Sea Urchin Crushing Positively Impacts Global Warming by Restoring Kelp Forests

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Abstract

Kelp forests contribute greatly to climate change in that they significantly reduce the amount of CO2 in ocean waters and the surrounding atmosphere through their photosynthetic process. Invasive sea urchins feed off of kelp forests, thus, releasing and increasing the CO2 levels in the ocean. To prevent this from happening, sea urchin crushing (culling) is the best solution in steadying their population as well as restoring the kelp forests that regulate and positively impact climate change.

Introduction

Sea urchins are one of the most abundant marine organisms in the world with about 950 different species residing in various oceans. Since there are so many urchins, they begin to eat and invade kelp forests. In fact, more than 95% of California's coastal kelp are gone (1) and are now classified as "dead zones". Aside from what kelp may home, there are other imperative benefits that come from maintaining and reviving these ecosystem facilitators. One of the biggest contributions kelp forests make is the absorption of carbon dioxide. Increased levels of carbon dioxide in the atmosphere or ocean waters causes high temperatures that can reach extreme levels. This means that kelp is an essential component in keeping balance in the ocean as well as the Earth as a whole.

Without kelp forests to assist in the regulation of climate change in both the ocean and, in turn, the global atmosphere, ocean surface temperatures have risen by 1°C which can cause a shift in various species tolerance ranges as well as the level of ocean acidification (3). These levels are expected to continue to rise exponentially as the century progresses and could cause havoc in the ecosystems that contain kelp forests. Restoration is the solution to this fast paced problem. The effectiveness of restoration is "greatly increased by removing essentially all sea urchins from discrete areas of urchin barrens" (2). One of the main methods that proves to be both effective in removal and benefitting the surrounding marine life is crushing, or piercing urchins (2). Sea urchin crushing and leaving the waste remains behind provides ample food for the ecosystem and allows for the kelp forests to prosper, free of the feeding urchins.

Materials & Methods

For this literature review, the main component was extensive reading of research articles that aid in learning more about what studies and applications have been done in the designated focus area. This specific area is the relevance between crushing sea urchins and climate change/global warming. In EBSCOHost and Google Scholar, the following key terms were used to conduct the search: "sea urchin reduction", "importance of kelp forests", "climate change and oceans", and "sea urchin population". Since this has been an issue for some time, the searches ranged from the years 1979 to 2022 in seabeds from California to Australia. The articles and studies are useful in the way that they tie together the urchin abundance to the growing danger of climate change while also providing ample data and research.

Results

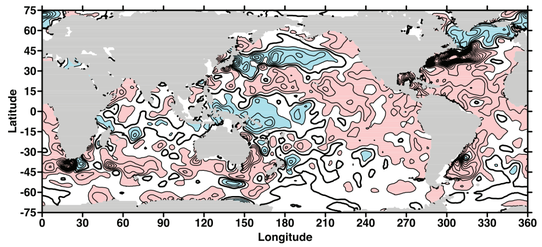

Figure 1. Linear trends from 1955-2003 of change in ocean heat content per unit surface area Wm-2 (watt per square meter) are illustrated above. The red shading indicates values that are equal to or greater than 0.25 Wm-2, and the blue shading indicates values that are less than or equal to 0.25 Wm-2. Watt per square meter is the measure of the average heating rate of the Earth's surface.

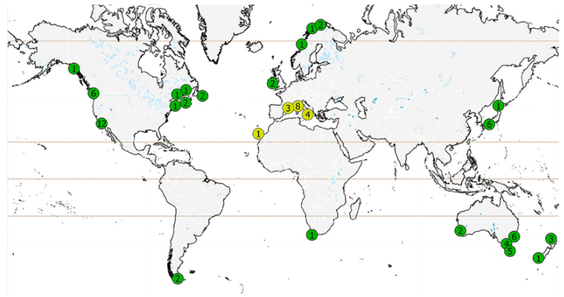

Figure 2. The green spots mark the areas with studies that have been published on sea urchin populations, reduction, and kelp forests (1) up to the year 2022.

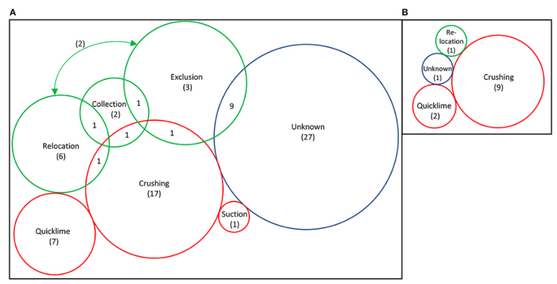

Figure 3. Each method of urchin removal is represented above in respective colors; red is for culling, green is for collection/relocation/exclusion methods, and blue is unknown (1). This data is based on how many studies have been published up to the year 2022.

Discussion & Conclusion

In Figures 1 and 2, the correlation between the ocean temperature and sea urchin abundance is prominent as those areas are the same (with the inference that sea temperature and heat rate have increased and followed the trend since 2003). This means that the areas with the sea urchins are directly related to how hot the ocean gets and how much excess CO2 there is. This is a result of the lack of kelp forests which is caused by the sea urchin population that feeds upon them. Figure 3 shows the most efficient and prominent way to remove the urchins from those areas with large amounts of sea urchins that are deficient in kelp forests. In recent studies, it is shown that there is an increase of kelp forest growth as a result of sea urchin crushing. Since it is established that there is a positive impact on kelp forests, there is also a positive impact on climate change and global warming as well.

The research conducted was to answer the question of what kind of impact urchin crushing has on climate change and global warming by keeping kelp forests alive. In order to find answers to this question, the search engines, EBSCOhost and Google Scholar were used. Through these search engines, the articles found had conducted studies and collected data that greatly relates to the topic at hand. It was found that there is a direct correlation between urchin invasion and climate change because of how much damage the urchins do to kelp forests. To combat this, the studies elucidated that sea urchin crushing was most impactful in the reduction of those populations and climate change overall. In future research, it would be helpful to conduct more sea urchin crushing attempts to truly see the difference that it makes on the ocean (and Earth's) climate.

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