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Cover Page Footnote

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by Sue Van Hook

Plastics are everywhere—in us and in every living organism and ecosystem—and many are causing harm (Almroth and Eggert 2019; Thushari and Senevirathna 2020). The annual input rate of plastics to the ocean was calculated to be 8.8 million tons in the year 2010 (Jambeck et al. 2015). The end life costs of plastics can no longer be ignored—it is part of the deadly cost of "cheap" plastic. Some plastics have essential applications, but when there are viable alternatives, plastics can be replaced. Natural mushroom mycelium-based MycoBuoys are an alternative to ubiquitous plastic flotation devices used in Maine aquaculture, fisheries and harbors.

The sustainability of the Gulf of Maine and beyond depends on the policies we enact now to reduce plastics pollution. But first, we must set the context for change. To make any lasting improvement, it is imperative that we think differently about our natural resource economies. We must discard linear, extractive, waste-producing manufacturing processes that have caused the environmental degradation we witness daily and replace them with circular product development that recycles natural resources and regenerates ecosystems.

To address plastics in the ocean, we need to encourage the development of nonplastic alternatives to plastic aquaculture and fishing gear. One way to do this is through extended producer responsibility legislation, which makes manufacturers financially and environmentally responsible for the end life of their products. Additionally, I believe we need to shift state and federal subsidies away from oil and plastics and toward such alternative products.

EXTENDED PRODUCER RESPONSIBILITY POLICY

What exactly does extended producer responsibility entail? Simply stated, EPR requires the producer or manufacturer of goods to be responsible for the end life of their products. Maine has EPR stewardship for recovery of mercury, fluorescent light bulbs, electronic waste, rechargeable batteries, cell phones, unused paint, unused drugs, and beverage containers. The state led the nation in 2021 by enacting the first EPR bill for packaging (LD 1541—An Act to Support and Improve Municipal Recycling Programs and Save Taxpayers Money). The law created a stewardship organization that funnels payment from packaging manufacturers for recycling costs of their material to eligible municipalities. The legislation has increased the amount of package recycling by a small percentage with savings for taxpayers (Maine Municipal Association 2021).

Maine is poised to require EPR for additional products. The state's product stewardship framework law (S1771) includes criteria to allow for additional programs to be established where toxic materials pose a risk to environmental health; taxpayers will benefit from recovery efforts; other countries have had success with similar products; and voluntary programs have not been effective in meeting the policy goals. Other countries are indeed ahead of the United States in rethinking plastic pollution and recovery. The United Nations' global plastic waste reduction standards (UNEP 2021) provide a blueprint for earning income from the recovery and re-manufacturing of plastics. However, in my opinion, governments and NGOs should not be bearing the societal costs of end-of-life immunity from product accountability by fossil fuel chemical conversion companies manufacturing cheap plastics today. The annual profits of these corporations exponentially dwarf the resources of municipalities handling their plastic product waste.

The European Union's Single Use Plastics Directive[1] passed in 2019, obligates all EU member states to implement EPR for all fishing gear containing plastics by the end of 2024. There is a ripple effect across the North Atlantic. Sweden has joined Estonia and Austria in adopting national frameworks for recovery of plastic fishing gear. The Swedish target is to collect at least 20 percent of the weight of fishing gear released on the market each year. And manufacturers are obligated to contract with stewardship organizations for recovery of materials before 2025. Iceland has passed a similar law and Norway and the UK are next in step. Fishing gear has been targeted because it contributes up to 27 percent of litter across European beaches. This is progress toward curbing plastic pollution, but collection and recovery programs are complicated. It makes far more sense to replace plastic fishing gear with viable natural alternatives, especially for cradle-to-cradle products.[2] By requiring

EPR of plastics manufacturers we automatically incentivize products with no end-of-life costs.

Plastic in the ocean is more of an issue in the Pacific where South Korea is rated as the top microplastics polluter in the world. To address the situation, the South Korean Ministry of Oceans and Fisheries began a replacement program in 2015 for all Styrofoam buoys used in seaweed and oyster aquaculture (Park 2021). South Korean aquafarmers used 41 million Styrofoam buoys in 2019 accounting for 55 percent of all the country's marine plastic waste (Lim 2020). Early attempts at substituting eco-friendly buoy materials failed, but recently buoys made from aluminum are being provided to oyster and seaweed farmers by the government to meet the ministry's ban on all plastic foam buoys by 2025. The aluminum buoys are bought back at $2.79 each (2022) for recycling and repurposing after three to five years of use.[3]

SUBSIDIES POLICY

A second long-term policy change that would help reduce plastic pollution is to shift government subsidies from fossil fuels toward bio-based products that can be substituted for plastics. At present, it is nearly impossible for bio-based alternatives to compete with cheap plastic products because of the subsidies.

According to World Bank Senior Managing Director Axel van Trotsenburg, "If we could repurpose the trillions of dollars being spent on wasteful subsidies and put these to better, greener uses, we could together address many of the planet's most pressing challenges (World Bank 2023)." More than $7 trillion (equivalent to 8 percent of global GDP) is spent each year on fossil fuel, agriculture and fishing subsidies for practices that are extractive rather than regenerative. Direct financial aid to these industries exceeds $1.25 trillion annually. Tax dollars fund both the subsidies and the environmental cleanups. I believe legislators at the state and federal level interested in reducing plastic pollution need to stop subsidizing fossil fuel companies and start subsidizing alternatives to fossil-fuel-based products.

MycoBuoys float Long Cove Sea Farm's non- plastic oyster cage.

Credit: Abigail Barrows

A NATURAL ALTERNATIVE TO PLASTIC FOAMS—MYCOBUOYS

As a girl, I watched my grandfather turn his wooden lobster buoys on a lathe out on North Haven Island during the 1950s and 1960s. I saw them replaced by polystyrene buoys that were cheaper, lighter weight, and easier to handle. The plastic, closed cell foam buoys seemed like a perfect solution. Yet, with no design, planning or responsibility for the buoy end life, Styrofoam buoys wash ashore and accumulate as bits of carcinogenic styrene above the high-tide line and below it as micro- and nanoplastics in the seawater. In Maine, the annual loss of lobster traps is estimated by the Gulf of Maine Lobster Foundation to be 175,000 (Owings 2012). This number represents an equal number of Stryofoam buoys once attached to these traps that now litter beaches, hang on garage walls, or pollute shoreline soils and the upper water column as microfragments of styrene. A 2019 review of marine plastic pollution on ecosystems highlighted the impacts to all organisms, all ecosystem services, and human health at an economic cost of $33,000–$330,000 per metric ton of the average 8–10 million metric tons of marine plastic lost to the oceans annually (Beaumont et al. 2019).

I believe we ignore these impacts to environmental and human health at our peril. That is why I have devoted 12 years to research and development of alternative buoys—MycoBuoys—made from fungal mycelium grown on hemp fiber. The growth process is simple: pasteurized hemp hurd (the inner fibers of the hemp plant) is inoculated with mycelium from our marine-resistant strain and is allowed to grow in any shape provided for five to seven days. The product is then dried and ready to use.

Field testing for four MycoBuoys designs to float oysters during their growth cycle is currently underway. MycoBuoys floated cages for four to five months at three Maine oyster farms during the 2022 season. These buoys grow at ambient temperatures with low embodied energy and generate no waste stream in the manufacturing process. At the end of useful life, they may be composted or used as mulch where 100 percent of the material enhances soil nutrients upon decomposition. There is additional value added when biofouling occurs on the submersed surfaces of the buoys. The biofilm of marine algae and invertebrates adds value for the

aquafarmer because after their useful life as buoys end, these biofouled buoys can be dried, ground, and sold as natural fertilizer.

It is not easy, however, to enter the market and compete with cheap, subsidized plastic buoys. Since the early days of working with mushroom mycelium composite materials to replace plastic foams, I have been acutely aware of the need to transform mariculture's reliance on plastic gear, particularly through broadening EPR legislation to include plastic marine fishing and aquaculture gear and changing policies around governmental subsidies. If we can end subsidies for fossil fuels and enact EPR legislation for all manufactured products, plastic foams used for buoys will no longer have an economic advantage. MycoBuoys goal is to enter the marketplace so there are replacement products ready for aquafarmers and fishermen when that time comes.

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NOTES

1 https://eur-lex.europa.eu/eli/dir/2019/904/oj

2 https://landbell-group.com/news/another-country-introduces-epr-for-fishing-gear/

3 http://m.powerkoream.co.kr/news/articleView.html?idxno=1107600

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Sue Van Hook is the foundress and CEO of MycoBuoys. She learned about fungi in northern coastal California, where the mushroom season lasts nine months. Van Hook has carried her passion for fungi through four careers in land conservation, as an academic at Skidmore College and as the founding mycologist for Ecovative Design, the international leader in mushroom materials.