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Riding the Wave of Microplastics in Bermuda

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Riding the Wave of Microplastics in Bermuda



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12/15/18

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Abstract

The presence of marine debris and microplastics in the Earth's oceans are a global environmental issue. Bermuda's location in the middle of the North Atlantic Gyre makes it the perfect case study for this work. As the crisis unfolds, Bermuda's environment, economy, and population are at risk of witnessing firsthand the effects of plastic pollution. This paper relies on scholarly research as well as anecdotal evidence from retail stores and locals to compile information in order to provide necessary recommendations to benefit Bermuda's ocean health. This research evaluates the pros and cons of policies which could mitigate the problem. Analysis of these policies has led to three major recommendations for the island of Bermuda, based on the foundation that small changes lead to larger long-term benefits. It is suggested that local businesses should provide incentives to consumers to reduce their use of single-use plastic. Marine debris and microplastic task forces should serve an educational purpose in schools around the island. Lastly, it was identified that Bermuda lacks quantifiable data with regards to their own plastic consumption as well as recycling schemes. Bermuda's ability to pursue such recommendations could have long-term lasting benefits on their ocean's health. Marine debris and microplastics are an expansive global epidemic, while this work focuses solely on the small island of Bermuda it is important to address that this epidemic reaches all corners of the globe.

Riding the wave of Microplastics in Bermuda

Background

Plastic is ubiquitous. In 2016 there was “335 million tonnes of plastic produced globally.” (Jambeck et al, 2015) Once produced, plastic takes on many roles. Its uses can be broken down into seven main categories, packaging, building and construction, automotive, electrical and electronic, household leisure and sport, agriculture and other. Plastic packaging, however, dominates the industry, 39.9% of plastic produced is used for packaging. Our current culture of convenience drives this need for fast, easy solutions and plastic has become our answer. However, with this culture comes the detrimental effects that plastic has on our environment. “Globally an average of eight million tons of plastic escape collection systems, winding up in the environment and eventually the ocean.” (Jambeck et al, 2015) Plastic stands to be a global phenomenon, affecting us as the population of planet earth but also our cohabitants. Pollution affects every square inch of this planet we call home, however, it has an accelerated adversity on our oceans and their ecosystem.

Our oceans make up 70% of the earth’s surface; this is a huge portion of the earth’s surface. The vast ocean is broken up into five main geographical divides the North Atlantic, South Atlantic, North Pacific, South Pacific, and Indian. These divides are also known as gyres. Gyres are large rotating ocean currents. Figure 1 below displays these divides and where they are geographically located. These gyres are home to some of the world’s largest floating trash piles. Once this debris is in the ocean the combination of UV rays and sea currents shred the plastics debris into smaller microscopic pieces called microplastics, which absorb any toxic chemicals present in the ocean. These microplastics filled with toxic chemicals are then ingested in large quantities by marine life and work their way up the food chain, having detrimental effects on the ocean's environment as well as our own. This topic of marine debris and microplastics presents a monumental global crisis. Despite being a global issue, the small island of Bermuda lends itself to being the ideal rest stop for a large amount of this floating debris.

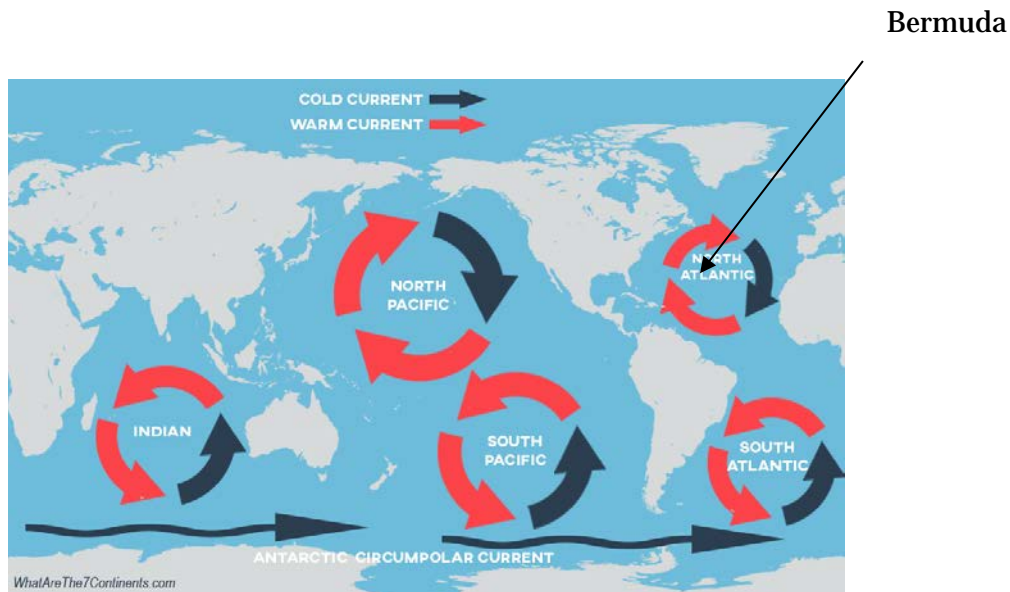


Figure 1

Why Bermuda

Bermuda, a small sub-tropical paradise located 665 nautical miles east off the coast of North Carolina provides the perfect resting spot for these microplastics and marine debris at the epicenter of the North Atlantic Gyre. Figure 1 illustrates Bermuda's location in reference to the gyres but more specifically the North Atlantic Gyre. Bermuda is a first-hand witness to the effect that microplastics and marine debris can have on an environment, culture, and economy. Bermuda's beaches are famous for their turquoise waters and pink sand, however, in recent years these beaches have become inundated with plastics and marine debris. The island is also well known for its very healthy green sea turtle population, which also faces the crisis. Bermuda's easy access from the east coast, beautiful beaches, and their subtropical climate are responsible for their booming tourism industry, an industry that contributed 17.1% to their Gross Domestic Product (GDP) in the year of 2017 and is forecast to rise by 3% in 2018 (World Travel & Tourism Council). Marine debris and microplastics may stand in the way of this profitable industry. There is a dire need to identify the problems and effects that microplastics and marine debris could have on their economy and environment. Bermuda is face to face with a global epidemic. The island's unique location and environment allow them an opportunity to showcase their fight and efforts against microplastics and marine debris and provide an example for other nations to follow.

Urgency

Microplastics and marine debris have shocking effects on the health of the ocean's ecosystems. Microplastics are also working their way up the food chain. We are already currently seeing an average of "eight million tons of plastic" escaping collection systems so what does that say for "2050 when the production of plastic is due to have increased by fourfold" (PlasticsEurope, 2015) from what it is now. This is a major environmental crisis that needs to be dealt with. Using Bermuda as a destination that can introduce policies that address the abundance of microplastics and marine debris in our oceans environment and help better their tourism industry, can be an example and platform for other nations and populations to follow.

Statement of Purpose

This paper will address the effects that microplastics and marine debris can have on Bermuda's economy, environment and population. It will outline the problem history that has led us to where we are today. Three policy options will outline how Bermuda can make major strides towards mitigating the epidemic at hand. Facing the problem of marine debris and microplastics head on could prove to be extremely advantageous for not only their population but also their economy and environment.

Methodology

I was born and raised in Bermuda and grew up on the water, any spare time I had was spent at the beach, sailing, windsurfing or kitesurfing. Once we reached a maturity level that my dad approved of we were immediately put to work in our family's souvenir store. From a young age, I noticed the abundant amount of plastic bags that circulated the retail industry as well as the heavy population of single-use plastic water bottles that tourists frequently purchased. Eventually, my experience on the water sailing led me to a unique opportunity in 2015 when I became the Head Instructor for the America's Cup Endeavour program. This was a local community project devoted to teaching middle school students' science, technology, engineering, arts, and math (STEAM) through the sport of sailing. One of the most powerful modules that we taught was marine debris. Over my two years in this role, it came to be my favorite subject to teach. Every week we would head to the same beach to collect marine debris.

Despite going to the same beach every week we would always find a new wave of microplastics and marine debris every time we went. The student's shock and dismay at the ordinary household products we would find such as toothbrushes, glow sticks and dental floss, lacked enthusiasm compared to when we would find debris with a foreign address on it. The students were always amazed to find out that the majority of the plastics and marine debris that end up on our beaches locally in Bermuda had drifted ashore from other countries. This is a problem that needs to be addressed both locally in Bermuda but also globally.

I have been fortunate enough to travel to places across the globe and it comes as no surprise that the problem of pollution and littering is not an issue that Bermuda faces alone. Whilst I have chosen to focus solely on Bermuda as the subject of this policy paper, it is extremely important to address the fact that this is a global issue. My travels throughout the United States, Europe, South America, Australia, and South Africa have only further emphasized my love and respect for our planet's natural beauty. However, these travels have made me learn to appreciate destinations that prioritize our environments health and wellbeing. Countries that I have traveled to face much larger issues than the war against microplastics and marine debris and the backseat that their environments health has taken is portrayed in the cleanliness of the country. Bermuda is an island whose physical beauty cannot be ignored, especially with a tourism industry that accounts for more than 15% of their local economy. Bermuda is in an unfortunate predicament in that their location draws in microplastics and marine debris from all over the Atlantic Ocean, due to their position in the North Atlantic Gyre. This means that Bermuda must do their part and more in order to protect their oceans from this ongoing problem. Bermuda's dataset regarding the topic leaves a lot to be desired, making this policy paper difficult to be data specific towards Bermuda. However, there is an ample amount of data regarding this topic globally. Throughout this study, I will evaluate policies that have been practiced elsewhere that Bermuda could adopt. I will also introduce new policies that could be successful. Bermuda's overall size and population lend itself to be the perfect platform to set an example for surrounding nations in their fight against tackling the abundance of plastic and microplastics in our ocean environments.

Problem History

The history of plastic dates back as early as 1600 BCE when the Mesoamerican population began to use natural rubber. However, large-scale plastic production has only come to the forefront of society more recently. The mid-1900s was when plastic production began to take off. The discovery of different types of plastic such as celluloid and synthetic polymers sparked the market for the rapidly growing industry.

World War II caused a great expansion of the plastic industry. The war saw a great need to preserve natural resources which made plastic production a priority as it was seen as a relatively cheap and easy option. During World War II the United States alone saw a “300% increase in plastic production.” (Freinkel, 2016) This surge in plastic production continued even after the war ended. Shortly thereafter in the 1960s plastic was first observed in the ocean.

Climate change and other environmental affairs were beginning to make major headlines. These headlines began to ignite conservationists to the alarming effects that plastic pollution and waste were having on the environment. Plastic's fame continued to fall as anxiety and concern about waste and pollution increased. Plastic products were recognized as disposable however it wasn't yet known that their chemical makeup would never fully decompose within the environment. Instead, it would leave behind plastic, toxic waste.

As social efforts began to fight the issue at hand the plastic industry offered a solution in the 1980s which would encourage municipalities to collect and process all recyclable materials. However, the recycling efforts made were and still are far from perfect. As discussed by Jambeck “Globally an average of eight million tons of plastic escape collection systems...” (Jambeck et al, 2015) It is important to recognize that while efforts are being made to address the problem of plastics, the plastics industry solution is not doing it justice.

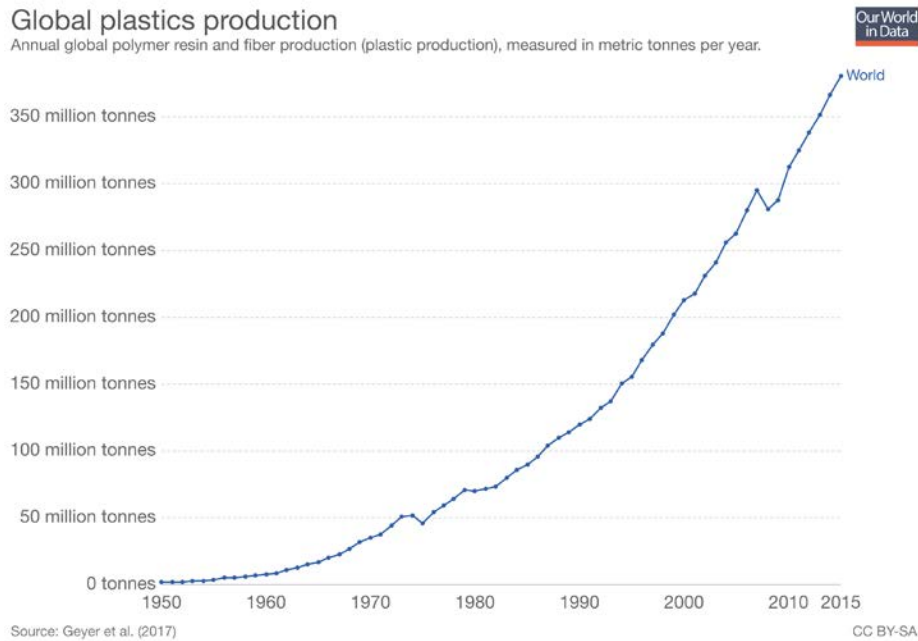


Figure 2

Figure 2 (Roland, 2017) displays the global production of plastic over time. The graph shows the exponential increase in the production of plastic over recent decades.

In recent years the plastic problem that we face globally has come to head with several social and government campaigns across the globe. Such campaigns are attempting to reduce our reliance on plastic as a convenience option and focus on more sustainable alternatives. Current policies that have been implemented across the globe include bans on single-use plastic bags by retail stores, bans on plastic straws used by restaurants.

Bermuda has followed the trends in plastic pollution over time. Alongside the rest of the world, we have seen the rise in reliance on plastic as an everyday convenience. However, the island needs to get onboard campaigns and efforts to end and resolve the fight against plastic pollution.

Current Environment

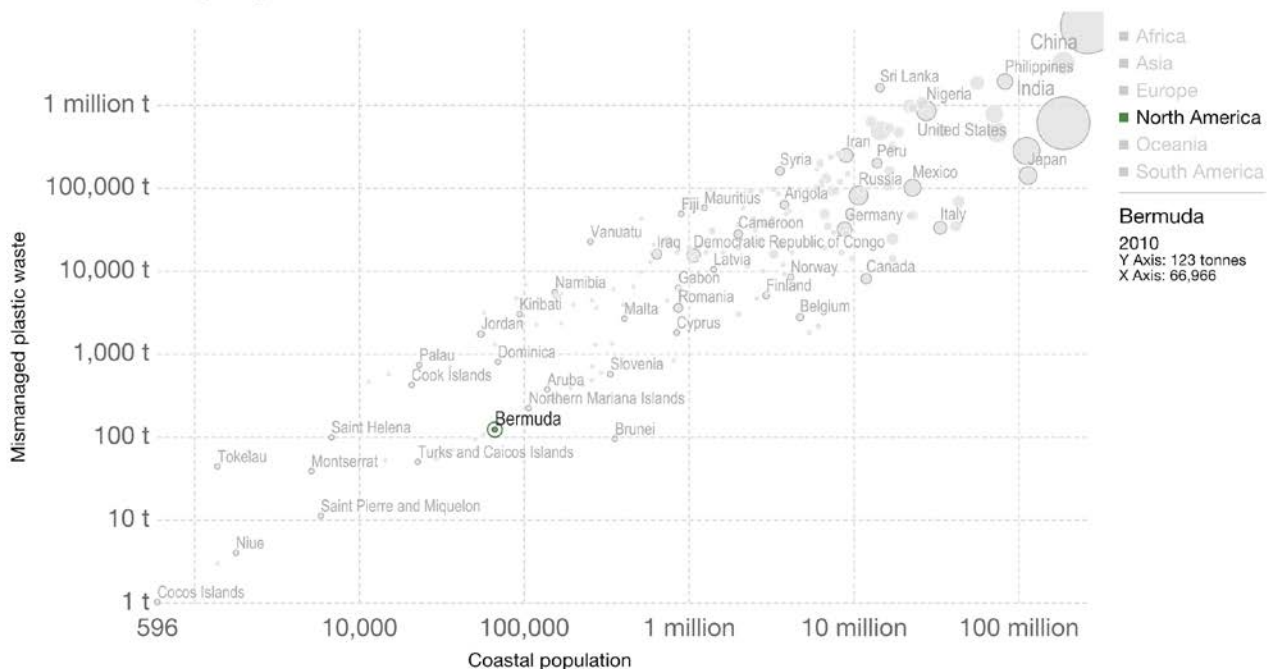
As of right now, there are no legislative policies and or regulations on the use of single-use plastics in Bermuda. The only current policy that exists in regards to waste is an optional recycling program. The program only recycles tin, aluminum, glass, and fishing line. There is also no facility on the island to deal with these recyclables, so all must be shipped off the island and sent to a facility elsewhere. All other waste produced on the island is burnt in a controlled incinerator.

Figure 3 (Roland, 2017) shows Bermuda's mismanaged plastic waste versus their population in 2010. It is important to recognize that whilst Bermuda is further down on the graph, their population is much less than that of the countries also being represented on the graph.

Mismanaged plastic waste vs. coastal population, Bermuda, 2010

Total mismanaged plastic waste (measured in tonnes) versus total coastal population (measured as the population within 50 kilometres of a coastline). Mismanaged waste is material that is either littered or inadequately disposed. Inadequately disposed waste is not formally managed and includes disposal in dumps or open, uncontrolled landfills, where it is not fully contained. Mismanaged waste could eventually enter the ocean via inland waterways, wastewater outflows, and transport by wind or tides.

OurWorld
in Data



Source: Jambeck et al. (2015)

CC BY-SA

Figure 3

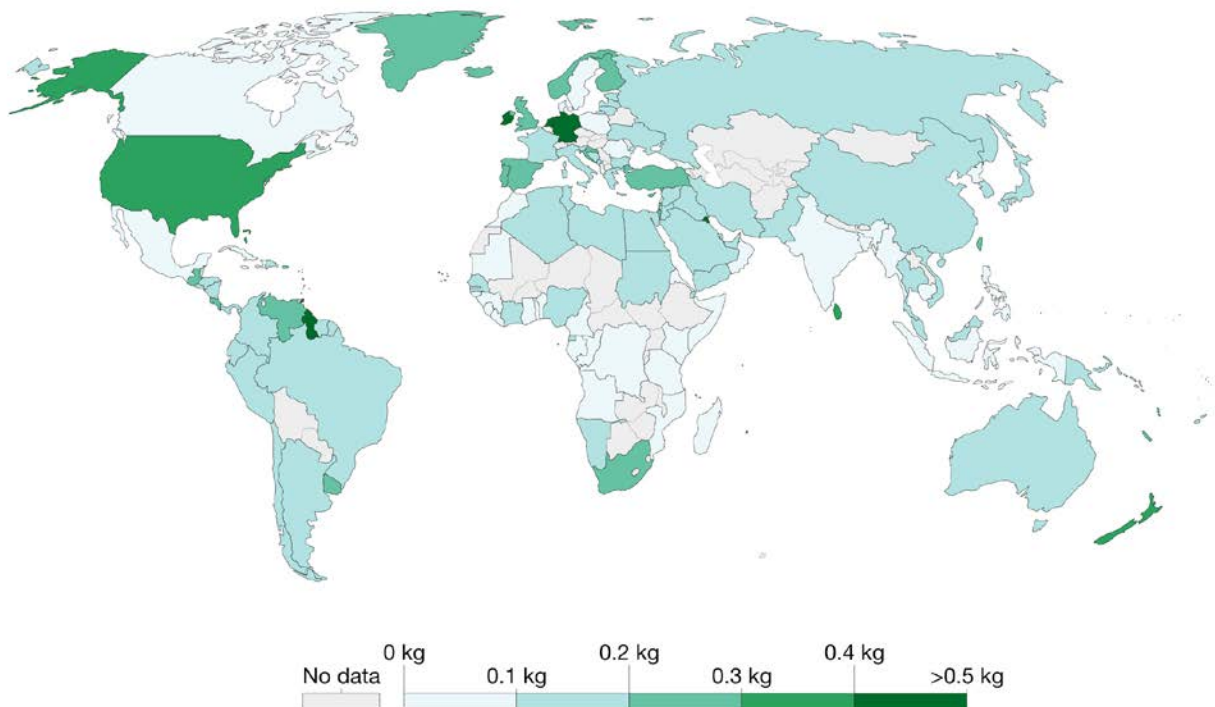
This figure alone demonstrates that 123 tonnes of plastic waste were mismanaged by the island in 2010 alone. It does not account for the mismanaged waste of other countries surrounding Bermuda that end up in the island's environment due to the ocean currents.

Bermuda's location in the middle of the North Atlantic gyre attracts more waste from surrounding nations. Figure 4 (Roland, 2017) represents plastic waste generation per person in 2010. The darker countries such as the United States, Germany, Ireland, Greenland and regions of South America show greater amounts of plastic waste generation. Unfortunately for Bermuda, these countries location in relation to the North Atlantic Gyre, place a lot of their mismanaged waste within the Atlantic Ocean.

Plastic waste generation per person, 2010

Daily plastic waste generation per person, measured in kilograms per person per day. This measures the overall per capita plastic waste generation rate prior to waste management, recycling or incineration. It does not therefore directly indicate the risk of pollution to waterways or marine environments.

Our World
in Data



Source: Jambeck et al. (2015)

CC BY-SA

Figure 4

Bermuda's population faces the task of turning the tide against plastic. The island's population may not have control over the waste that ends up there due to other nations, they must take control over their own waste. Bermuda's beaches are currently in a state that needs to be addressed. Figure 5 represents a photo of one of the many beaches in Bermuda that is seeing the effects of plastics. Plastic is also affecting their marine environment including their green sea turtle population.



Figure 5

If the plastic consumption of Bermuda's population continues than it could directly impact their tourism industry. Bermuda's beaches are famously known for their pink sand and turquoise waters, however, if and when those vibrant colors are replaced with waste, the tourist population will lose interest in visiting such sites.

Retail stores on the island are aware of the effects of single-use plastics but are faced with a tough dilemma. One store, in particular, Flying Colours, a local family run souvenir business. Flying Colours shared that in 2014 alone consumers used 99,200 single-use plastic bags. The business and its owners recognize the environmental hazards and introduced a large reusable bag (Figure 5), however, it is available for sale or to shoppers that spend \$125 dollars or more. The reason for this is the cost. The average cost of a single-use plastic bag after it is imported and taxed by local government is thirteen cents, whilst the reusable bag (Figure 5) is

\$2.24 per bag. This is a drastic cost for a small local business. Steps toward leading more sustainable practices need to be taken. Policies and legislation should be put in place to make it more affordable and easier for local businesses to reduce the use of single-use plastics on the island.



Figure 5

Policies

The policy options below outline the changes that can be made in both Bermuda's consumer environment and natural environment. Each policy outlined have their own individual strengths and weaknesses. It is a matter of change that needs to occur within Bermuda in order to mitigate the severity of their own epidemic of marine debris and microplastics. The ability to address and identify changes that can and should be made will serve the island of Bermuda in a positive way.

Policy I: Single-use plastic ban

One of the largest hurdles we face is reducing and or eliminating society's reliance on single-use plastics. Placing a ban on single-use plastics in Bermuda could drastically reduce the amount of marine debris and microplastics found within their marine environment. Eliminating all single-use plastics is not economically viable for any nation at this point in time. The B.A.N list 2.0 identifies the top 20 items that are most frequently found amongst our ocean environments today, Figure 6. Placing a ban on items such as plastic bottles, plastic bags, plastic straws, and plastic utensils could have a huge effect on Bermuda's ocean environment.

MERGED NATIONAL DATASETS: THE TOP 20 PRODUCTS								
PLASTIC PRODUCT	COUNT						TOTAL	%
	ICC	NOAA	MDT	Heal The Bay	CDA	Project AWARE		
1 Food Wrappers (candy, chips, etc.)	318880.0	272.0	16315.0	307.0	14827.0	217.0	350818.0	18.6
2 Bottle Caps (Plastic)	273088.0	779.0	11735.0	27352.0	2328.0	205.1	315488.1	16.7
3 Beverage Bottles (Plastic)	206993.0	122.0	7809.0	6297.0	5508.0	289.0	227018.0	12.0
4 Bags (Plastic)	157702.0	39.0	6970.0	5248.0	7871.0	313.0	178144.0	9.4
5 Straws, Stirrers	125835.0	172.0	4845.0	4028.0	8102.0	185.0	142745.0	7.5
6 Lids (Plastic)	75821.0	188.9	409.0	5829.5	15347.0	57.9	97751.2	5.1
7 Utensils	42598.0	33.0	1848.0	47133.0	1864.0	352.0	93829.0	4.9
8 Cigarette Butts*	51550.5	25.3	2337.9	6775.9	643.0	9.1	61341.7	3.2
9 Take Out/Away Containers (Foam)	41805.0	102.9	537.7	17698.0	548.0	8.3	60697.8	3.2
10 Take Out/Away Containers (Plastic)	49973.0	123.0	37.0	5624.0	1021.7	9.9	56788.6	3.0
11 Cups, Plates (Plastic)	48559.0	14.6	732.6	1862.2	1788.0	9.6	52943.9	2.8
12 Cigar Tips	41211.0	47.0	328.0	6243.0	2351.0	16.0	50196.0	2.6
13 Cups, Plates (Foam)	42047.0	12.4	4495.7	680.0	2021.0	8.3	49274.5	2.6
14 Tobacco Packaging/Wrap	39434.0	82.3	604.5	352.0	684.0	19.0	35185.8	1.8
15 Balloons	23492.0	19.0	1442.0	5263.0	480.3	13.0	30709.3	1.6
16 Other Plastic Bottles	17548.0	62.0	1578.0	4768.6	1429.0	9.0	25395.6	1.3
17 Cigarette Lighters	10750.0	24.0	676.5	10750.0	405.0	3.0	22608.5	1.2
18 Personal Care Products (condoms & tampon applicators)	11555.0	37.4	827.5	2213.2	1875.1	14.0	16522.2	0.8
19 6-Pack Holders	8224.0	3.0	180.0	641.0	130.0	10.0	9188.0	0.4
20 Diapers	3938.0	12.5	276.8	2150.6	82.0	7.0	6466.9	0.3
Sum Total	1584905.5	2169.3	63785.2	161223.9	69293.0	1735.1	1883112.0	100.0

Figure 6

Advantages

Banning the plastic products with a single-use lifetime could have several advantageous effects on the island of Bermuda as well as their environment.

- Plastic bottles account for 12% of the national dataset of plastic waste found within the marine environment in 2015 alone. Single-use plastic bottles are not only extremely harmful to the environment but also to humans. Placing a ban on this product in Bermuda would mean encouraging and facilitating easy viable alternatives such as reusable water bottles and more access to refillable water stations.
- Plastic bags represent 9.4% of total plastic waste found in the oceans in 2015. Plastic bags are an everyday convenience that has been used and abused for too long. Despite the chemical makeup of a plastic bag and its dangers to the oceans environments. It is frequently mistaken for jellyfish by sea life such as green turtles, who survive on a gelatinous diet of jellyfish. The ban on plastic bags would mean that shoppers, retailers and other local programs would need to source alternatives such as reusable bags or brown paper bags.
- Making the switch to plastic bags is a lot easier said than done. For retailers, the overall cost of importing and switching to reusable bags is far greater than that of single-use plastics. In Bermuda alone, the cost of importing such items is 40% of the original purchase cost. This is a dramatic increase in price for retailers. As for consumers, it is much more of a willingness to change that can affect the use of reusable bags. One must remember to bring their bags back and into stores with them when they shop.
- Straws make up 7.5% of the total plastic waste found in oceans in 2015. Straws are not only made up of harmful chemical toxins but also extremely dangerous to sea life that ingests them. There are several other alternatives that can be introduced in place of plastic straws. This includes but is not limited to paper, bamboo or reusable stainless steel straws. Straws are also not vital to everyday life, so the ability to say no to needing one is also a viable alternative as well. Straws are not vital to everyday life. While the act of being able to use a straw is a bonus to some people it is not necessary for all. Luckily, placing a ban on plastic straws is probably the simplest of all the items as there are several alternatives that can be

used in place of straws. In fact, we are seeing more and more communities switch to alternative options such as paper, stainless steel and bamboo straws.

Disadvantages

Unfortunately, banning single-use plastic is a lot easier said than done. Accompanied by advantageous effects for the environment and locals are several hurdles and disadvantages which are outlined below.

- Making the switch to plastic bags is a lot easier said than done. For retailers, the overall cost of importing and switching to reusable bags is far greater than that of single-use plastics. In Bermuda alone, the cost of importing such items is 40% of the original purchase cost. This is a dramatic increase in price for retailers. As for consumers, it is much more of a willingness to change that can affect the use of reusable bags. One must remember to bring their bags back and into stores with them when they shop.
- Another complexity that comes with banning single-use plastic water bottles is the lack of refillable water stations. Whilst water is currently available at most convenient, grocery and corner markets banning single-use bottles would eliminate these water sources unless they introduce refillable stations. Refillable stations are also more expensive at the initial point of investment for retailers.
- It is important to evaluate why what appears to be a simple ban can be much more complicated. Introducing reusable alternatives can be extremely expensive at the initial point of investment. The price of a single-use plastic water bottle in Bermuda's grocery stores is on average \$2.53 whereas the price of a basic reusable water bottle is upwards of \$10. However, if you evaluate this scenario with a long-term mindset the price of the reusable water bottle will pay for itself after approximately 25 uses.
- Utensils account for 4.9% of the plastic pollution found in our marine environment in 2015. The hard plastic that makes up these utensils make them chemically toxic and easily broken down into microplastics. Unfortunately in our culture of convenience restaurants and take away options tend to give out these harsh plastic utensils even when they are not requested by the consumer.

- The reality of getting the government to place such a ban on plastic items is extremely difficult. The population of Bermuda is also extremely vocal in expressing their opinions, especially on things that inconvenience them. Unfortunately, the predicament of this situation would serve as an inconvenience for many.

Evaluation

Overall, this policy option of placing a ban on some of the most harmful single-use plastic items in Bermuda could have a large impact on improving their ocean environment and reducing the number of single-use plastics that end up on their beaches. Government policies may pose as a major hurdle in overcoming this ban, with large duty and importation taxes, trying to order and replace single-use plastics with reusable items is far more expensive. Despite the initial price investment, over the long-term reusable items will pay for themselves making it a cheaper option over time.

Policy II: Plastic Tax

As an isolated island in the Atlantic Ocean, most of Bermuda's produce, products, and other consumer goods are imported. This means that Bermuda's government has control over the importation taxes and duty that is processed with various goods. Implementing a policy which increases the duty and taxes on single-use plastic products such as water bottles, straws, plastic bags, and utensils could decrease the amount of plastic pollution and marine debris present on the island. Complimenting this increase and offering an incentive in reduced taxes and importations on reusable goods such as water bottles and bags could provide reusable alternatives at a more reasonable cost to consumers. It is important to evaluate the success of other policies which have been implemented similar to this, both in Bermuda and abroad.

The European Parliament made major news headline for their backing of the proposed policy against single-use plastics. The proposal states that "... 10 single-use plastic products would be banned by 2021 and European Union (EU) states [would be] obliged to recycle 90% of plastic bottles by 2025." (Wilkinson, CNN) The passing of this proposal was widely celebrated by environmental activists around the world. The passing of this bill in a major global economy should provide a success story for other nations to follow. The vote was carried with 571-53.

Members of the Parliament rejoiced that it was “a victory for our oceans, for the environment and for future generations.” (Frederique Ries, MP) Ries went on to further state that “It is essential in order to protect the marine environment and reduce the costs of environmental damage attributed to plastic pollution in Europe, estimated at 22 billion euros (\$25b) by 2030.” (Ries, MP) As Ries describes, this proposal is not just a win for the environment but also the economy and future generations. This legislation should provide Bermuda’s government with the framework necessary for introducing a policy which politicians, citizens, and businesses can get behind.

Bermuda currently lacks any legal policy which discourages and prohibits the use and disposal of single-use plastic items. However, more recently Bermuda’s government introduced a ‘Sugar Tax’ on items such as sugary soft drinks (namely sodas, energy drinks, not- 100% fruit juices, drink powders and dilutables), on candies and pure sugar imports, to help tackle the country's ongoing epidemic of type two diabetes. This bill introduced that “new duty rates would be set at 50% duty on October 1st, 2018, and increased further to 75% in the next fiscal year from April 1st, 2019. Allowing businesses to adjust and prepare for the new tariffs.” (Kim N. Wilson JP MP) It is too soon to evaluate the success of this tax. However, similarly to the problem of microplastics, this tax was put in place to fight a problem. The problem of microplastics and their abundance should warrant a similar solution from the local government of Bermuda. The successful introduction of the sugar tax in Bermuda provides the necessary proof that legislation can be put in place to address a problem. An increase in importation taxes on single-use plastic items could help drastically to reduce the number of single-use plastics within their environment and oceans.

Advantages

The advantages of introducing a policy such as the increase of duty on single-use plastic items accompanied by the reduction of taxes on reusable and sustainable alternatives are copious.

- One of the most sizeable and beneficial advantages that could come from such a policy would be the drastic reduction in the number of microplastics and marine debris of single-use plastic pollution that exists within Bermuda’s marine environment. The introduction of increased taxes would hopefully lead to a decrease in sales of items such as plastic bags, straws, utensils, and water bottles. A reduction in sales would lead to a minimized

presence of plastic pollution and marine debris within Bermuda's marine environment. This would advantageously benefit the marine ecosystem including fish, turtles, seabirds and all other marine life. It would also benefit the overall aesthetic of Bermuda's captivating turquoise oceans and pink sand beaches.

- This policy would also provide incentives for citizens to switch to reusable and more sustainable alternatives. The increase in tariffs on single-use plastic items may discourage consumers from buying plastic items. However, the decrease in tariffs on reusable and sustainable alternatives will provide consumers with incentives and reason to switch to such items.
- This policy will not only provide incentives for consumers but also local businesses. As discussed previously locally operated businesses have been using single-use plastic bags over reusable options due to their inexpensive qualities. As outlined previously by a local business owner the cost of a reusable bag once shipped to Bermuda is \$2.24 whereas the single use plastic bag is only 13 cents. Decreasing the 40% tax importation on reusable bags and increasing the tax on single-use plastic bags can make the switch to reusable bags more affordable to local businesses.
- A secondary advantage that would come from this policy would be the positive publicity that Bermuda would receive for approving such a proposal. The European Parliaments announcement made major news headlines across the world. If Bermuda were to introduce such a proposal the positive publicity could have a lasting effect on their tourism industry.

Disadvantages

The disadvantages of introducing such a policy provide the harsh reality and lack of enthusiasm and response that Bermuda's government has towards tackling the problem of microplastics and marine debris within their environment.

- Bermuda's population is extremely vocal. The locals will not be shy about voicing their disapproval or lack of enthusiasm regarding an increase in price in products that are

frequently used in our culture of convenience. Bermuda is already an extremely expensive destination so any increase in price is usually noticed immediately.

- Despite efforts to reach out to the Bermuda government to discuss local efforts that currently exist regarding the topic of marine debris and microplastics, there was no response. The government's lack of response suggests that there is no current plan of action in terms of combating this ongoing problem. It also suggests a lack of enthusiasm to even have a conversation regarding the topic at hand
- Introducing such a policy could take multiple years before it actually comes into effect. The reality of passing such a policy could mean several years before it actually comes into effect. Most legal policies worldwide suffer the same issue in that once a proposal is addressed the process in which it takes before actually coming into effect can take several years. Unfortunately, the government of Bermuda is no more effective in passing such policies.

Evaluation

Overall, Bermuda lacks any and all legal policies which would help contribute to the reduction of microplastics and marine debris within their environment. Introducing the policy outlined above could have unfathomable advantages to the island. However, despite these advantages, the disadvantages provide tough hurdles in order to make such a policy possible. Examples of policies such as the one most recently implemented in the European Parliament as well as the sugar tax in Bermuda provide current up to date policies that could be used to create the framework for implementing a policy that could benefit Bermuda's environment. Increasing importation taxes and duty on single-use plastic items while reducing taxes and duty on sustainable alternatives, provides a policy option which could carry Bermuda to a healthier more sustainable marine environment. This policy option would have drastic benefits on reducing the amount of marine debris and microplastics found within Bermuda's environment.

Policy III: Trash Talk Education

One of the most significant issues faced by the epidemic of marine debris and microplastics is the lack of awareness and education. This is why an education policy should be

introduced into Bermuda's school curriculum. The lack of understanding, information, and awareness can and should be considered a root of the problem at hand. Introducing an education policy within Bermuda's education system could have extensive advantages for addressing the issue. This policy would state that all middle school students must complete a certain level of marine debris education accompanied by beach and coastline clean up. The ability to address school-aged children on the issue is beneficial. However, the ability to pair it with hands-on experience in taking part in a coastal cleanup allows them to put their knowledge to work. The reinforcement that is associated with the hands-on experience and seeing such a problem firsthand allows students to feel as though they have control over the situation which can help empower younger generations. This policy will also introduce an education program that can be implemented in local businesses and offices. Similarly to the school program, it will lead a 'Trash talk' to employees which will be accompanied by a coastal cleanup. The office program will also offer tools and tips on how to keep the office as sustainable and environmentally friendly as possible.

My experience with the Endeavour program in Bermuda allowed me to become familiar with the level of awareness that young Bermudians have regarding the topic of plastic pollution. Students are incredibly naive as to the repercussions of choosing plastic products over reusable options. A large portion of students were unaware of the effects that marine debris and microplastics had on the marine environment but also our beaches. Each week as a part of our curriculum we led an afternoon field trip to a local beach where we would discuss the causes and effects of marine debris on our local ecosystem. Figure 8 represents some of the school kids from their weekly marine debris task force lesson. Every single time this lesson was taught students were amazed and shocked to hear that the majority of plastic waste found on our beaches comes from overseas. The most memorable part of the discussion was when we discussed Dame Ellen McArthur who is most famous for her solo nonstop circumnavigation of the world. McArthur warns that "There will be more plastic than fish in the sea by 2050." (Ellen McArthur) This information stood out to most. Students were asked at the end of the week to discuss one thing that stood out to them and more often than not this quote was repeated. This lesson provided students with the basis of information regarding how this marine debris came to be on our beaches, while also learning about the detrimental effects that it has on our marine environment. Students also discussed how if McArthur's statement were to come true our beaches would be unrecognizable by 2050. Once the conversation occurred students began to notice the different employment and job opportunities that are produced by our tourism economy and what an effect

our dirtying beaches could have on this industry if this pollution were to continue. The conversation closed with ways in which each student could change their daily habits to make better choices for our environment.



Figure 8.

Advantages

The advantages that an education policy could have on Bermuda's marine environment is unfathomable. It introduces and educates the population on an increasingly troublesome problem but also facilitates discussion on how the island can improve.

- Education is key. Every problem including marine debris has a root. A large root of the problem at hand is a lack of awareness and education surrounding the issue. The ability to introduce the conversation of marine debris at a young age to local Bermudians is the first step in

addressing how to tackle the issue. Raising awareness could lead to a drastic decrease in the use of single-use plastic items which would decrease the amount of pollution and debris found on beaches.

- Education of the issue would also encourage students to make more sustainable, earth-conscious decisions from a younger age. It would allow them to invest in the health of our oceans and help decrease the issue in the long run.
- Sparking ideas among younger generations also inhibits conversation. Raising awareness and conversation surrounding the issue at hand can play a significant role in helping reduce the effects and consumption of single-use plastic.
- The excitement and passion that can inspire younger generations are unmeasurable. Introducing hands-on learning activities can have great benefit to a child's development and learning. Introducing alternative academic ideas can also inspire career paths outside of the traditional classroom environment.

Disadvantages

It is hard to see beyond the copious amount of advantages that such a policy could have in Bermuda. However, it is essential to recognize that each policy comes with disadvantages.

- Passing such a bill through the ministry of education can be extremely difficult and take a lot of time and effort. This disadvantage is multiplied when it comes to Bermuda's lack of response and enthusiasm regarding the topic of marine debris.
- Bermuda's government has also set a precedent on several other controversial issues which puts the topic of the health of our oceans at the bottom of the pile. Bermuda's laissez-faire attitude towards such global topics could mean waiting until it is too late to recognize how big of an issue marine debris is.
- There is also astigmatism surrounding school field trips in which both student and teachers view it as 'time off.' Unfortunately, this laid-back attitude can negatively affect the learning

experience for students. Taking students outside of a classroom environment can cause decrease focus and encourage distraction.

- It is also vital that the teachers tasked with teaching this topic is not only well informed but also passionate. The overall tone of the message being delivered can have a drastic effect on how the message is perceived.

Evaluation

Overall this final policy option can be the most potent and effective. Investing in education can take time and effort but proves to be one of the most powerful tools we have. Raising awareness and facilitating conversation about the topic of marine debris and microplastics can inspire the change that is necessary. Investing in education proves to be beneficial to both students and the environment. The extensive advantages provide proof that this policy option could help better younger generations understanding of the causes and effects of marine debris. It will also encourage them to make more sustainable choices that can help the health of our oceans environment.

Recommendations

The policies outlined above are ideal scenarios in which combating the problem of marine debris and microplastics in Bermuda were to be made a priority by the local government. However, the harsh reality of the problem is that it is extremely difficult to bring such an issue to the forefront of the government. The following recommendations serve to provide small alternative fixes that can make a lasting impact in the long run. It is important to recognize that while the government has control over major decisions such as laws and legislation, small movements can be made within the population in order to remedy these problems.

- *Local businesses can provide incentives to consumers to reduce their use of single-use plastic.* Retail stores and local grocery stores can offer a rewards program for customers

that bring reusable shopping bags. For example, the customer may receive a ten percent discount off their purchase or a gift card to use towards future purchases. This could largely reduce the amount of plastic bags in circulation of the island. As discussed by the B.A.N list 2.0 plastic bags accounted for 9.4% of the total plastic waste found in oceans in 2015 and ranked number 4 in the top 20 items that are most frequently found amongst our oceans. Reducing and in hopes eliminating plastic bags from circulation around Bermuda could help reduce this number. Similarly, restaurants that offer take away services could offer similar rewards for consumers who bring their own reusable containers. The B.A.N list 2.0 equates plastic wrappers, bottles, lids, utensils, and bags for 50% of the plastic waste found in 2015. Introducing reward schemes or programs by local businesses can encourage consumers to make more mindful decisions regarding their own plastic consumption while making it a more economically viable option for their household.

- *Marine debris and microplastic task forces should serve an educational purpose in schools across the island.* All schools within Bermuda are located less than a mile from the ocean, each and every student in Bermuda is directly affected by marine debris and microplastics. Initiating a program that serves to educate students on the effects that the problems of marine debris and microplastics can have on the environment can serve as a major advantage to protecting our oceans. As we know it our future lays in the hands of younger generations, so educating students while they are young can have a lasting impact on improving the health of our oceans.
- *Bermuda lacks quantifiable data with regards to their own plastic consumption as well as recycling schemes.* Access to more data could help Bermuda better understand their plastic consumption and waste relative to other nations. Bermuda is an extremely small island, whose impact and contribution to the large-scale problem of marine debris and microplastics could be insignificant. However, it is nearly impossible to quantify due to the lack of data and information regarding the topic of plastic consumption and waste in Bermuda. Bermuda may be small but their impact can be global. Access to such data can provide insight into the issue and provide the foundation needed to establish a better more comprehensive waste or recycling program for such materials.

Conclusion

Plastic is ubiquitous.

Today's culture of convenience has driven the increase in plastic consumption around the world. Bermuda serves a unique platform as the island's location provides the perfect resting stop for microplastics and marine debris on their journey in the North Atlantic Gyre. This paper addresses the issue of microplastics and marine debris in Bermuda specifically, however, it is vital to recognize that this is a global environmental issue. Recent research completed during the most recent edition of the Volvo Ocean Race found that "The highest levels, 349 particles per cubic meter, were found in a sample taken in the South China Sea that feeds into the North Pacific Gyre." (Volvo Ocean Race, 2018) They also found that "Even close to Point Nemo, the furthest place from land on Earth, where the nearest humans are on the International Space Station, between nine and 26 microplastics per cubic metre were recorded." (Volvo Ocean Race, 2018) Our impacts as humans on planet earth are unquantifiable. Far beyond where land meets the human eye, our pollution has spread. It is in our hands and future generations to make the appropriate changes needed to reduce our impact on the environment. It is vital to our own human health as well as the earth's health to drastically reduce our plastic consumption. Drastic measures need to be taken otherwise it is predicted that by 2055 there will be more plastic in the sea than fish.

"Take nothing but memories. Leave only footprints." - Chief Seattle



Photo credit: Molly Riihiluoma

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