%20even%20rough%20storms.) harbor a “greater variety and higher diversity of plants and animals than almost any other ocean community.” This means that a kelp forest dying is equivalent to clear-cutting an entire forest. [Smithsonian’s](https://www.smithsonianmag.com/smart-news/these-sea-stars-are-literally-wasting-away-but-they-may-soon-receive-protection-180981848/#:~:text=Beyond%20the%20threat%20to%20the%20species%20itself%2C%20its,%E2%80%9Curchin%20barrens%E2%80%9D%20where%20kelp%20forests%20used%20to%20be.) article also mentions the importance of kelp for supporting a healthy environment as it can absorb large amounts of carbon dioxide. Coastal ecosystems can capture up to twenty times more carbon per acre than forests and seaweed in total “is thought to store nearly 200 million tons of carbon dioxide each year—equal to about a year’s worth of emissions from New York state,” helping resist future heat waves and mitigating the negative environmental impacts of carbon emissions.

An article from the [World Resources Institute](https://www.wri.org/insights/what-kelp-forests-protect) states that around 40-60% of kelp forests have been damaged over the past 50 years. This is a massive amount considering that kelp covers “an area about the size of the Amazon rainforest” and is “the most extensive marine vegetated ecosystem in the world.” Kelp can survive in tropical waters but prefer colder water temperatures and have been moving towards the poles in pursuit of colder regions. As well as this the Pacific Coast of British Columbia is home to some of the biggest kelp forests in the world. [This CBC article](https://www.cbc.ca/news/canada/british-columbia/coastlines-kelp-1.6485310) states that 25 to 30 percent of carbon dioxide in the atmosphere is absorbed through the ocean, with kelp playing an essential role in this process by absorbing 1 to 10 billion tons of carbon dioxide a year, according to a [MIT Technology Review](https://www.technologyreview.com/2021/09/19/1035889/kelp-carbon-removal-seaweed-sinking-climate-change/#:~:text=An%20expert%20panel%20assembled%20by%20the%20Energy%20Futures,10%20billion%20tons%20of%20carbon%20dioxide%20per%20year.) article. The study from [PNAS](https://www-pnas-org.ezproxy.library.uvic.ca/doi/pdf/10.1073/pnas.1416625111) explains how research on climate change is largely focused on tropical areas and neglects the Pacific Coast which raises concern as kelp may not be receiving the research attention and support it so desperately needs. One suggested solution to assist the regrowth of kelp and help mitigate the effects of climate change is the creation of human-made kelp farms. These farms could potentially increase habitat sequestration spaces for animals, produce oxygen, and absorb massive amounts of carbon dioxide. This could be an incredibly effective strategy, but this [MIT Technology Review](https://www.technologyreview.com/2021/09/19/1035889/kelp-carbon-removal-seaweed-sinking-climate-change/#:~:text=An%20expert%20panel%20assembled%20by%20the%20Energy%20Futures,10%20billion%20tons%20of%20carbon%20dioxide%20per%20year.) article breaks down the challenges and complications of kelp farming and why proceeding with caution around this new idea is essential to its success and the health of the planet. A major issue is that many specifics for kelp farming projects are unclear. No one knows how much kelp companies can grow, how much carbon the kelp can hold or for how long, or the consequences of depositing such large amounts of carbon into the kelp and storing it in the ocean. These uncertainties, however, have not prevented companies from trying to make these plans work. Studies show that if the kelp forests can absorb carbon dioxide and successfully sink to deeper waters they could hold carbon for up to 750 years. If these kelp farms can be implemented, it could be the largest successful carbon sequestration solution and a major solution to mitigating climate change effects. However, assuming the project does become successful, it could have unwanted negative effects on the ecosystem. Examples of this include the bed of kelp disrupting animal migration patterns or the large amounts of carbon affecting the biochemistry of ocean water. Additionally measuring the carbon removal could prove challenging, and there are concerns that these projects will progress even if it has not been proven to be the most effective strategy. The project could provide incentives for companies to make money and would be an opportunity to purchase carbon offsets, improving the appearance of their business even if the project is not the most effective. It is therefore important that those studying the possibility of creating kelp forests only go ahead with the best plan if it is truly best for the earth and not just because they are receiving vast amounts of funding. There are also no set means of holding companies accountable for mistakes such as miscalculating the amount of carbon promised to be absorbed or the positive effects on the environment. There are also many logistical obstacles to growing this sheer amount of kelp, including how kelp is suffering due to climate change so it may be difficult to get it to behave as wanted.

Due to these complications and many others, kelp farms should and will remain only part of numerous strategies for mitigating the effects of climate change and carbon dioxide sequestration. Kelp farming is a promising plan but there cannot be one solution to climate change. Overall, the kelp farms are incredibly promising, but more studies must be done to ensure this is the best and most effective strategy and to ensure the strategies put in place will work effectively and as promised.

Research from [Global Ecology and Conservation](https://dspace.library.uvic.ca/server/api/core/bitstreams/70dcc282-982d-430e-a420-bf2073457ddf/content) explains that most research done on oceans until now has been on tropical coral reef areas and cold deep-water areas such as the Arctic. There has not been much research focused on temperate sea areas other than to suggest them as a place of refuge for coral, but there is little proof that this could be possible. This article highlights the importance of studying this region superficially off the British Columbia coast as the waters there are the most acidic in the global ocean so changes in oxygen level are especially notable making the area more responsive to oceanographic changes related to climate change. In-depth research in this area remains minimal, and the paper is largely meant to serve as a basis for further discussion. This is also due to the limitations of studying this area as “detailed information on species distributions, habitat preferences, and physiological tolerances (e.g., to temperatures, acidic waters) is generally not compiled for species in Canada’s Pacific waters.” This region needs drastically more research and would provide helpful information for studying the effects of climate change in other areas of the world. The area also desperately needs protection as [Blueprint of the Coast](https://blueprintforthecoast.ca/resources/the-coast-is-clear-for-a-bc-coastal-marine-strategy/#:~:text=British%20Columbia%20is%20one%20of%20the%20only%20provinces,law%20or%20strategy%20to%20direct%20its%20ocean%20management.) states nearly every other province in Canada and state in the United States has a coastal protection law or established strategies to guide its ocean management.

In December of 2022, British Columbia released [A Coastal Marine Strategy Policy Intentions Paper](https://engage.gov.bc.ca/app/uploads/sites/121/2022/12/Coastal-Marine-Strategy-Intentions-Paper.pdf). It was written by the staff of the Ministry of Water, Land, and Resource Stewardship with the support and collaboration of coastal Indigenous nations. This paper is essential as according to [Blueprint for the Coast](https://blueprintforthecoast.ca/resources/the-coast-is-clear-for-a-bc-coastal-marine-strategy/#:~:text=British%20Columbia%20is%20one%20of%20the%20only%20provinces,law%20or%20strategy%20to%20direct%20its%20ocean%20management.), historically the province has “made management decisions affecting coastal and marine areas through a hodgepodge of different departments and ministries, using several pieces of legislation,” some of which lack specific focus or design on marine issues entirely. The intentions paper outlines what the province aims to do regarding ocean protection, the reasons behind these actions, and how First Nations people will be involved. The paper encourages feedback from the public, emphasizing the importance of reflecting the values of BC residents as the paper is intended to guide BC for the next twenty years. [Blueprint for the Coast](https://blueprintforthecoast.ca/resources/public-feedback-for-the-coast/#:~:text=The%20Government%20of%20BC%20released%20a%20%E2%80%9CWhat%20We,on%20the%20Coastal%20Marine%20Strategy%20Policy%20Intentions%20Paper.) summarizes the feedback with around nine hundred responses received providing feedback and ranking the importance of strategy outcomes, calling for legislation and commitment to work with indigenous communities, and signaling overall approval of the suggested plan. Feedback and soliciting public opinion are good steps but possibly not a reason to delay the implementation of this vital plan. In 2024 an official Coastal Marine Strategy will be released which will be implemented between 2024 and 2044 achieving “better outcomes for the environment, communities, and the economy” over the next twenty years. The paper is a good start and promising regarding future marine protection in BC. The devastating effects of climate change on the Pacific Coast of BC are undeniable and continued efforts in research, conservation, and policy are imperative to protecting marine survival and biodiversity in the face of climate challenges that will only worsen without our help.