Bio 488

Dr.Fink

3/16/2020

The assessment and analyzation of threats to marine life and habitats and project proposals to combat these threats.

Abstract

The purpose of this research is to identify, analyze, and assess the main threats to marine life and marine ecosystems. As you may know the ocean covers around 71% of the earth and is home to an abundance of wildlife, many of which are relied around the world for food and jobs. Currently there are five main issues affecting marine life, these issues are overfishing, pollution, habitat destruction, ocean warming and acidification. If these issues aren’t resolved, they could spell disaster for the majority of the world. You might be asking; how can we combat these issues? Well I’ll tell you. For overfishing I propose that periodically we slightly expand fish sanctuaries and modify regulations to allow populations more time and more areas to grow. For pollution, the areas of pollution should be sectioned and ranked, then starting with the highest priority areas start pollution cleanup with both man and machine. Once the pollution is collected, I propose that the use of plastic eating bacteria and caterpillars be implemented to further break pollution down. In regard to habitat destruction I think the best approach is to treat the areas like a garden, plant new seeds, give them the nutrients and support so that they can flourish. Ocean warming and acidification are two issues from the same problems, pollution and climate change. In order to help combat these issues I think that implementing filters on and around high priority dump sites and starting campaigns specifically small global ads on social media to help raise more awareness about the issues at hand and how serious they are.

Introduction

Throughout mankind’s time on earth we have been dependent upon the sea and the life and materials it produces. Unfortunately, over mankind’s time on here especially over the past 100 years pollution has become an ever increasing concern to marine life which intern comes back onto us and our way of life. The oceans cover over 71 percent of the planet’s surface, provide over 97 percent of the world’s water supply and over 70 percent of the oxygen we breathe but through constant pollution this massive resource could soon be unavailable if not monitored treated properly. Due to the heavy reliance mankind has on the oceans and the materials it produces it should be a major priority to highlight the major threats harming marine ecosystems and marine life and finding ways to help combat these issues. One study analyzed the current level of harm to marine life just in the United Kingdom and predicted some possible affects that further devastation to marine life might have. Further harm to marine life could result in a varying, and at present unpredictable, change in the provision of goods and services, including reduced resilience and resistance to change, declining marine environmental health, reduced fisheries potential, and loss of recreational opportunities (Beaumont, 2008). Another study looked at marine ecosystems that have heavy human influence and discovered that these ecosystems are experiencing accelerating loss of populations and species. They also found that with an increase in human usage of resources from the ecosystems the rate for recovery potential, stability, and water quality decreased exponentially with declining diversity (Worm, 2006). Throughout this paper the five main threats to marine life will be examined, analyzed, and assessed to see their impact on marine life and to find ways to help combat these issues. The five main issues being looked at throughout this paper that are affecting marine life are overfishing, pollution, habitat destruction, ocean warming and acidification. Each issue will be looked at in depth to identify the major levels of severity, the impact they have on marine life, the impact they have on our lives, where the major sites of impact are, the causes of the issue, and then a plan will be created to help combat the issue. The hypothesis of this research proposal is that if the main areas of concern and can be highlighted and projects made for each issue can be made and implemented then there will be a major reduction in ocean pollution and an increase in marine life. This research will look at sites and issues around the world and if implemented to its fullest extent would be implemented on a global level in order to protect the maximum amount of marine life and habitats. Although there are many contributing factors to the threat and degradation to marine life. The main approach will be to identify the five main threats to marine life and after that identify sites/areas which are of high interest and that can be used as examples of problematic areas.

Literature Review

Although there are many contributing factors that play a role in the reduction and quality of marine life the five biggest issues that are killing/harming wildlife in our oceans are overfishing, coastal pollution, habitat destruction, ocean warming, and water acidification (Stone, 2014). Research on each issue has led to an enormous amount of information about the impact each has on marine life. First while looking at overfishing it is apparent that overfishing not only has led to a decrease in fish population but also overall fish size. When looking at a change in fish sizes, a trend in decline can be seen first in the nearshore waters of industrialized countries of the Northern Hemisphere, then spread offshore and to the Southern Hemisphere (Pauly, 2005). Another study looking at overfishing came to the conclusion that suggest fisheries exploitation affects not only target stocks but also communities of organisms, ecological processes, and even entire ecosystems. Conservationists, and the non-governmental organizations they represent, consider such impacts a cause for concern, because the loss of biodiversity that can result is largely irreversible (Agardy, 2000). The main concern when looking at pollution and how pollution affects marine life is the drastic affect plastic has on marine life. Plastic kills fish, birds, marine mammals and sea turtles, destroys habitats and even affects animals’ mating rituals, which can have devastating consequences and can wipe out entire species. Some of these species are already on the endangered species list which makes finding a solution even more important. When looking at the effects of pollution on marine life it is also important to note that natural populations in polluted areas are possibly subjected to selective pressures for an increased resistance to toxicants. But the fact that the evolution of resistance to environmental pollutants does seem to occur in some populations in polluted environments warrants taking that possibility into consideration when evaluating the results of bioassays and monitoring programs (Klerks, 1987). Not only does plastic pollution have an affect on the marine life but it also affects us through biomagnification and bioaccumulation (Derraik, 2002). One of the main concerns for habitat destruction are those of fish populations, specifically highly abundant fish populations. When looking at habitat destruction, it predicts that the most abundant species can be among the first species driven extinct by habitat destruction, given that abundant species are the poorest dispersers and best competitors. The amount of destruction sufficient to produce extinctions changed considerably as model assumptions changed, but the biased extinction remained (Tilman, 1997). For the case of ocean warming, the main cause is climate change which is a worldwide problem. In one study scientists synthesized all available studies of the consistency of marine ecological observations with expectations under climate change. This yielded a meta-database of 1,735 marine biological responses for which either regional or global climate change was considered as a driver. One of the main studies found during this study was that of the species responding to climate change, rates of distribution shifts were, on average, consistent with those required to track ocean surface temperature changes (Poloczanskas, 2013). When looking at the affects and causes of ocean acidification the main focus is on the acidification of coral reefs and other calcareous organisms, but other concerns were also identified. Elevated dissolved CO2 concentrations may impose a physiological strain on marine animals, impairing performance and requiring energy that would otherwise be used for locomotion, predation, reproduction, or coping with other environmental stresses such as rising temperatures. It is with these stresses that the decrease in marine life and habitats are being seen (Brewer, 2009). Also, ocean warming, and acidification occur at global scales and, in the case of temperature, have already caused shifts in marine ecosystem composition and function. These changes in bio-envelopes may have major implications for the ranges of geographical distribution of these organisms and in species interactions. The main causes of ocean acidification being climate change and factory dumpsites (Pörtner, 2008). Also, when looking at the main reasons and effects for ocean warming and acidification, we can see an impact from the pollution from dumpsites. The effects of pollution by organic matter, oil or industrial waste on marine communities are remarkably similar. Under severe pollution stress, the dominant species are those which give the departure from a log-normal distribution can be suggested as being the most significant and the earliest detectable change caused by pollution in a community (Gray, 1979). Also, when looking at marine ecosystems, not only are rising atmospheric CO2 and climate change associated with concurrent shifts in temperature, circulation, stratification, nutrient input, oxygen content, and ocean acidification there are other biological responses as well. Some of these include altered community structure and diversity, changes in phenology, and demography, and the modification of energy and material flows as well as biogeochemical cycles (Doney, 2012). After looking at the background for the causes of overfishing, coastal pollution, habitat destruction, ocean warming, and water acidification and the effects they have on marine life, marine ecosystems, marine habitats, and our daily lives, the background on solutions for these issues can be looked at. There should be several considerations when attempting to identify solutions to these issues. To successfully conserve these long‐lived animals, efforts must be prioritized according to feasibility and the degree to which they address threats with the highest relative impacts on population dynamics (Žydelis, 2009). On the topic of overfishing a team of scientists looked at the movement of individuals to determine a “spatial neighborhood”. This information was then used to determine management strategies along with the data of fishery demands and how local human communities use marine resources. The conclusion of this research was that regulations need to me modified to set reserve size based on adult neighborhood sizes of highly fished species and determine spacing of a reserve network based on larval neighborhoods (Palumbi, 2004). As for coastal/ocean pollution there are several well know proposed solutions to help combat this issue. Some of these proposed solutions are recycling, beach clean ups, robotic clean up methods both on land and in the water, and even the use of plastic eating microbes. As for habitat destruction some simple solutions that have been or trying to be implemented are restrictions on areas allowed to be harvested, implementation and area growth of MPA’s ‘marine protected areas’, and rehabilitation methods such as replanting and reintroduction (Carr, 2000). When looking at some ways to combat ocean warming there is not much to help with this issue as it involves a global issue, climate change. There are still some proposals on a smaller level such as the use of no-take reserves are important for protecting coral reef biodiversity from climate change and other human impacts. Ensuring that reserve populations are connected to each other and non-reserve populations by larval dispersal allows for recovery from disturbance and is a key aspect of resilience (Jones, 2007). One of the proposed solutions on monitoring and helping with ocean acidification is through the monitoring of MeHg “Methylmercury” production, bioaccumulation, and biomagnification in marine food webs. Monitoring methylmercury can give us a better understanding of the effects of ocean acidification in sources and higher trophic levels, such as fish that are ultimately vectors of human and wildlife exposure (Chen, 2008). Even with these specific solutions the main solution that will have a detrimental impact on every issue is the reduction on the distribution and intensity of human activities that overlap with marine ecosystems. One team of scientists used a multiscale spatial model to synthesize 17 global data sets of anthropogenic drivers of ecological change for 20 marine ecosystems to develop ecosystem specific regulations (Halpern, 2008).

Methods

After looking at the background on for the causes, effects, and other solutions for the problems of overfishing, coastal pollution, habitat destruction, ocean warming, and water acidification, I have come up with my own solutions to combat these threats. For overfishing I propose that periodically we slightly expand and move fish sanctuaries, plus regulations should be modified to allow populations more time and more areas to grow. For pollution, the areas of pollution should be sectioned and ranked, then starting with the highest priority areas start pollution cleanup with both man and machine. Once the pollution is collected, I propose that the use of plastic eating bacteria and caterpillars be implemented to further break pollution down. In regard to habitat destruction I think the best approach is to treat the areas like a garden, plant new seeds, give them the nutrients and support so that they can flourish. Also, for habitat destruction I think that the use of oyster farms/ habitats be implemented to also help with ocean acidification and to give plants places to root. Ocean warming and acidification are two issues from the same problems, pollution and climate change. In order to help combat these issues I think that implementing filters on and around high priority dump sites and starting campaigns specifically small global ads on social media to help raise more awareness about the issues at hand and how serious they are.

Results

As there are no current results for this project the expected results will be listed for the problems of overfishing, coastal pollution, habitat destruction, ocean warming, and water acidification after the solutions are implemented. The results from changing fish sanctuaries and regulations would be measured by looking at changes in population, and average adult size, specifically an increase in population and average adult size. The results for coastal pollution would be measured in metric tons of pollution gathered from land and water along with pollution percentage of areas both before and after cleanup efforts, ideally the lower the pollution percentage and the higher the amount of pollution collected the better. The results for habitat destruction will be measured in amount of area restored and by level of biodiversity returned from the original habitat. When looking at the results for habitat destruction, for 100% success there would need to be full restoration and fully restored or an increase in biodiversity. The results for ocean warming would be measured in degrees Celsius and to see success for this problem there would need to be stabilization of the temperature or a decrease in overall temperature. As for ocean acidification the results would be measured by PH tests, bioaccumulation and biomagnification tests, along with amount of chemicals found in the water. Some positive results would be seen in the regeneration of increase in coral reef populations and biodiversity along with lower acidification levels.

Discussion

The habitats, ecosystems, and habitats found in our ocean are absolutely amazing but not for long. These issues affect each and every one of us and are only getting worse. It is only a matter of time before the lack of marine conservation comes to impede our everyday life on a global scale and it is only a matter of time before the damage done is irreversible. The time to implement these solutions is now in order to have a better future for us and future generations. Although the solutions proposed do seem perfect for their situations there are some limitations. One of the limitations for these solutions is the pure size of the project, meaning that the necessary manpower and funding would require nations and organizations alike to come together. Not only that but there will most likely be regulations on what can be done where along with people who disagree with the concepts presented. Although there are many limitations something must be done and we must start somewhere, there is no better time to start than now.

Literature Cited

Agardy, T., 2000. Effects of fisheries on marine ecosystems: a conservationist's perspective. ICES Journal of Marine Science, 57(3), pp.761-765.

Beaumont, N.J., Austen, M.C., Mangi, S.C. and Townsend, M., 2008. Economic valuation for the conservation of marine biodiversity. Marine pollution bulletin, 56(3), pp.386-396.

Brewer, P.G. and Peltzer, E.T., 2009. Limits to marine life. Science, 324(5925), pp.347-348.

Carr, M.H., 2000. Marine protected areas: challenges and opportunities for understanding and conserving coastal marine ecosystems. Environmental conservation, 27(2), pp.106-109.

Chen, C., Amirbahman, A., Fisher, N., Harding, G., Lamborg, C., Nacci, D. and Taylor, D., 2008. Methylmercury in marine ecosystems: spatial patterns and processes of production, bioaccumulation, and biomagnification. EcoHealth, 5(4), pp.399-408.

Derraik, J.G., 2002. The pollution of the marine environment by plastic debris: a review. Marine pollution bulletin, 44(9), pp.842-852.

Doney, S.C., Ruckelshaus, M., Duffy, J.E., Barry, J.P., Chan, F., English, C.A., Galindo, H.M., Grebmeier, J.M., Hollowed, A.B., Knowlton, N. and Polovina, J., 2011. Climate change impacts on marine ecosystems.

Gray, J.S., 1979. Pollution-induced changes in populations. Philosophical Transactions of the Royal Society of London. B, Biological Sciences, 286(1015), pp.545-561.

Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E. and Fujita, R., 2008. A global map of human impact on marine ecosystems. Science, 319(5865), pp.948-952.

Jones, G.P., Srinivasan, M. and Almany, G.R., 2007. Population connectivity and conservation of marine biodiversity. Oceanography, 20(3), pp.100-111.

Klerks, P.L. and Weis, J.S., 1987. Genetic adaptation to heavy metals in aquatic organisms: a review. Environmental Pollution, 45(3), pp.173-205.

Palumbi, S.R., 2004. Marine reserves and ocean neighborhoods: the spatial scale of marine populations and their management. Annu. Rev. Environ. Resour., 29, pp.31-68.

Pauly, D., Watson, R. and Alder, J., 2005. Global trends in world fisheries: impacts on marine ecosystems and food security. Philosophical Transactions of the Royal Society B: Biological Sciences, 360(1453), pp.5-12.

Poloczanska, E.S., Brown, C.J., Sydeman, W.J., Kiessling, W., Schoeman, D.S., Moore, P.J., Brander, K., Bruno, J.F., Buckley, L.B., Burrows, M.T. and Duarte, C.M., 2013. Global imprint of climate change on marine life. Nature Climate Change, 3(10), pp.919-925.

Pörtner, H.O., 2008. Ecosystem effects of ocean acidification in times of ocean warming: a physiologist’s view. Marine Ecology Progress Series, 373, pp.203-217.

Stone G. The Five Biggest Threats to Our Oceans. HuffPost. 2014 Aug 5 [accessed 2020 Feb 25]. https://www.huffpost.com/entry/the-five-biggest-threats-\_b\_5453534

Tilman, D., Lehman, C.L. and Yin, C., 1997. Habitat destruction, dispersal, and deterministic extinction in competitive communities. The American Naturalist, 149(3), pp.407-435.

Worm, B., Barbier, E.B., Beaumont, N., Duffy, J.E., Folke, C., Halpern, B.S., Jackson, J.B., Lotze, H.K., Micheli, F., Palumbi, S.R. and Sala, E., 2006. Impacts of biodiversity loss on ocean ecosystem services. science, 314(5800), pp.787-790.

Žydelis, R., Wallace, B.P., Gilman, E.L. and Werner, T.B., 2009. Conservation of marine megafauna through minimization of fisheries bycatch. Conservation Biology, 23(3), pp.608-616.