Plastic Beaches:

Urban Communities and Marine Pollution

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Introduction

Marine pollution doesn't get much attention In mainstream media. The effects of the massive amounts of waste produced by mankind are especially devastating in marine ecosystems. It harms marine life and endangers people as well (Bayne, Brian Leicester, 1985). Marine pollution is defined here as pollutants found in aquatic environments. Marine pollution has consequences that can be felt across the globe by communities of all sizes. Marine pollution can endanger public health. Consequently, economies based on fishing and marine attractions have the most to lose from this type of pollution (Joshua Lipton, James W. Gillett, 1991). Urban communities contribute a significant amount to marine pollution (EPA, 1983). Cities with an outlet to larger bodies of water like rivers, bays, or marshes must be extra careful in regards to waste disposal and runoff. These are issues are not without a solution.

The Issue

For far too long there has been a mentality around marine pollution that best summed up by the phrase "dilution is the solution to pollution."(Gershon Cohen, 2002) The idea is that pollution is only dangerous in high quantities, ergo, the best way to deal with pollution is disperse it across a larger area like the ocean.

This philosophy has endangered entire ecosystems. Some pollution like plastic bags can lead to suffocation of marine life while other pollution is extremely toxic. Eventually the deaths of individual animals amount to the endangerment of entire species, which leads to a lack in biodiversity, functionally endangering entire ecosystems. As a planet, we are at an apex concerning marine ecosystems and every action counts.

Hazardous aqueous pollution puts public health at risk because many of the same vectors for marine pollution also interact with water used for public consumption (Jerker Fick, Hanna Söderström, Richard H. Lindberg, Chau Phan, Mats Tysklind, D. G. Joakim Larsson, 2009).

Cities contribute to marine pollution primarily through runoff and ineffective waste management systems. “Not too long ago, urban runoff was considered an insignificant contributor to drinking water contamination. The pollution potential of urban runoff was negligible compared to other sources.” (T.L. Pedersen. 1997) Runoff is defined as the part of the precipitation, snowmelt, or irrigation water that appears in uncontrolled (not regulated by a dam upstream) surface streams, rivers, drains or sewers. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or groundwater runoff (USGS, 2016). Urban runoff is dangerous for two reasons. 1) it carries metallic, plastic, domestic chemical pollutants. 2) These pollutants can be found in high quantity because of high population density.

Ineffective waste management includes aqueous and solid waste management systems. Aqueous waste means waste that’s almost entirely water based and contains floating or suspended materials like wax, paint flakes, or oil. Solid waste is any waste that is solid, semi solid, or insoluble. Systems of waste management can be defective in many ways. The most concerning are those that don’t account for the various types of waste produced by their respective populations. Lower income urban communities can’t always afford fully functional waste management (George Owusu, 2010). The effects of this can be felt on an international scale.

The Effects on The Economy

Marine pollution can be disastrous for many seaside economies. Seaside economies are defined here as economies that are largely dependant on marine and seaside based goods and services i.e fishing, beach resorts and other such attractions.

The Syringe Tide of 1987-88 had devastating effects on the seaside economies of beaches along the Atlantic coast. The Syringe Tide was an environmental catastrophe in which large amounts of medical waste washed up on the shores of beaches across the atlantic coast. Public and commercial beaches were forced to close down during their busiest season in response to the hazardous waste. The Jersey Shore lost upwards of 40% of their normal tourist revenue, approximately one billion US dollars (Alfonso A. Narvaez, 1986).

The syringe illustrates when marine pollution washes up onto the shore, but marine pollution does damage even when waste isn't visible. Many seaside economies are struggling because the marine life caught is becoming scarce and increasingly inedible (Aaron Fronda, 2015). There is a direct correlation between marine pollution and illness in marine organisms (A. D. Vethaak, T. ap Rheinallt, (1991).

The Effects on Public Health

Waste disposal methods are important for more than just marine quality. Vectors for marine waste also affect drinking water. Drinking water can be poisoned runoff much like marine environments when not properly treated. A prime example of this is the Flint Michigan water crisis.

The Flint Michigan water crisis was a case of mass public water contamination. On April 4th, 2014, the City of Flint changed it's water source from Detroit's treated water system to the

Flint river, a heavily contaminated body of water. The Flint river was subjected to industrial waste and dumping for decades. This resulted in a high bacteria count making it unsuitable for human consumption. City officials used chlorine to treat the water. This chlorine reacted with organisms in the water, producing acidic water. This lower PH dissolved the lead in the pipes that poisoned the water (Tim Carmody, 2016). This crisis was the result of poor infrastructure but could have been avoided if the Flint river wasn't intensely contaminated with pollution. The pipe system acted as a vector for lead contamination for water both going into the city of Flint and for water moving towards the Flint river.

Solutions

A cheap waste management system that focuses on runoff pollution would be ideal but is unrealistic as many urban communities are dealing with budget issues.

A study done by the Department of Civil and Environmental Engineering at University of Cincinnati suggest absorbent mulch as a solution. "A series of adsorption experiments was conducted in order to assess the ability of three mulches to remove several of the heavy metal ions typically encountered in urban runoff."(Am Jang, Youngwoo Seo, Paul L. Bishop, 2005) The primary issue with this solution is that it would be ineffective close to river beds, where runoff may carry away the mulch. That would make maintenance for this solution expensive.

Porous Cement was a solution introduced by the NURP in their 1983 report on urban runoff. This solution is effective because it's only slightly more expensive than normal concrete. Case studies collected by Columbia University show that permeable concrete was an effective method of dealing with runoff contamination in most test applications (Edward Basch, Rene

Brana, Emily Briggs, Cathy Chang, Atelisika Iyalla, David Logsdon, Ryan Meinke, Michael Moomjy, O. Douglas Price, Serena Sinckler, 2012).

The issue with this solution is that cost of execution and maintenance. Porous cement is hard to mix and lay. It also requires contractors experienced with porous cement (Craig Tosomeen, 2007). To successfully replace all the sidewalks with the porous cement would be costly poorer urban communities that couldn't justify the expenses.

Conclusion

As the dominant species on this planet, humans have a duty to protect life on earth. The state of marine life is at a tipping point and every action is crucial. We must consider every detail to help these ecosystems flourish once more. Non coastal urban communities are often inclined to feel detached from marine pollution but that's not the case. Landlocked cities have just as much responsibility towards marine life as their coastal counterparts.

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References

1. Bayne, Brian Leicester. (1985). Effects of stress and pollution on marine animals. Praeger.

2. Joshua Lipton, James W. Gillett. (1991). Uncertainty in ocean-dumping health risks: Influence of bioconcentration, commercial fish landings and seafood consumption. SETAC.

3. EPA. (1983). Results of The Nationwide Urban Runoff Program. EPA.

4. Gershon Cohen. (2002). The ‘Solution’ to Pollution Is Still ‘Dilution’. Earth Island Journal.

5. Jerker Fick, Hanna Söderström, Richard H. Lindberg, Chau Phan, Mats Tysklind, D. G. Joakim Larsson. (2009). Contamination of surface, ground, and drinking water from pharmaceutical production. SETAC.

6. T.L. Pedersen. (1997). Urban Run-Off as a Source of Contamination in Drinking Water. UCD Extoxnet. URL:

7. USGS. (2016). The USGS Water Science School. USGS. URL:http://water.usgs.gov/edu/runoff.html

8. George Owusu. (2010). Social effects of poor sanitation and waste management on poor urban communities: a neighborhood-specific study of Sabon Zongo, Accra. Journal of Urbanism: International Research on Placemaking and Urban Sustainability.

9. Alfonso A. Narváez. (1986). New York City to Pay Jersey Town $1 Million Over Shore Pollution. The New York Times.

10. Aaran Fronda. (2015). Save the ocean: how mankind destroyed an economic force. World Finance.

11. A. D. Vethaak, T. ap Rheinallt. (1991). Fish disease as a monitor for marine pollution: the case of the North Sea. Springer

12. Tim Carmody. (2016). How the Flint River got so toxic. Vox Media.

13. Am Jang, Youngwoo Seo, Paul L. Bishop. (2005). The removal of heavy metals in urban runoff by sorption on mulch. Elsevier.

14. Edward Basch, Rene Brana, Emily Briggs, Cathy Chang, Atelisika Iyalla, David Logsdon, Ryan Meinke, Michael Moomjy, O. Douglas Price, Serena Sinckler. (2012). Roadmap for Pervious Pavement In New York City

15. Craig Tosomeen. (2007). Porous Concrete Sidewalks: How to Build Sidewalks and not Stormwater Ponds