Problem Definition

The Oceans cover 71% of the Earth's surface and are home to an incredible amount of biodiversity. Marine plants produce 70% of the oxygen in the world's atmosphere (National Geographic 2015), and oceans provide valuable resources that have driven both human culture and economic progress throughout history. Despite the ocean's evident importance to life on Earth, humanity has not worked with much effort to maintain their health.

Ocean pollution has been accumulating for decades, and the current poor health of the world's saltwater bodies is the result of human negligence. The massive amounts of waste in the oceans of the world consist of dredge, industrial waste, sewage, and radioactive waste (Ocean Pollution, n.d.). However, trash is the most significant problem. The United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution estimates that 60-80% of the waste in the ocean is made up of plastic debris (Le Guern 2009).

The location of the waste itself is difficult to track due to the immense size of the ocean. We do know that the rotational movement of ocean gyres cause trash to concentrate in large patches across the world, the largest being the Great Pacific Garbage Patch. The Great Pacific Garbage Patch is comprised of the Western and Eastern Garbage Patches, the former located near Japan, and the latter between Hawaii and California. The amount of trash in the body is unknown, as the waste is located on the ocean surface, floor, and space in between in unknown concentrations (National Geographic 2012).

Existing Policies

The problem of marine pollution is a very serious one, but there has been little international attention given to it, with most world leaders focusing instead on issues like climate change and deforestation. However, there are a few international conferences held over the years that address marine pollution. These meetings include the United Nations Convention on the Law of the Sea (UNCLOS), the Global Programme of Action for the Protection of the Marine Environment (GPA), London Convention, London Protocol, and International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).
To adequately describe the outcomes of even this subset of international policies is beyond the scope of this brief, but all address marine litter in various aspects. UNCLOS created the standards for maritime law used to this day and established the “exclusive economic zone” (EEZ) concept. As part of this treaty, responsibility for managing resources in EEZ’s was assigned to the country controlling it. Waste in international waters is mentioned, albeit briefly, with the treaty recommending that nations collaborate to keep oceans clean.

The GPA identified marine litter as a priority, and follow-up conventions continued refining the management recommendations. The London Convention, London Protocol, and MARPOL 73/78 all prohibit the dumping of waste from ships, with the Protocol being an update to the Convention that incorporates the precautionary principle and forbids the dumping of plastics. These treaties are legally binding but do not address land-based sources of waste in a meaningful way. The GPA does concern land-based sources but is not legally binding. A concrete international plan for dealing with the problem is needed, but as of now, it is unclear who will initiate that process. This work addresses that gap by designing an indicator which identifies the countries that most deserve to bear responsibility for the waste in the ocean.

**Ethical Background**

A familiar adage worldwide stands that “if you make a mess, you clean it up.” We applied this fundamental principle when designing our indicator, as countries should not be treated any different than individuals when they have made a mess. This work operates with the idea that the nations who caused most ocean pollution should be responsible for cleaning it up.

There exists a large body of literature that discusses the moral obligation that entities have for cleaning up the messes they have made. Luigi Pellizzoni (2004) creates a typology of responsibility. Pellizzoni comes up with a few different types of responsibility, but this study focused on one: liability. Liability holds that countries that caused and benefitted from environmental harm in the past are responsible for fixing the damage now. This definition was a big part of the determination of responsibility in this study, but care was also taken to ensure that the responsible countries have the financial resources to take care of the problem.

There are similar discussions regarding climate change that put the task of cleaning up emissions with the wealthy countries who have the available resources. As discussed by Roda Verheyen in his 2005 book on climate change law, the international discussion on the issue does not usually assign responsibility for damage but instead focuses on the legal consequences of those actions. These consequences are generally borne by rich, developed countries. Little discussion or literature exists for ocean litter, but the underlying ethical principles are the same as for climate change.

For this study, a hybrid of these two discussions was used. The absolute moral code established by Pellizzoni was merged with the legal responsibility discussed by Verheyen. In the end, it was determined that the countries who carry the most responsibility for cleaning up the masses of waste in the oceans are those who grew their economies by polluting in the past and are financially capable of cleaning up the debris now. To determine which countries are responsible for preventing future inputs to the ocean, the financial dimension of a nation's situation was ignored. Rich, developed countries are held accountable for their past pollution while poor, undeveloped countries are held accountable for their current pollution.

**Methods**

As discussed in earlier sections, the problem of ocean pollution requires a two-part solution: cleaning up the existing mass of pollution and reducing current and future inputs of waste into the ocean. Data regarding the waste production of 192 coastal countries was collected in an extensive study by Jambeck et al. titled “Plastic waste inputs from land into the ocean,” published in *Science* in 2015. Jambeck's data is included in this research; specifically, data regarding gross waste production, mismanaged waste, and waste input into the ocean. According to Jambeck’s team, mismanaged waste results from improperly managed landfills, littering, and other practices that cause waste to make its way toward the water. The waste input to the ocean was estimated as a constant proportion of the mismanaged waste, extrapolating from a study conducted in the San Francisco area (Jambeck et al. 2015).
In the absence of reliable time-series data concerning countries’ cumulative waste production, the 1990 scores of the competitive industrial performance (CIP) index developed by the United Nations Industrial Development Organization (UNIDO) were used as a proxy. Countries that have been highly industrialized for decades got to where they are through heavy pollution during a period where environmental standards were much lower than they are today. Including CIP in the indicator ensures that a sufficient amount of liability comes from past waste input to the ocean, and not just current levels.

Finally, the per capita GDP of countries was taken into account as a measure of each country’s capacity to fund efforts to remove ocean trash. Wealthy nations can fund the research, development, and implementation of solutions to existing waste problems, so this measure can address Verheyen’s dimension of responsibility which is discussed above.

These measures were combined to form a nine-point index, where each measure was scaled to range from 0 to 1 and added together. Five of the nine points come from the sum of gross waste measurements (gross waste production, mismanaged waste, and amount of waste input to the ocean). Three points come from the 1990 CIP (industrialization index), and the remaining point comes from the per capita GDP.

In order to determine which countries should focus on reducing current waste inputs, another 9-point indicator was created. For this indicator, the highest 10% of countries received a 1, the next 10% received a 0.9, and so on. This transformation helps account for some outliers, such as the large waste production of China, as well as the high per capita waste production of Trinidad and Tobago. Six points of this indicator come from the sum of gross waste scores (gross waste, mismanaged waste, and waste input to the ocean). The sum of the per capita scores for these measures constitute the remaining three points. Both gross and per capita measures were included in this indicator to penalize the countries that are currently contributing to high pollution, but also identify which small countries have a lot of room for improvement, despite their size.

Results

The top two countries that hold the responsibility for cleaning up waste in the open ocean are China and the United States, with respective scores of 5.5 and 4.5. Interestingly, the United States produces more waste than China, despite having less than a third of the population. However, due to superior waste management, the US has less waste that ultimately ends up in the ocean. Highly industrialized (therefore historically high polluting) and wealthy countries fill ranks three to seven: Japan, Germany, the United Kingdom, Italy, and France. Due to very high amounts of pollution, Indonesia takes the eighth spot and is then once again followed by the highly industrialized and wealthy countries of the Netherlands, Canada, and Belgium.

The countries that score highly on the second indicator differ from those of the first indicator, being primarily concentrated around Southeast Asia, with some African countries included as well. Also, the highest score for this indicator is a 9 out of nine possible points, whereas the highest score of the first indicator was a 5.5 out of nine possible points. This highest spot is taken by Sri Lanka, indicating that this nation is in the top 10% of countries for all measures of gross and per capita waste production. Other countries that make up the top ten include Malaysia, South Africa, Thailand, Vietnam, Egypt, Trinidad and Tobago, the Philippines, Algeria, and Turkey. The lowest score of the top ten, Turkey, is a 7.9, indicating a high need to improve waste management.
Conclusions and Policy Recommendations

To contextualize the results, each country’s participation in the major international conferences addressing this issue is evaluated. Of the conferences discussed earlier, data is available for country-level participation (ratification or attendance) in all meetings except the GPA. To replace GPA, one of the follow-up conventions that refined the original treaty is used. Of the top ten countries responsible for cleaning extant waste, half had participated in all five conferences, with none participating in less than three. Conversely, the top ten countries to prevent waste inputs had poor participation rates. Most participated in three or less, with number ten Turkey involved with just one of the five conferences.

In analyzing these trends to make recommendations, much of the responsibility for solving this problem is vested in rich, developed countries. While they may not be polluting as much anymore, they are responsible for much of what is in the ocean. Since they are currently the ones most likely to be attending international conferences, the Global North dominates the debate. The debate should include the high-polluting countries that do not get a powerful voice, so conventions should also be reimagined, placing lesser-developed countries at the forefront. To prevent future pollution, new systems of economic development need to be devised, and developed countries with the power and resources to create sustainable solutions should begin doing so. In the meantime, historically polluting countries should stop blaming each other and start working together to clean up the islands of trash covering the Earth’s oceans.

References


