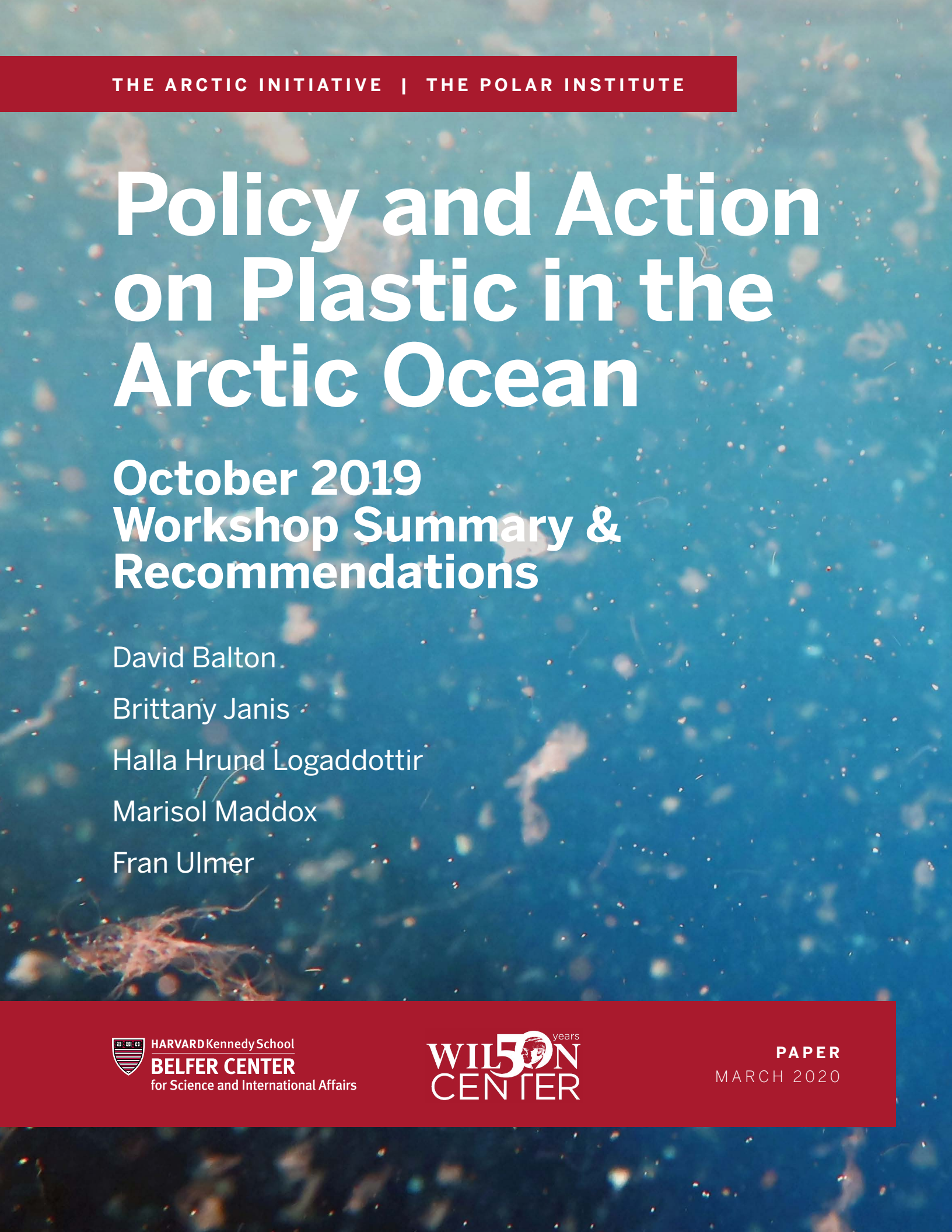

THE ARCTIC INITIATIVE | THE POLAR INSTITUTE

Policy and Action on Plastic in the Arctic Ocean

October 2019 Workshop Summary & Recommendations

David Balton

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Marisol Maddox

Fran Ulmer

HARVARD Kennedy School
BELFER CENTER
for Science and International Affairs

WILSON 50 years CENTER

PAPER
MARCH 2020

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The Arctic Initiative: The Arctic Initiative at Harvard Kennedy School is a joint project of the Environment and Natural Resources Program and the Science, Technology, and Public Policy Program at the Belfer Center for Science and International Affairs. With the goal of providing knowledge and tools that will help reduce risk and increase resilience in the region and elsewhere, the Arctic Initiative is initiating new research; convening stakeholders such as policymakers, scientists, and Arctic residents; and training a new generation of public and private experts to understand and address the many factors that are driving change and risk in the region.

The Polar Institute: Since its inception in 2017, the Polar Institute has become a premier forum for discussion and policy analysis of Arctic and Antarctic issues, and is known in Washington, DC and elsewhere as the *Arctic Public Square*. The Institute holistically studies the central policy issues facing these regions—with an emphasis on Arctic governance, climate change, economic development, scientific research, security, and Indigenous communities—and communicates trusted analysis to policymakers and other stakeholders.

The Icelandic Chairmanship of the Arctic Council: The theme of the Arctic Council Chairmanship program for 2019-2021 reflects Iceland's commitment to the principle of sustainable development and refers to the necessity of close cooperation between the states and peoples of the region and beyond. With sustainable development as an overarching theme, Iceland will highlight four priorities: The Arctic Marine Environment, Climate and Green Energy Solutions, People and Communities of the Arctic, and a Stronger Arctic Council.

Statements and views expressed in this report are solely those of the authors and do not imply endorsement by any organization or institution.

About the Authors

David Balton is a Senior Fellow in the Polar Institute of the Woodrow Wilson International Center for Scholars. He previously served as the Deputy Assistant Secretary for Oceans and Fisheries in the Department of State's Bureau of Oceans, Environment and Science, attaining the rank of Ambassador in 2006. He was responsible for coordinating the development of U.S. foreign policy concerning oceans and fisheries, and overseeing U.S. participation in international organizations dealing with these issues. His portfolio included managing U.S. foreign policy issues relating to the Arctic and Antarctica.

Ambassador Balton functioned as the lead U.S. negotiator on a wide range of agreements in the field of oceans and fisheries and chaired numerous international meetings. During the U.S. Chairmanship of the Arctic Council (2015-2017), he served as Chair of the Senior Arctic Offi—cials. His prior Arctic Council experience included co-chairing the Arctic Council Task Forces that produced the 2011 Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic and the 2013 Agreement on Cooperation on Marine Oil Pollution Prepared—ness and Response in the Arctic. He separately chaired negotiations that produced the 2018 Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean.

Brittany Janis is Project Coordinator for the Arctic Initiative at Harvard Kennedy School. Her research focuses on advancing the Initiative's marine conservation and climate resilience research streams. Ms. Janis leads Arctic Initiative strategy development, student and fellow engagement, events and communications. Outside of the Arctic Initiative, she teaches as a course coach for "Persuasion, The Art and Science of Effective Influence" and "Leadership in Environmental Conflicts" at the Kennedy School, where she is also a member of the Green Team Plastic Pollution Working Group and is a founder of the Harvard Alumni for Climate and the Environment (HACE) Special Interest Group.

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Halla Hrund Logadóttir is the Co-founder and Co-Director of the Arctic Initiative at Harvard Kennedy School where she also lectures on policy and innovation for the changing Arctic. In Iceland, her home country, Ms. Logadóttir serves on the advisory board to the Minister of Industry, Innovation, and Tourism on Iceland's Energy Fund and collaborates with the country's leadership on environmental and Arctic issues. She is the Founder of the Arctic Innovation Lab; a platform established to encourage solution-based dialogue on Arctic challenges and an advisor to *Arctic Today*, a key media on circumpolar issues. Previously, Ms. Logadóttir was the director of the Iceland School of Energy at Reykjavík University where she continues to lecture on energy policy.

Ms. Logadóttir is a frequent commentator on environment, energy, and innovation within the Arctic. She was one of the 15 invited writers in United Nations Chronicle's special edition on sustainable energy published in relation to COP21. In 2019 Ms. Logadóttir was selected as a Young Global Leader by the World Economic Forum.

Marisol Maddox is an Arctic analyst at the Woodrow Wilson Center in Washington, DC, a nonresident research fellow at the Center for Climate & Security, and a graduate student in International Security at George Mason University. Her research considers the security implications of an opening Arctic, the evolution of US strategy in the region, polar geopolitics, transnational crime, climate change risk mitigation, and opportunities for enhanced international collaboration on regenerative solutions to shared security concerns.

Maddox received her bachelor's degree in Environmental Studies with a concentration in Ecosystems from Binghamton University in New York. She spent several years studying organic regenerative agriculture and ecology, and now combines her background in resilient systems design with the security field to foster policies that focus on long-term stability.

Frances A. Ulmer is a Senior Fellow at the Belfer Center's Arctic Initiative. She has chaired the US Arctic Research Commission (USARC) since 2011, and was a Special Advisor on Arctic Science and Policy at the State Department from 2014-2017. Ms. Ulmer served as Chancellor of the University of Alaska Anchorage, and previously Director of the Institute of Social and Economic Research. In 2018, she was a visiting professor at Stanford University.

Ms. Ulmer served as an elected official for 18 years as the mayor of Juneau, a state representative, and as Lieutenant Governor of Alaska. She previously worked as legal counsel to the Alaska Legislature, legislative assistant to Governor Jay Hammond and Director of Policy Development for the state. She was the first Chair of the Alaska Coastal Policy Council, co-chair of the Aspen Institute' s Commission on Arctic Climate Change, and currently chairs the Global Board of the Nature Conservancy.

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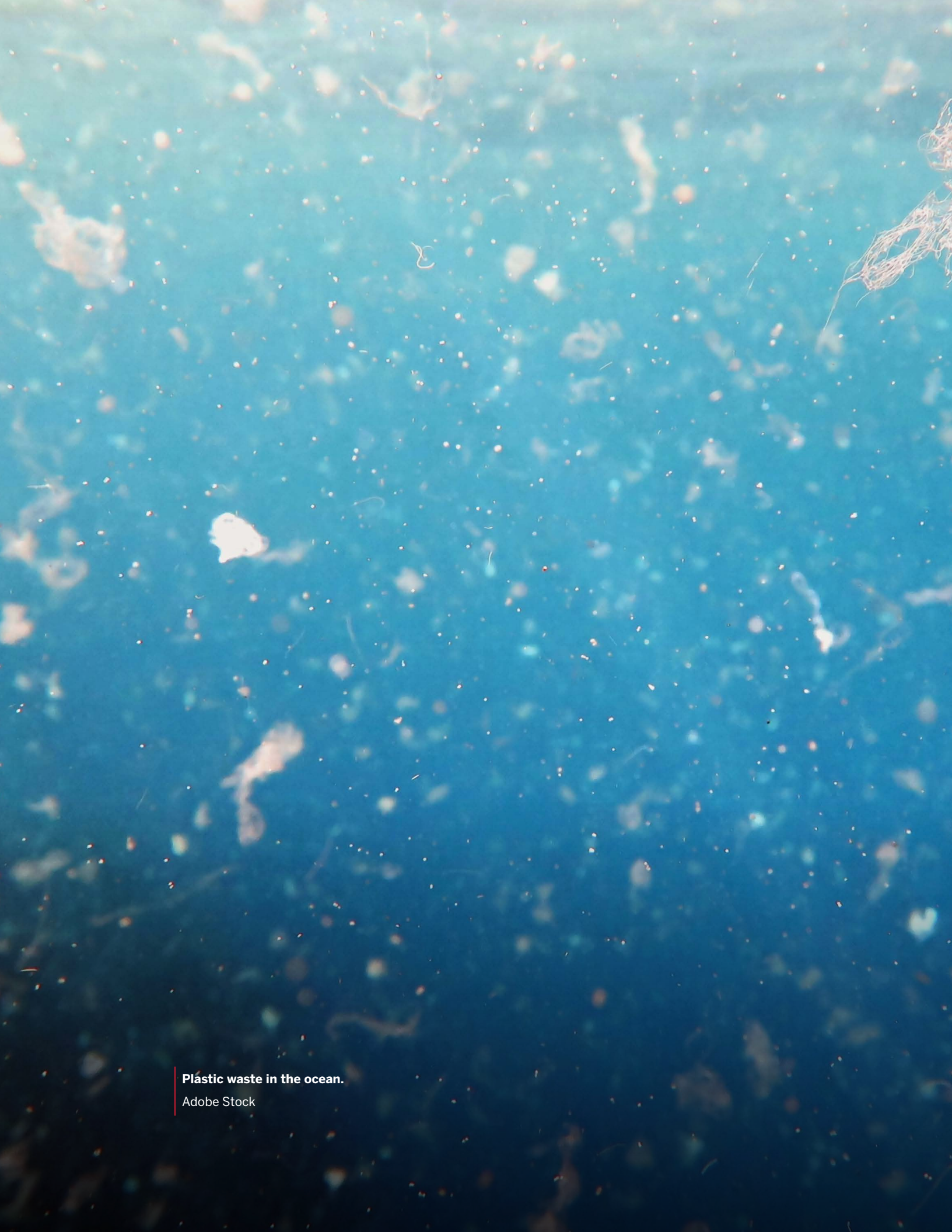
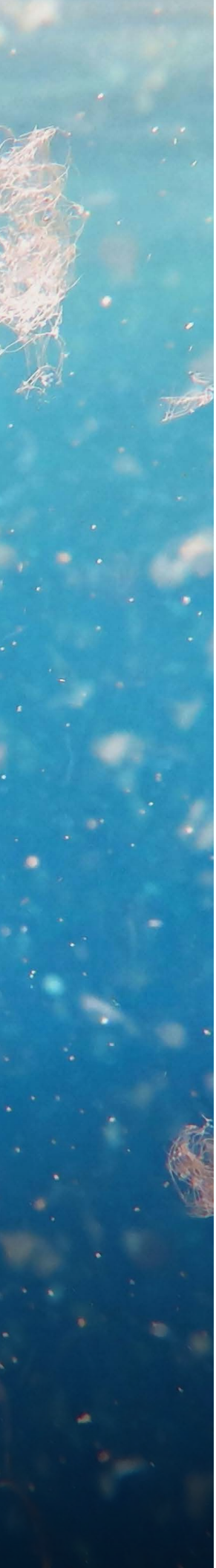


Plastic waste in the ocean.
Adobe Stock



Introduction

October 2019 Workshop on Policy and Action on Plastic in the Arctic Ocean

The Belfer Center's Arctic Initiative and the Wilson Center's Polar Institute co-hosted a workshop with the Icelandic Chairmanship of the Arctic Council at the Harvard Kennedy School of Government entitled, Policy and Action on Plastic in the Arctic Ocean. The event convened global thought leaders, diverse stakeholders, and subject matter experts to begin developing a framework for tackling Arctic marine plastic pollution as one of the focus areas for the Icelandic Chairmanship.

Is Arctic marine plastic pollution a problem?

The workshop revealed the massive scale of plastic consumption that exists, with approximately 8.3 billion metric tons of plastic being cumulatively produced as of 2017. There has been rapid growth in plastic production in recent years, with half of all plastic having been produced in just the last 13 years, and 34 billion metric tons of plastic expected to be produced by 2050. Litter is found across the Arctic marine environment including shoreline, sea ice, sea surface and subsurface waters, water column, seafloor and sediments, and in the food chain. An estimated 8 million metric tons of plastic enters the ocean worldwide every year, though only 1% of it has been accounted for. This raises the question, where is all the plastic in the ocean?

Different categories of plastic debris include: macroplastics, mesoplastics, microplastics, and nanoplastics. These different types of debris present challenges to a comprehensive understanding of the plastic pollution issue because they disperse differently in the environment and in some cases have completely different trajectories, requiring different methodologies to study them effectively.

A lack of consensus on definitions of plastic marine debris categories constitutes a second challenge to consistency across the field, making a common vocabulary and shared definitions beneficial, especially for clarity of comparative research. Despite gaps in knowledge about occurrence, sources, transport, and the spectrum of impacts of plastic in the environment, we know enough that the plastic pollution problem is serious, and that we must seize opportunities to address it.

Where does the plastic come from?

Plastic debris of all sizes comes from sea-based activities, land-based activities, riverine deposition, and through atmospheric transport. Sea-based activities, particularly commercial fishing, generate large quantities of plastic debris in the Arctic marine environment, especially ghost gear (lost or discarded fishing gear). Other known sea-based sources include aquaculture, shipping, the oil and gas sectors, and ocean transport of debris from outside the Arctic. Land-based sources of debris come from tourism, extractive industries, inadequate water treatment plants (particularly microplastics), lack of treatment plants, and poor landfill management. There has also been documentation of atmospheric deposition of small particles across vast distances. Significant inputs of plastic debris enter the Kara and Laptev Seas, which demonstrate the role of rivers as pathways for litter, currently estimated to be about 2 million tons each year.

Research Recommendations

The problem of plastic pollution in the Arctic is sufficiently understood to know it poses a risk to marine ecosystems. However, there are daunting gaps in knowledge of the abundance and distribution of Arctic marine plastic from these different sources. These gaps can make it more challenging to assess how to best target interventions. To fill these gaps there is a need for:

- development of harmonized protocols and standardization of data to measure trends over time in a consistent way that is conducive to data sharing

- consistent monitoring throughout the year to account for seasonal fluctuations
- establishment of baselines from which to measure progress
- better data collection from certain parts of the Arctic Ocean region, particularly the Central Arctic Ocean and coastal areas in Siberia, Arctic Alaska, and Canada
- increased sampling of snow on ice floes to improve estimates of atmospheric transport of litter
- seafloor sediment monitoring, since plastics of all sizes accumulate there
- identification of "hot spots"—areas of acute contamination with greatest risk to wildlife and the marine ecosystem
- improved use of satellite imagery to assess where ice forms and how it moves, thereby providing information about where ice picks up microplastics
- further initiatives to develop remote sensing for detecting large debris at sea, as well as sensors to detect plastics in the water column that could be installed opportunistically on vessels
- increased collaboration between Arctic communities and scientists in community monitoring of plastic pollution

All those involved—scientists, politicians, industry leaders, communities, indigenous peoples, non-governmental organizations, and other stakeholders—should co-create solutions to the Arctic marine plastic pollution problem within the context most appropriate for the given circumstances. Prioritizing actions that can inform understanding about significant sources of plastic pollution emissions, and allow for monitoring and assessment of policy interventions, may prove the most impactful given limited resources.

Learning from Other Regional Plans

The OSPAR Regional Action Plan and the Caribbean Regional Action Plan offer models from which a Regional Action Plan for the Arctic can benefit.

The OSPAR Plan combines national actions, recommendations, and 32 collective actions. Its success derives from relatively good data on pollution sources and a commitment to measuring the effects of interventions, which promotes engagement with sectors that are contributing to pollution issues.

Implementation of the Caribbean Plan demonstrates that such plans are only as effective as local implementation capability and that communities must have buy-in from the beginning. Those developing the regional plan must communicate clearly with affected communities about the relevance of the marine plastic pollution problem and seek their engagement in building solutions.

An Arctic Regional Action Plan to address plastic pollution should draw from the harmonized approach for marine litter monitoring modeled by OSPAR; focusing on science that can establish a baseline of current plastic pollution, and a foundation for collaborative science to enable effective plastic pollution monitoring and intervention assessment going forward. Like the Caribbean Plan, local knowledge must be integrated and communities should be recognized as integral parts of the intervention solution. Recognizing that plastic pollution is a major transboundary concern within the region, a plan should endeavor to couple unique approaches that work locally with collaborative monitoring and collective action.

Innovation and Working with Industry

As with many challenges, prevention is key. It is significantly easier and more cost-effective to prevent plastic from entering the environment than it is to clean it up. Partnering with industry and innovators to prevent plastic from polluting the environment, to encourage the reuse of already existing plastic materials, to reduce raw plastic consumption, and to ensure better recyclability of new plastics products could begin to stem the flow of plastics into the environment. At the October workshop presenters highlighted several promising partnerships and technologies toward that goal.

The Icelandic Recycling Fund (IRF) has found success in using financial incentives to increase the proper disposal of waste, including the explicit funding of collection and recycling. The incentive is funded through a recycling fee on products for producers and importers, which is a model that could be scaled up or applied to other places in the Arctic. Through the IRF partnership with the fishing industry, fishermen can return gear (such as nets and ropes) to waste collection points without paying a fee. IRF then works with technology partners to recycle the gear they collect. In order to build engagement from fishermen, IRF has found it beneficial to communicate the risks that plastic pollution poses to the health of fisheries upon which their livelihoods depend. This collaboration is a promising public/private partnership addressing one of the significant sources of sea-based plastic pollution in the Arctic.

Plastix, a Danish company, uses a circular economy model through increasing the recyclability of plastic-based products like fishing nets. Plastix has overcome the challenge of recycling products that contain different polymers through a process that breaks the products down into raw materials that can be turned into new products. This is an example of a method that helps to keep manufactured plastics in the value chain and out of the waste stream.

Cruise industry partnerships with local governments can leverage each other's strengths. For example, the Association of Arctic Expedition Cruise Operators (AECO) has established a Clean Seas Project, which focuses on dramatically reducing single-use plastics onboard expedition cruise vessels,

while educating and motivating passengers and crew to better understand the negative impacts of plastic pollution on the sensitive Arctic marine environment. AECO brings tourists to the Svalbard area who contribute to debris removal efforts, while the Svalbard government retrieves the aggregated waste that is collected so the cruise ship does not incur costs of disposal. This is an example of how opportunistic trips to the Arctic could be systematically leveraged to assist in debris recovery and removal, while addressing a potential source for marine pollution through education and intentional reduction of single-use plastics consumption.

Rhizoform, LLC is a bio-materials startup company that has developed a mycelium-based packaging product substituts for polystyrene to insulate shipments of fish, as well to insulate houses. This, and other bio-based materials, offer fully biodegradable alternatives to plastic that could both decrease the demand for new plastic as well as limit the amount of plastic that Arctic communities have to process through waste management facilities or as waste to be retrieved from the environment.

Drawing on innovators and industry to be part of the solution to the plastic pollution problem offers a valuable multi-sector approach.

Policy Recommendations

The Arctic region is too diverse for a single set of solutions to the marine plastic pollution problem. The Arctic Regional Action Plan should allow for subregional and local efforts and communications campaigns tailored to specific needs and capabilities. Local communities must co-develop these efforts with incorporation of indigenous knowledge where relevant. A Hackathon model could be used to gather interested community members with partners to innovate and problem solve collectively. Increased investment in innovative solutions that comie from Arctic residents to address the reduction, reuse, recycling, and recovery of plastics could provide opportunities for regional leadership on this issue.

Keeping the importance of the local perspective in mind, the Arctic Regional Action Plan can usefully employ the following strategies:

- promote awareness and understanding of the plastic pollution issue through targeted communication and education efforts to increase community engagement and solutions co-creation
- convene industry to educate about economic and environmental threats from plastic pollution and to generate reasonable and realistic practices for plastic pollution mitigation
- work with industry to develop and promote guidelines that reduce plastic waste and address appropriate disposal, recycling, and reuse of plastic materials
- based on those guidelines, implement measures to reduce plastic pollution from ships in the Arctic Ocean and adjacent seas, particularly lost and abandoned gear from fishing vessels and plastic waste from transport and tourist vessels
- share information about promising projects already happening in the Arctic region to enable those efforts to be scaled up
- provide incentives for cross-sector collaboration to promote synergy between different actors addressing the plastic pollution problem
- encourage more producer responsibility to account for management of environmental costs associated with a product throughout its life cycle, and decrease the use of plastics that cannot be recycled
- promote financial incentives to identify alternative packaging products, by using industry challenges, similar to the Defense Advanced Research Project Agency (DARPA) Grand Challenge
- identify and fund research priorities to identify major contributors to the waste stream and to measure impact of reduction strategies
- enable researchers to coordinate, share data, and learn from each other
- work with the Arctic Economic Council to develop an innovation fund and to encourage circular economy model development from production of raw materials to reclamation and reintegration of spent materials into new products.

Appendix 1: Plastic Pollution Case Studies

FROM THE GLOBE

Lessons Learned Developing a Regional Action Plan to Reduce Plastic Pollution; **Caribbean Environment Program Regional Action Plan for Marine Litter (RAPMaLi)**

By Brittany Janis

Like the Arctic, the Caribbean is home to an abundance of natural assets. The waters of the Caribbean help provide food and income for those who live in the region, and the pristine beaches and biodiverse rich ecosystems attract tourists which account for an estimated 19% of the regional economy.[1] Maintaining marine ecosystems is important for the health of the people and economy of the Caribbean, making pollution prevention and waste management a critical issue in most Caribbean States.

According to the United Nations Environment Programme (UNEP) "Seventy to eighty-five per cent of marine litter in the Caribbean Sea comes from land, and most of it consists of plastics. Together with agrochemical run-off and domestic wastewater, it is one of three priority pollutants for the wider Caribbean region."[2] In 2008, the first Regional Action Plan for Marine Litter (RAPMaLi) for the Wider Caribbean Region (WCR) was developed as a project under the directive of the United Nations Environment Programme (through its Regional Seas Program) in response to growing global concerns of litter accumulation in the Caribbean marine environment. This Action Plan was developed within the framework of the 1986 Cartagena Convention for the Protection and Development of the Marine Environment of the

1 Thomas, Desmond, "The Caribbean Tourism Industry in the 21st Century: An Assessment", Kimberly Green Latin American and Caribbean Center, Florida International University, Working Paper No. 3/2015, https://lacc.fiu.edu/research/publications/lacc-working-paper-series/tourism-caribbean-desmond-thomas-wp3-1.pdf

2 "The Caribbean addresses the scourge of plastic pollution", UN Environment Programme, June 19, 2019, https://www.unenvironment.org/news-and-stories/story/caribbean-addresses-scourge-plastic-pollution

Wider Caribbean Region and the Protocol on Land-Based Sources of Marine Pollution which became legally binding in 2010. The RAPMaLi provided a comprehensive toolkit to assist countries of the WCR and in particular small island developing States (SIDS) to incorporate best practices in solid waste management. It was designed to addresses the complex and interconnected nature of the marine litter problem and outlined actions at the National and Regional Level within five thematic areas:

1. Legislation, policies and enforcement
2. Institutional framework and stakeholder engagement
3. Monitoring programs and research
4. Education and outreach
5. Solid waste management strategies[3]

Key to this effort was a focus on a regional approach, which promoted problem solving at the national and local levels, recognizing that unique regional characteristics shape the kind of solutions that are most effective in a given community and that pollution was a major transboundary concern for countries in the WCR. A series of pilot projects in places like Guyana, Barbados and Saint Lucia allowed tactics outlined in the plan including monitoring, governance, communication, capacity building & training to be developed and tested in local communities. The Caribbean is not uniform in cultural identity so finding unique approaches that work locally was key to enabling uptake. A testament to the success of this approach was evidenced in the increased level in participation of 20 countries in 2014, when the RAPMaLi was updated, from 14 countries included in the original report.[4]

When updating RAPMaLi, the program relied on a variety of partners to assess the progress that had been made, and revisions necessary to existing recommendations. The Caribbean Youth Environment Network (CYEN) compiled data and conducted surveys and interviews with government

3 "Solid Waste and Marine Litter — Caribbean Environment Programme." http://cep.unep.org/publications-and-resources/marine-and-coastal-issues-links/solid-waste-and-marine-litter

4 Corbin, Chris, Sanya Wedemier-Graham and Emily Franc, "Regional Action Plan on Marine Litter Management (RAPMaLi) For the Wider Caribbean Region 2014", UN Environment Programme, November 2014, https://www.cbd.int/doc/meetings/mar/mcbem-2014-03/other/mcbem-2014-03-115-en.pdf

representatives, non-governmental organizations and regional organizations involved in marine litter monitoring and management. Critical to the development of the RAPMaLi was the understanding of the broad ecosystem of regulations, protocol, partnerships and players who were active in the marine conservation space. The 2014 RAPMaLi update mapped "new or amended institutional, legal and policy arrangements for the management of marine litter at all levels, national legislation and policies; identification of government, quasi government agencies and NGO's that work with national marine litter problems; and existing national and regional monitoring programs on marine litter."[5] The update also enabled the plan to highlight a growing concern in the region, microplastics, that had been absent from the 2008 version.

Working through existing partnerships like the Global Partnership on Marine Litter, a voluntary open-ended partnership for international agencies, governments, businesses, academia, local authorities and non-governmental organizations hosted by UNEP[6], through its Global Programme of Action to address pollution from land-based sources and activities, the RAPMaLi was able to be pull from a variety of lessons learned in finding innovative solutions for the marine litter problem. Asking local people for feedback insured the plan was continuing to build on the diverse voices of the Caribbean. It also helped in the development of targeted education campaigns that focused on messaging that resonates with local communities.

In February 2017, UNEP launched the Clean Seas campaign to engage governments, the public, civil society and the private sector in the fight against

5 Corbin, Chris, Sanya Wedemier-Graham and Emily Franc, "Regional Action Plan on Marine Litter Management (RAPMaLi) For the Wider Caribbean Region 2014", UN Environment Programme, November 2014, https://www.cbd.int/doc/meetings/mar/mcbem-2014-03/other/mcbem-2014-03-115-en.pdf

6 Clean Seas: Turn the Tide on Plastic, "About", https://www.cleanseas.org/about

marine plastic litter, with a focus on reducing the production and consumption of non-recoverable and single-use plastics. By April 2019 nine Caribbean governments[7] has signed onto that agreement. With that new initiative, on top of many other successful campaigns to combat plastic pollution happening in the region, The Cartagena Convention Secretariat/Caribbean Environment Program is finalizing a third revision of RAPMaLi, which will result in an implementation strategy, regional and national priority actions, targets and indicators that will form the basis for new national and regional projects. The following four strategic areas of focus have been identified:

- Research and monitoring
- Governance
- Communication
- Capacity building and training

Activities under research and monitoring and building on the experiences of the OSPAR Commission has resulted in the development of a harmonized approach for marine litter monitoring that will form the basis for more informed policy and decision-making.

At the Policy and Action on Plastics in the Arctic Ocean Workshop, hosted at the Harvard Kennedy School in October to 2019, Chris Corbin, Senior Programme Officer with the Ecosystems Division of the United Nations Environment Programme (UNEP), emphasized the need to coordinate among global efforts, while continuing to ensure that the challenge of plastic pollution in the marine environment maintains a local focus, and becomes a local issue, despite it's global implications.

When thinking about developing a Regional Action Plan for the Arctic, Corbin emphasized the importance of taking into account the many different communities, languages, and local contexts of the Arctic in order to provide a plan that can be relevant, and still aspirational. He explained "The goal of the regional body is to bridge the gap between global tools and resources and local communities. "

7 The Caribbean addresses the scourge of plastic pollution", UN Environment Programme, June 19, 2019, https://www.unenvironment.org/news-and-stories/story/caribbean-addresses-scourge-plastic-pollution

A Reusable Solution to Reducing Plastic Packaging Waste; **Algramo— A Private Sector Solution for a Circular Economy**

By Brittany Janis

Jose Manuel Moller grew up in Chile to parents that believed in giving back to their community. His parents founded a kindergarten for children from underprivileged families, and as a child José Manuel and his siblings volunteered in the social service programs his parents founded. This drive to give back followed him to college at Pontificia Universidad Católica de Chile (Catholic University of Chile), where he founded a student group, InvolUCrate (Get Yourself Involved), which helped improve the conditions of workers at the university and promoted the study of social innovation in the business school.[8]

While in college, José Manuel began working on poverty in Chile. He wanted to work side by side with the poorest families in the country, to help them find solutions to poverty and gain access to necessities. With three of his college friends he moved to one of the poorest areas in Santiago, located in the peri-urban community of La Granja, and began living like those around him, trying to understand what was keeping people in poverty. La Granja, like many low-income communities, faced serious environmental justice concerns because of insufficient waste management which led to pollution.

José Manuel oversaw cooking for his household, and quickly realized there was what he termed a poverty tax on basic essentials. Living on a limited budget like his neighbors, he was forced to buy products in smaller portions, but these smaller portions came at a premium price. He and his neighbors were excluded from economies of scale because low liquidity meant they couldn't afford the slightly higher price tag of bulk items, even though there were more affordable per gram. This meant not only higher prices for these communities that could not afford them, but also

8 Jose Manuel Moller", 2014, https://www.ashoka.org/en-us/fellow/jose-manuel-moller

more waste and pollution in those same neighborhoods, since the smaller portions of products came in small plastic satchels, which could be seen littering the streets. This realization led him to design Algramo.

Algramo, which translates to "by the gram" is a company that distributes both refillable returnable bottles and vending machines full of bulk staples which offer products in small quantities in reusable containers across a network stores. Brian Bauer, who works on the circular economy and strategic alliances at Algramo explained; "When you buy in small formats, you pay from 30% to 50% more for the product, depending on what the product is, and then in doing that, you also produce a lot of packaging waste. That's typically the type of packaging waste that's most likely to escape into the environment because it's smaller format, and it's also in low-resource areas where there aren't very good waste management systems in place. So there's a lot of that packaging that ends up in the environment, ultimately, in oceans or other places it shouldn't be."[9]

Algramo has grown rapidly since its founding in 2013. It operates in over 2,000 family owned stores that reach over 325,000 end-customers in Santiago de Chile.[10] Their business model has attracted the attention of a number of large brands, including Unilever and Nestlé, which are currently partnering with Algramo to pilot a mobile dispensing system that uses electric tricycles to deliver products. They are now looking to expand their operations into new markets.

9 Peters, Adele, "This startup is ditching plastic waste by bringing the refills to you", Fast Company, October 14, 2019, https://www.fastcompany.com/90416401/this-startup-is-ditching-plastic-waste-by-bringing-the-refills-to-you

10 Closed Loop Partners Invests in Algramo to Advance Affordable, Reusable Packaging Systems", October 14, 2019, https://www.closedlooppartners.com/closed-loop-partners-invests-in-algramo-to-advance-affordable-reusable-packaging-systems/

Key to the design of the company model is the idea of reuse. Algramo's smart packaging, equipped with RFID chips, which encourages consumers to reuse the plastic packaging by offering a discount. Each time a customer refills their existing container or bottle with product, they earn credit that can be applied to future purchases. The more the packaging is used, the more value it accrues. Once the containers reach the end of their life, they can be traded in by shoppers for a new container — this deposit ensures packaging goes back to Algramo, for recycling at end of life.

Algramo is currently experimenting with what threshold of discount is necessary to attract a wider range of consumers and has landed on 30%. Brands who partner with Algramo can meet these numbers, because they also benefit from reduced packaging costs and optimized logistics, since they can focus on distribution of concentrates and bulk goods, rather than lots of little bottles or bags. For Arctic communities where shipping costs are a significant portion of an items expense, a similar bulk vending solution could be attractive to both brands, distributors and consumers.

Reuse rates by customers have risen from around 10% when Algramo began to more than 80% now[11]. By decoupling consumption from packaging waste, Algramo has created less pollution. Particularly for communities with expensive or insufficient waste management this kind of solution stops the problem at its source— single-use plastic waste. This also gives communities with low liquidity easier access to bulk products since families can buy the exact quantity of products they need with bulk prices. As Algramo expands with new investments, it offers the opportunity for a win-win-win solution, more affordable products for consumers, reduced packaging and distribution costs for companies, and less plastic pollution going into the environment.

11 Perella, Maxine, "Chilean Startup Eliminating Packaging Waste, 'Poverty Tax' in Latin American Product Market", Sustainable Brands, October 29, 2019, https://sustainablebrands.com/read/defining-the-next-economy/chilean-startup-eliminating-packaging-waste-poverty-tax-in-latin-american-product-market

Managing Plastic Waste from Fisheries; **The Icelandic Recycling Fund**

By Katie Segal

Nearly 80 percent of all the plastic ever produced worldwide is sitting in landfills or polluting the environment, and only nine percent has been recycled.[12] With plastic production projected to increase substantially over the coming decades, it is crucial for governments to implement policy that stems the flow of plastic waste and better manage disposal. Iceland has set a global example for managing plastic pollution through the Icelandic Recycling Fund, which aims to increase the proper disposal of waste through a fee-based system. In October 2019, Olafur Kjartansson, managing director of the Icelandic Recycling Fund, visited Harvard Kennedy School to participate in a workshop titled "Policy and Action on Plastic in the Arctic Ocean." Mr. Kjartansson highlighted how the Fund is maintained as well as its progress and challenges in reducing discarded fishing gear, a major contributor to marine plastic pollution.

The Fund's goal is to provide a financial incentive to increase waste collection and proper disposal. Producers and importers of specified products are subject to a fee, and the Fund uses revenue from the fee to cover the costs of environmentally responsible waste collection, disposal, and recycling. A wide variety of waste categories are covered, from packaging waste to used tires.[13] The Fund is a governmental organization operating under the Iceland's Ministry for the Environment and Natural Resources but maintains a board of directors with representatives from other stakeholder groups, including industry and municipal governments. It was established in 2003 after conversation between the Icelandic government and waste-producing industries and stakeholders.

12 Geyer, Roland, et al. "Production, Use, and Fate of All Plastics Ever Made." *Science Advances*, vol. 3, no. 7, July 2017, p. e1700782. *advances.sciencemag.org*, doi:10.1126/sciadv.1700782.

13 No author listed. *Waste Management—National Reports: Iceland*. UN Sustainable Development, https://sustainabledevelopment.un.org/content/documents/dsd/dsd_aofw_ni/ni_pdfs/NationalReports/iceland/waste.pdf.

In Iceland and around the world, fishing gear constitutes a significant portion of plastic debris, which often ends up contaminating the marine environment. Approximately ten percent of global marine plastic pollution comes from "ghost gear," or discarded fishing equipment, according to a report from UNEP and FAO.[14] Iceland's economy depends on healthy marine fisheries and a strong fishing industry, with over 1.3 million tons of catch from the Icelandic fishing fleet in 2018, and an estimated 1,300+ tons of fishing nets. When developing the Icelandic Recycling Fund's approach to tackling fishing gear, Iceland engaged in discussions with Fisheries Iceland and local producers of fishing nets, so that the policy could incorporate the needs of these critical stakeholders. The owners of fishing trawlers were willing to claim responsibility for used fishing nets and ensure proper disposal. Mr. Kjartansson sees this as a positive arrangement because experts onboard the boats are familiar with handling such nets, and therefore can manage nets more efficiently than a third-party waste management company. The Icelandic Recycling Fund maintains a voluntary agreement with the fishing industry, allowing them to return gear (such as nets and ropes) to waste collection points without a fee.[15] The fund then works with technology partners to recycle the gear.

Mr. Kjartansson noted some indicators of the Icelandic Recycling Fund's success in reducing the amount of fishing gear lost at sea. First, he cited an increased awareness of the importance of handling nets properly among fishing companies. Second, the Fisheries Iceland mentions their system of fishing net collection in their environmental declaration, indicating that the association's members—and other fishing industry stakeholders—see the benefits of collecting nets. Fishing gear is expensive, so cost is a major factor motivating companies to prevent loss of fishing gear.

While collecting nets is critical for preventing pollution of the marine environment, it unfortunately does not guarantee that the nets can be recycled once they have reached land. Materials used to make fishing nets stronger and more durable often make them less recyclable. The recycling process

14 United Nations Environment Program, and Food and Agriculture Organization of the United Nations. *Abandoned, Lost, or Otherwise Discarded Fishing Gear*. http://www.fao.org/fileadmin/user_upload/newsroom/docs/Ghost_fishing_report.pdf.

15 Mengo, Elena, and Centre for Environment, Fisheries & Aquaculture Science. *A Review of Marine Litter Management Practices for the Fishing Industry in the North-East Atlantic Area: Report for OSPAR Action 36: To Develop Best Practices in the Fishing Industry*. 2017.

requires that component plastic materials are separated, but modern fishing nets combine multiple types of plastic, making it difficult for recyclers to separate the materials for processing. This disconnect between production and disposal highlights the importance of producer participation at every phase of the policy discussion. It is not enough for fishing net producers to simply pay a fee—a truly circular economy will require fishing net producers to take on more responsibility by modifying production practices and ensuring the product can be disposed of responsibly at the end of its useful life. The Icelandic Recycling Fund applies economic incentives to establish practical arrangements for processing waste, which means providing the monetary prerequisites so that businesses in the market will realize the benefit of involving themselves in the processing program. This has led to promising collaborations with waste processors, recycling companies, and net producers which has the potential to address the recycling challenges common with fishing nets.

As fishery conditions evolve in Iceland, so does the type of fishing gear used. In recent years, total catch has declined significantly as the quality of the fishery changes. The composition of fish has also changed (for example, Iceland's waters have seen fewer herring recently). Additionally, there is less demand for catching a large quantity of fish at once, and more demand for catching fewer, higher-quality fish. These shifts have led to a change in the types and quantities of fishing gear in use. The Icelandic Recycling Fund and similar initiatives must stay aware of industry trends and update waste reduction policies accordingly.

Although there is still progress to be made, the Icelandic Recycling Fund has been largely successful in targeting waste disposal across an array of categories, including fishing gear. Other governments can look to Iceland as an example when developing their own recycling fund or a similar policy. Mr. Kjartansson emphasized that the Icelandic Recycling Fund can serve as a model for other countries seeking to manage recyclable waste. He has observed a positive shift in attitudes as a result of the Fund's success, and a growing awareness of the importance of responsible waste management. Creating similar policy elsewhere is one step towards a more sustainable economy and a healthier environment.

Creating a Model for more Sustainable Arctic Tourism; **AECO Clean Seas Program**

By Brittany Janis

The Arctic is an increasingly popular tourism destination. The number of expedition cruise ships operating in the Arctic is on the rise, and new groups of travelers are discovering this region. Expedition cruising in the Arctic gives tourists an opportunity to visit regions of unique natural beauty and experience local communities that have coexisted with nature for millennia. For many visitors, a trip to the Arctic is an opportunity to reflect on some of the environmental challenges that impact both the Artic region and on a global level. In order to offer a sustainable travel experience, it is critical that cruise activities consider minimize their environmental impact and how they can play a role in being good stewards of the environment. In addition, expedition cruise operators are in a position to educate guests and find ways that tour operators and tourists in the Arctic can give back to the region that they visit.

The Association of Arctic Expedition Cruise Operators (AECO) is an international association for expedition cruise operators operating in the Arctic and others with interests in this industry. It was founded in 2003 and has since become an important organization representing the concerns and views of Arctic expedition cruise operators. AECO considers part of its mission to be "managing responsible, environmentally friendly and safe tourism in the Arctic". AECO strives to set the highest possible operating standards for their members, with the understanding that Arctic tourism depends on maintaining Arctic ecosystems and landscapes.

For nearly two decades, members of AECO have been engaged in cleanup activities in the Arctic and witnessed the growing amount of garbage that floats ashore on these beaches. This fostered a discussion on how the industry as a whole could contribute more. In 2018, AECO decided to step up the association's efforts to combat marine plastic pollution by launching AECO's Clean Seas Project. The project includes four main objectives:

1. Significantly reduce the use of single-use plastics onboard expedition cruise vessels;
2. Enhance cleanup efforts in the Arctic;
3. Educate and motivate passengers, staff and crew; and
4. Share knowledge and best practices.

This project is supported by the Svalbard Environmental Protection Fund and the Norwegian Environmental Directorate. In addition, donations have been received from Ship to Shore and Cheesemans' Ecology Safaris. AECO has signed a memorandum of understanding with the United Nations Environment Programme (UN Environment) and is contributing to #CleanSeas, a UN-led campaign to combat marine plastic pollution. At the time of the projects launch, Frigg Jørgensen, Executive Director of AECO remarked; Our ambition is to change people's attitude towards disposable plastics. We want to show people that there are good alternatives to things like plastic straws and plastic packaging. It's not too late to tackle the issue of plastic marine debris, but we have to act now."[16]

AECO's members showed a strong support and willingness to address single-use plastic onboard their vessels. Internal surveys of AECO members concluded that 90% of respondents listed the reduction of single-use plastic as a high priority. In order to develop best practices to help reduce plastics consumption on expedition cruise ships, AECO needed to inventory the common waste generated by ships and identify plastic free alternatives or other non-disposable replacements. AECO grew its team and hired an environmental agent to manage the Clean Seas project, which included visiting and monitoring member-cruise vessels sailing in Svalbard, to collect and systematize data on current plastic use and disposal. AECO's first environmental agent, Sarah Auffret, noted of these ship visits; "When I visit ships to assess how much disposable plastic is in use, it often opens up a very productive discussion on what they are using and what they can do better"[17]. In 2020, AECO's current Environmental Specialist, Melissa Nacke, plans the conduct further assessments onboard vessels.

16 "AECO to Combat Marine Plastic Litter", Association of Arctic Cruise Operators, April 23, 2018, https://www.aeco.no/2018/04/aeco-to-combat-marine-plastic-litter/

17 "Arctic Cruise with Less Plastic and More Beach Clean-ups", Association of Arctic Cruise Operators, July 9, 2018, https://www.aeco.no/2018/07/arctic-cruise-with-less-plastic-and-more-beach-cleanups/

AECO members are currently rethinking their facilities and adapting their products. For example, they are installing water and soap dispensers, providing reusable products, like water bottles, removing single-use items and requiring products from suppliers to come in different packaging. The main challenges faced by member ships included a lack onboard storage space, availability of alternative goods in ports, and cost of alternative products/facilities. AECO began working with members to address these challenges by identifying availability of alternatives for commonly used plastic items and assessing strategies to improve waste reception facilities at relevant ports. As operators evolve their approach to plastic consumption, AECO is currently working to developing a suite of recommendations and best practices to further reduce plastic use on ships. These best practices and innovative solutions could also be applied to other ship-based industries as well as land-based industries, such as hotels. and develop best practices, which will be applicable to a wider audience.

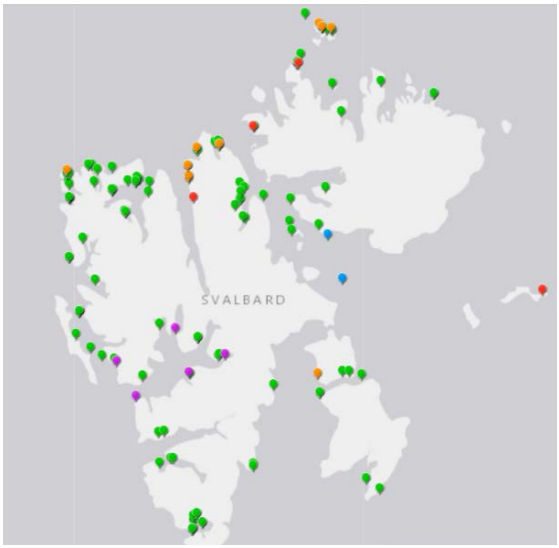


Figure 1

2018 reported cleanup efforts for Clean Up Svalbard Project—green dots represent AECO member clean ups.

While targeting the ways their members' ships operate, AECO also focused on influencing the tourists who were traveling with them to reduce plastics coming into the region and onto the ships. In May of 2019, AECO launched its Clean Seas Guidelines for Visitors to the Arctic. The guidelines provide travelers with information on responsible solutions for reducing their waste and plastic footprint before, during and after their trip. The guidelines were developed in collaboration with AECO's sister

organization, the International Association of Antarctica Tour Operators (IAATO), who created equivalent guidelines targeted at visitors to Antarctica. The guidelines include recommendations to travelers packing reusable items such as water bottle and reusable cutlery, discouraging throwing any non-organic items in the toilet and ensuring all belongings are well secured when ashore or on deck. Now travelers who are coming to the Arctic with an AECO member expedition vessel are given these guidelines before coming, so they can preemptively plan for a reduced plastics vacation.

In addition to developing best practices for their members' fleets to reduce their plastic waste, they are also finding ways enhance cleanup efforts of Arctic beaches by engaging tourists in cleaning up plastic pollution. In cooperation with the Governor of Svalbard, AECO-members have joined the Clean Up Svalbard project. When AECO members bring passengers ashore to get closer experiences of fauna, flora and geological formations they now have the additional opportunity to make a difference by participating in a beach clean-up, which, gives their trip a different meaning. AECO has published Clean Up Svalbard Guidelines, which include information on how visitors can contribute and participate in cleanup activities.

AECO collects information about cleanup activities, including the location and amount of waste, and inputs this data into the Clean Up Svalbard report form, which has allowed for increased data on the origin, composition and distribution of plastic pollution found on Svalbard beaches. Engaging visitors in citizen science activities to improve understanding of the plastic pollution problem. The Governor of Svalbard support the safe disposal of plastic waste collected, which is crucial to the success of the Clean Up Svalbard project. AECO also participates in research efforts like the SALT Deep Dive Workshops and Akvaplan-niva MALINOR Project, both of which strive to map marine litter locations as well as types and engage tourists in citizen science efforts to combat plastic pollution. These efforts also have support that makes participation by AECO members possible. Supporting partnerships like this will be critical to scaling similar efforts.

The Clean Seas Guidelines and other educational materials that have been developed by AECO can be used outside of the expedition cruise industry,

but they aren't being used yet. The challenges expedition vessels face are similar to those faced by larger cruise operators as they begin to expand their services in the region. Sharing of best practices and lists of alternative products (which AECO is currently developing) could help the increasing tourism industry in the Arctic engage in more sustainable visits. Clean up efforts can also be scaled up with the support and partnership of local government. As the tourism industry in the Arctic grows, and more cruise ships enter the region, having sustainable practices will be critical to maintaining the Arctic ecosystems that attract visitors. AECO's work has begun to establish practices that reduce plastic pollution, how to scale these efforts remains that opportunity and the challenge.

Innovation in Biomaterial Alternatives to Plastic;
Dr. Philippe Amstislavski, Rhizoform, LLC and University of Alaska Anchorage

By Marisol Maddox

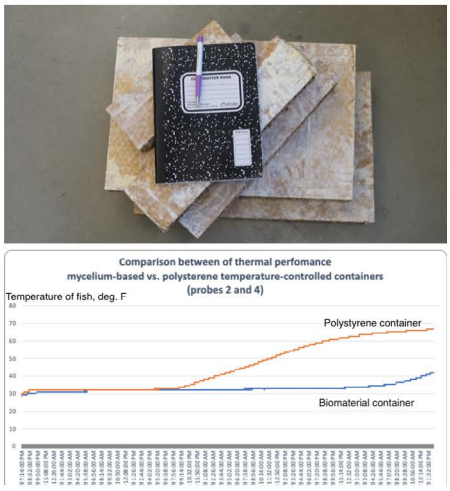
Dr. Philippe Amstislavski is an Associate Professor of Public Health at the University of Alaska Anchorage and the co-founder of Rhizoform, LLC, a biomaterials startup company that focuses on the use of fungi-based materials to replace polystyrene. Rhizoform seeks to provide a biomaterial alternative to polystyerene, with an initial focus on two specific and common uses: material insulation in boxes used to ship frozen fish, and as insulation in housing.

Dr. Amstislavski spent 20 years working in public health, during which time he identified garbage dumps as a particular management challenge for rural areas of the Arctic (specifically Russia and Alaska). Polystyrene is not recycled in Alaska and in most of the Arctic, and with limited waste management services this plastic typically is discarded in open dumps. Because the waste is not well-contained, lightweight plastics end up being blown from dumps to the tundra and into the larger environment. Since subsistence fishing and hunting activities are critically important to food security and cultures of the Arctic, Dr. Amstislavski's motivating concern was in regards to the cumulative effects that plastic contamination might have on the quality of drinking water and traditional food sources.

While in graduate school Dr. Amstislavski studied human exposure to dust particles smaller than 2.5 microns (PM2.5), a known concern for human health. Little is known, however, about the human health implications of exposure to micro and nano-plastic particles. It is now recognized that plastic particles smaller than 2.5 microns have the ability to cross cellular membranes and enter living tissues. Unlike larger plastic debris, micro and nano-plastics can accumulate intra-cellularly and deliver adsorbed toxins directly into cells. The large surface areas of these minute plastic pieces allow for the transport of toxins and pathogenic bacteria and viruses to

novel environments, as these particles can be carried across significant distances. Dust particles from the Sahara Desert, for example, have been shown to travel over 5,000 miles to the Southeastern United States. This long-range transport is a possible vector for toxins and bacteria that have found their way into salmon habitats. One example is Aeronomas salmonicida, a bacterium which causes skin sickness and mortality of salmon, that has been found to travel on microplastics.

Through the development of his mycelium-based packaging, Dr. Amstislavski is seeking to reduce the amount of plastic that enters the environment and potentially impacts human health. Market analysis has shown that over one million insulated boxes travel through Alaska every year, so associated polystyrene use is significant. Kodiak, AK is the third largest seafood processing port in North America, and it uses a significant amount of polystyrene for insulating frozen fish that is shipped across the globe.

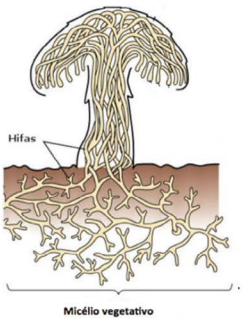


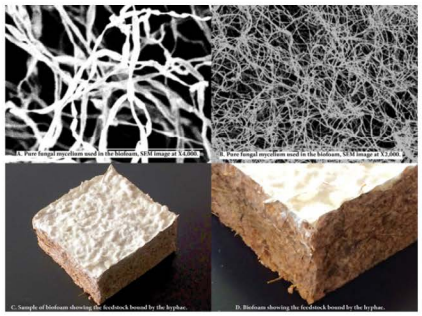
The mycelium-based packaging material being developed by Dr. Amstislavski's team at Rhizoform has a thermal insulating ability that is on par with that of polystyrene. Research has shown that the mycelium-based insulated boxes can keep the fish or other seafood frozen for over 24 hours while it is shipped to consumers due to mycelium's ability to trap air inside the box walls.

Cellulose can be used as a source of nitrogen for growing mycelium in a lab, but there is the potential to use other materials, such as fish industry waste, to better capture opportunities within a circular economy model.

Bio-materials and bio-design, in the form of kayaks and parkas among many other examples, already have an established history amongst Arctic indigenous peoples who have inhabited the region for thousands of years. Like those materials, when a mycelium-based packaging product has run its course it can be buried, as it is fully biodegradable and able to integrate into a forest ecosystem.

Chitin-based Materials as Plastic Alternative?





Fungal Mycelium-Based Biofoam: a three-dimensional matrix consisting of biomass, natural fibers and nutritive substrate bound together by the fungal mycelium.

The use of biomaterials as insulation for fish served as a launching pad for the idea to scale the product up, and use it as insulation in retrofitting houses in Alaska; thereby creating another specific opportunity to replace environmentally persistent polystyrene with a biodegradable material.

Challenges to innovation in the materials sector for the Arctic include deficits in available funding, resources, infrastructure, personnel, and equipment. Dr. Amstislavski has found this is especially challenging in regard to the potential for scaling up facilities to expand production capacity to a volume that makes the product cost competitive for industry.

Dr. Amstislavski was awarded a 2020-21 Fulbright to collaborate with a leading biomaterials team at VTT-Finland in Tampere to develop non-plastic insulation, which will further contribute to the development of biomaterials technology.

In this new era of disruptive climate change, concepts such as this one offer important alternatives to environmentally persistent and fossil fuel intensive products such as polystyrene. While lowering the carbon footprint of

shipping, biomaterials such as the mycelium-based insulation also allow for the prevention of contamination of the environment, food chain, and human health.

Appendix 2: Full Event Summary

Policy & Action on Plastic in the Arctic Ocean Workshop

Oct. 30 & 31, 2019
Harvard Kennedy School's Belfer Center

Introduction

Belfer Center's Arctic Initiative and the Wilson Center's Polar Institute co-hosted a workshop with the Icelandic Chairmanship in late October at the Harvard Kennedy School of Government entitled, *Policy and Action on Plastic in the Arctic Ocean*. The event convened global thought leaders, diverse stakeholders, and subject matter experts to begin developing a framework for tackling Arctic plastic pollution.

Iceland has chosen to highlight the issue of plastic debris in the Arctic Ocean—a growing challenge for the region—as one of the focus areas during its Chairmanship of the Arctic Council from 2019–2021. The primary goal of the workshop at Harvard was to identify key questions to be addressed in order to effectively implement solutions to the serious plastic pollution problem.

Grounding the conversation in the latest science on sources and concentrations of plastic pollution, the workshop gave participants an opportunity to explore different policy levers and innovations that can shape a successful strategy. Drawing on promising case studies from the Arctic and beyond, the workshop considered solutions to the plastic pollution problem that could be deployed in a way that leverages local knowledge and new technology.

This workshop served as a precursor to—and provided input to—the 2020 *Symposium on Plastics in the Arctic and Sub-Arctic Region*, organized by the Icelandic Chairmanship of the Arctic Council.

Workshop Summary

Opening Remarks

David Balton, Senior Fellow, Woodrow Wilson Center

Halla Hrund Logadóttir, Co-founder and Co-Director, Arctic Initiative at Harvard Kennedy School

- Purpose of the workshop is to address how the work of each panelist is part of the puzzle of identifying the scope of the Arctic marine plastic pollution issue, and how it might best be addressed through policy.

Magnús Jóhannesson: The priorities of Iceland's 2019-2021 Chairmanship of the Arctic Council

- With sustainable development as an overarching theme, Iceland is highlighting four priorities: The Arctic Marine Environment, Climate and Green Energy Solutions, People and Communities of the Arctic, and a Stronger Arctic Council.[1]
- Iceland seeks to address two main questions at this workshop:
    - 1. Of the issues involving plastic pollution in the Arctic marine environment, which are the most pressing?
    - 2. Where would be the most impactful place for Iceland to begin addressing this problem? Plastic is ubiquitous, so addressing this issue will require a society-wide effort, but where is a good place to begin? Ambition and reality must be balanced, with a focus on the *origins* of plastic pollution in the ocean, including inadequate wastewater treatment, solid waste management, mining, aquaculture, tourism, and the like.

1 Arctic Council. "Iceland's Chairmanship 2019-2021." https://arctic-council.org/index.php/en/about-us/arctic-council/iceland-chairmanship

- The PAME desktop study on Marine Litter shows the Arctic Ocean is unusual in regard to origins of litter. Whereas worldwide marine litter originates largely from land-based sources, in the Arctic most plastic pollution is believed to be generated from sea-based activities related to fisheries, aquaculture, and shipping (including tourism).[2]
- Iceland seeks a strong, evidence-based analysis of the Arctic marine plastic pollution issue, since appropriately understanding sources of pollution will be key to addressing the problem and developing consensus on appropriate policy and action.

Issue overview: What is the status of plastic pollution in the Arctic?

- Moderator: **Hrönn Jörundsdóttir,** Ph.D., director of Matís Department of Food safety and analytical service.
- **Jenna Jambeck,** Ph.D., National Geographic Fellow & Associate Professor, College of Engineering, University of Georgia
- **Elizabeth McLanahan,** Director of NOAA Office of International Affairs, Senior Advisor to the NOAA Administrator, PAME Vice Chair

Jenna Jambeck presented the latest research on plastic pollution in the marine environment, revealing the massive scale of plastic consumption to the tune of 8.3 billion metric tons of plastic cumulatively produced as of 2017. There is projected rapid growth in plastic production, which is estimated to reach 34 billion metric tons by 2050.[3] 79% of plastic that has already been produced has ended up in the environment or in landfills and 8 million metric tons are estimated to enter the oceans annually.[4] One question stands out: where is that 8 million metric tons of annual material ending up?

2 "Desktop Study on Marine Litter including Microplastics in the Arctic." PAME. May 2019 https://www.pame.is/images/03_Projects/Arctic_Marine_Pollution/Litter/Desktop_study/Desktop_Study_on_marine_litter.pdf

3 Geyer, Jambeck, Law, Science Advances, 2017.

4 Jambeck et al., Science, 2015.

There are three categories of plastic debris: macroplastics, microplastics, and nanoplastics, which disperse differently in the environment. The three categories present challenges to a comprehensive understanding of the plastic pollution issue because different monitoring methodologies are necessary for identifying different sizes of marine debris.

Import and export of plastics is problematic since it is expensive and difficult to remove waste from rural areas. The Arctic has a lower than average volume of imported materials, though Sweden is an outlier in the amount of waste it imports. A critical question is, how can demand for plastic be reduced? Where are opportunities to decouple economic growth from waste generation?

Plastic litter found throughout the Arctic ecosystem has numerous known harmful impacts, including entanglement of mammals and birds, as well as animal ingestion of plastic with ecological and ecotoxicological impacts that are still not well understood. A recent desktop study published PAME, presented by **Elizabeth McLanahan**, shows that given the scale of the problem, there are still big questions about occurrence, sources, transport, and impact of plastic in the Arctic environment.

Studying the Arctic coastal and marine environment is a challenge due to extreme weather conditions and vast distances between communities. Additionally, lack of harmonization of methods and reporting of results is an obstacle to a comprehensive comparison of studies and monitoring initiatives. Citizen science programs have been a helpful source of data, for example the use of the phone app, Marine Debris Tracker.

Plastic pollution in the Arctic is known to be derived from sources both local and afar. However, further studies are needed to better understand specific inputs, distribution, and fate of marine litter. The mobile nature of plastic in a marine environment dominated by strong currents that travel vast distances can make attribution a challenge. However, beach studies show that fishing gear is potentially the largest contributor by mass. Other sea-based sources are known to derive from aquaculture, shipping, and oil and gas sectors. Ghost gear—discarded or lost fishing gear that ends up in the marine environment—is a major source of marine debris in the

Greenland, Bering, Barents, and Norwegian Seas. This is a particularly deadly form of plastic pollution as the gear entangles fish and marine mammals without a human to harvest or free them. Land-based sources of debris are likely from tourism activities, extractive industries, water treatment plants (particularly microplastics), the lack of treatment plants, and poor landfill management.

Determining the extent of the impact of plastic on the Arctic environment is challenging with a lack of comprehensive monitoring in the region. The Arctic Council's Regional Action Plan will focus on identifying actions for prevention, reduction, and removal of litter, as well as monitoring, research needs, and education. Despite the lack of comprehensive knowledge, enough is known that demonstrates the plastic pollution problem is serious, and opportunities must be seized to address it. In order to address the problem inclusively, solutions should be co-created among scientists, politicians, industry, communities, indigenous peoples, non-governmental organizations, and other stakeholders, within the context most appropriate for the given circumstances.

Thematic Session 1: Strategies in Monitoring: How is plastic pollution being tracked and what are the current gaps in knowledge?

- Moderator: **Soffia Guðmundsdóttir**, Executive Secretary, PAME
- **Jennifer Provencher,** Wildlife Health Unit Head, Canadian Wildlife Service
- **Melanie Bergmann**, Senior Deep-Sea Researcher, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research *(attending virtually)*
- **Nancy Wallace**, Director, NOAA Marine Debris Program
- **Tiina Kurvits**, Project Manager, Grid-Arendal

Jennifer Provencher discussed research on plastic ingestion by seabirds from the 1980s to the present in the Arctic, particularly in the North Sea, largely overcoming the tyranny of distance through collaboration with Inuit communities, hunters, and citizen scientists. Northern fulmars, birds that feed at the ocean surface, are particularly vulnerable to plastic ingestion. Research shows there has never been a northern fulmar sampled that did not have some amount of plastic in its stomach. The development of harmonized protocols and standardization of data is critical to measuring relevant trends over time. AMAP is interested in understanding these trends, and in fulmars as the best available monitoring tools.

Cooperation and coordination among Arctic Council working groups is important as three of them have mandates to address plastics: CAFF (AMBI), PAME, and AMAP. The ability to discern the efficacy of measures taken to address the plastic pollution problem is important. While a pristine environment does not include plastic, there is value in determining current baselines of debris so progress of interventions can be monitored. Due to the circulation of global wind and ocean currents, understanding contamination in the Arctic environment is an important part of understanding contaminants at the global scale.

Tiina Kurtis spoke about GRID-Arendal's work with PAME in the development of the Desktop Study noted above. The study found that marine litter in the Arctic comes from human activities both inside and outside the region, with fisheries and sea-based activities contributing significantly to the plastic pollution problem. Additional sea-based sources include aquaculture, passenger and commercial shipping, and oil and gas exploration activities. Land-based sources in the Arctic are thought to not be as important contributors of debris, in contrast to most other regions of the world, however, deficiencies in waste and wastewater management systems in coastal Arctic communities **do** create localized hotspots for discharge of debris and there are still data gaps, especially from the Russian Arctic.

The Arctic acts as a reservoir for plastics from the parts of the world, but the proportion of litter from distant sources is difficult to gauge against local sources. Sources include:

- Oceanic Transport—Regional circulation and currents and trans-polar sea-ice drift.
- Riverine Transport—Several large rivers drain into the Arctic Ocean but their contributions to marine litter in the Arctic needs further research. The populations in the Ob', Yenisey, and Lena watersheds, which extend beyond the boundaries of the Arctic, is around 38 million people, which is an order of magnitude larger than the population of the entire Arctic region.
- Atmospheric Transport— There is a big research gap with no current studies being able to quantify plastics from long-range winds, and other air-based vectors.
- Biological Transport—Through ingestion and entanglement, biota contribute to the redistribution of litter within and across the Arctic marine environment.

Knowledge of the distribution of marine litter in the Arctic is geographically skewed towards regions of concentrated human activity, including the Barents, Bering, and Norwegian Seas. Far less data is available for the Central Arctic Ocean and coastal areas in Siberia, Arctic Alaska, and Canada.

Marine litter is found across the Arctic marine environment including shoreline, sea ice, sea surface and subsurface waters, water column, seafloor and sediments, and in the food chain. The coastline and seafloor accumulate the largest items. There are hotspots where shorelines accumulate high volumes of debris. The seafloor has been identified as an important sink for plastics, including microplastics.

There is concern about socioeconomic impacts of plastic pollution on fisheries and aquaculture sectors, tourism, traditional values, and cultural practices. Impacts to fisheries, for example, could include reduced quality of fish or changes in stocks. Tourism may be affected as plastic pollution does not mesh with the pristine image people have of the Arctic. To date, no economic assessment has been made of the cost of plastic litter to these sectors. This would be a valuable assessment to have in order to further make the case for policy intervention.

There are no formal, consistent monitoring programs that cover all sources, pathways, types, and impacts of marine litter. Developing a monitoring program, including traditional ecological knowledge, in parallel with the development of a Regional Action Plan on marine litter in the Arctic, could help further knowledge and assess efficacy of measures taken to address the problem.

Through a deep-sea towed camera system, **Melanie Bergmann** and her team have observed a portion of the sea floor in the Fram Strait annually since the 1990s. In fewer than 15 years they have documented a more than 23-fold increase in the amount of plastic debris in the area of study. There was a significant increase in seafloor debris (majority plastic, some glass, and other materials) from 2001-2015, including an increase in smaller debris which could be an indication of fragmentation of materials.

Approximately 8 million tons of plastic debris enter the ocean every year and 2 million tons are estimated to enter from rivers.[5] Currently it is only known where about 1% of plastic debris is ending up, which represents a massive gap in knowledge, and begs the question: Where is all the plastic?

Temporal trends can be developed through repeated measurements and sustained data collection. Ice core concentrations of microplastics have been found to be very high. Satellite imagery can be used as an analytic tool to assess where ice formed and how it has moved, thereby providing information about where the microplastics were picked up by the ice. There are known to be significant inputs of plastic debris from the Kara and Laptev Seas, which demonstrate the role of rivers as pathways for litter.

Atmospheric transport of litter could be better assessed by studying snow on Arctic ice floes, as there have been very high amounts of plastics in snow samples. The seafloor is another place where monitoring would be helpful, as plastic pollution becomes incorporated into the seafloor sediment over time. More than 6,000 microplastic particles have been found per kilogram of dry sediment, as well as over 300 times more macroplastics debris than at the sea surface.

5 Lebreton et al.

Nancy Wallace discussed NOAA's Marine Debris Program (MDP), which is the lead for the federal government of the United States on this topic. MDP focuses on reducing the impacts of marine debris through funding removal projects, working on preventing debris from entering the environment, researching impacts of debris, and conducting country-wide monitoring, including positioning staff to work with local partners to understand site-specific litter challenges. Opportunistic research projects are limited though by the short field season in Alaska. Partnerships with local communities, indigenous peoples, and other agencies have been found to be crucial for gathering data on remote locations. In some identified hotspots in Alaska, there have been 120 microplastics per kilogram of sand which is tremendous, given the 100 microplastics per kilogram of sand that has been found at the densely populated National Harbor outside of Washington, DC.

The St. Paul Aleut community has been hosting beach cleanups since 1998 and they use unmanned aerial systems to detect debris. The Pribilof Islands are hotspots for marine debris, having the second highest average concentration in the Arctic, with approximately 70% of debris estimated to be vessel related. For further research there should be increased cooperation and coordination of efforts amongst Arctic states. Core collection needs should be identified and prioritized as the range of research needs is vast. Assessing the composition of debris is a useful tool for ascertaining the source. It would be useful to offer comparisons of quantity and composition of debris found within the Arctic region and outside of it, as well as how those specific types may change as activity in the Arctic increases. Large gaps in knowledge and data could be filled by engaging more with indigenous communities as well as Russia.

Key Questions in Discussion

What is the right balance of time/energy/investment in data gathering vs. making the case that the known amount of plastic is already sufficiently problematic to warrant action? What aspects of the impact of plastic pollution will appeal with the general public to garner support for action?

- One success story emerged from the Pacific Northwest, where citizen scientists found tiny yellow plastic debris and traced it back to oyster culture farms in the region. Because of this specific data, the oyster farms were approached directly and undertook steps to make appropriate changes to their practices; no political intervention was necessary.

How are seasonal fluctuations in water column content handled? How high is confidence in representation of current samples?

- There is less seasonal fluctuation in seafloor samples than in shallower waters, but there is not enough data from different seasons to ascertain specific variations in trends. Most data are collected in the warmer months when scientists have access to the region.
- There is a need to move beyond opportunistic sampling and identify locations where active monitoring could be most valuable. It is important to think critically and strategize where to prioritize standardized monitoring and evaluation.

Are the origins of the plastics from Dr. Bergmann's studies known?

- Origins are difficult to pinpoint, but there is potential of transport through winds (see cyclical graphic from her presentation. Referred to records of pollen from trees traveling from Central Europe to Arctic within 3 days as a model for how microplastics and nanoplastics may be transported. Shows that particle transport through air is an important source).

What is the potential of undisclosed military and industry sources to be impacting local communities (e.g., in the McKenzie River watershed)?

- There is over a thousand miles of oil and gas infrastructure in Alaska right now. As industries bring people and equipment into the region, they need plans for bringing waste out so as to reduce the burden on local waste management. **Recommend working with industry to discuss this issue.** Pipelines rely heavily on plastics, and there are issues with aging infrastructure.

- Recommendation to explore potential for behavioral changes in regard to activities that release microplastics and a transition to a circular economy model.
- Regional partnerships will be important for finding appropriate, place-based solutions as opposed to a one size fits all approach.

Thematic Session 2: Mitigation Efforts at the Global Level: What are promising case studies of plastic pollution mitigation globally that may be able to inform the strategy for the Regional Action Plan?

- Moderator: **Pia Elísabeth Hansson**, Director of the Institute of International Affairs, the Centre for Small State Studies, the Centre for Arctic Studies and Höfði Reykjavik Peace Centre, University of Iceland
- **Christopher Corbin**, Senior Programme Officer, Ecosystems Division, United Nations Environment Programme (UNEP)
- **José Manuel Moller**, CEO, Algramo
- **Julia Cohen**, Co-Founder and Managing Director, Plastic Pollution Coalition
- **Philip Stamp**, Deputy Secretary, Secretariat to the OSPAR Commission *(attending virtually)*

Christopher Corbin reviewed the global framework for plastics management that currently exists within the United Nations. The complexity of the plastic pollution problem makes partnerships across agencies, governments, non-governmental organizations, and local communities more important than ever. Corbin, who worked on the development of the Caribbean Regional Action Plan for Marine Litter, talked about the process of developing that plan, and the many players that were involved in making that process successful. He noted that while nation state level change is necessary, it is important to have regional agreements, cooperation, and

action plans, to account for the strong transboundary aspects of plastics and other litter dispersion throughout the marine environment. For regional plans to be effective, they must be co-developed with local communities so that place-specific solutions can be developed to meet the larger region's goals.

The Caribbean Regional Action Plan, most recently updated 2014, used methodology for monitoring and management developed by OSPAR, and includes four themes: 1. research and monitoring, 2. governance, 3. communication, and 4. capacity-building and training. The Caribbean strategy is a living document, which makes it more adaptive and responsive to the best and latest scientific discoveries. For example, in the wake of research on microbead impacts on the environment, momentum for a ban grew. Many countries signed on to the #cleanseascampaign and the regional plan evolved to include microplastics.

Corbin emphasized that **regional action plans are only as effective as local implementation capability**, and therefore it is important for communities to have buy-in from the beginning. Communication of how an issue like plastic pollution is relevant and impactful at the individual and community levels makes the issue more relevant to local populations. Several messaging campaigns were found to be effective in raising Caribbean community awareness of plastic pollution and spurring local support.

Depending on the scale at which policy development is being targeted, different drivers of motivation and framing will be useful. At the national level a focus on the blue economy may be most effective, while at the international level a larger vision of meeting sustainable development goals may be more important. Communication strategy must necessarily be nuanced.

Philip Stamp discussed OSPAR, which aims to protect the North Atlantic Ocean. OSPAR members are countries bordering the northeast Atlantic or who have major riverine inputs to it. OSPAR adopted a Regional Action Plan in 2014, which is due to be reviewed in 2021. The Action Plan is a combination of national actions, recommendations, and 32 collective actions.

The OSPAR Regional Action Plan has a broad scope: it focuses on both sea-and land-based litter, and provides recommendations for monitoring, education, and removal activities. It includes analysis of issues not core to marine life competencies (for example, solid waste management and infrastructure that support storm water runoff). OSPAR has conducted extensive monitoring and assessments related to plastic pollution, which Stamp notes is important to the credibility of the plan. An understanding of pollution sources and how to measure progress of interventions is critical, especially for engagement with sectors that are contributing to pollution issues to get them on board. To that end, a marine litter assessment will be produced by 2023, including litter impacts, harmful impacts, and effectiveness of measures taken. Plastic pollution has not traditionally been included in marine issues, which has made addressing it challenging, partially because sources are often outside the marine environment.

Among the OSPAR outputs are evidence documents, policy recommendations (non-binding), and strategies for collaboration with other parties, all which feed into European Union decision-making processes. In order to determine progress on reducing litter in the absence of baseline data, measurable targets could be identified, or an evaluation criterion could be developed to describe targets and goals.

When the Action Plan was written, plastic pollution was a relatively new field, but that is no longer the case. Marine plastic litter has become a major issue for many bodies including the EU (as evidenced by their directive on banning single use plastics), and at the nation state level. This raises the question: how to add value in a constructive and collaborative way?

Julia Cohen discussed the work of the Plastic Pollution Coalition, which is active in 60+ countries, on six continents, and has over 1100 member organizations and businesses.

Plastic pollution is a global problem, with 8 million tons of plastic entering oceans annually (by 2050, there is expected to be more plastics than fish in the ocean, by weight), becoming a source of toxic chemicals, and representing an urgent and growing global challenge.

The normalization of a "throwaway lifestyle" has resulted in massive environmental pollution and degradation. Global plastic production is still on the rise, largely due to cheap fossil fuels. However, there is growing awareness of the problem of plastic pollution, resulting in an increasing number of plastic bans, taxes, reduction campaigns, and regulations. Brand audits reveal top polluters like Coca Cola, PepsiCo, and Nestle, and apply pressure for more producer responsibility. Certain products, such as small, sample-sized packets, are not conducive to recycling which compounds issues that already exist with recycling. It is for this reasons that the Plastic Pollution Coalition purports recycling to be more of a false solution than a real one. They have found that most products do not actually end up being recycled, recycling systems are often not worth the money that has been put into them, most jurisdictions don't have industrial compost systems required to properly break down "compostable" plastics, and recycling through pyrolysis is problematic due to energy requirements. Cohen suggests the focus ought to be on solutions such as extended producer responsibility, adherence to circular economy models, and increasing reuse and refill methods. Long term solutions should also be planned, including a full transition away from plastic-based packaging, increasing government transparency and commitment to reduce and phase out plastics, and increased corporate transparency on waste generation.

Jose Manuel Moller started his company Algramo after embedding himself in a low-income neighborhood to better understand systemic issues of socioeconomic inequality. He found that many households do not have the money to buy full size versions of products like laundry detergent, so they buy the smaller and cheaper versions, even though the per unit cost of those products is significantly higher. The greater cost of a product whose packaging costs more than its contents is considered a poverty tax because people with fewer means end up paying the most. This type of packaging additionally increases the volume of waste that must be dealt with by disadvantaged communities.

Algramo envisions the packaging itself as a kind of wallet. Each wallet has its own ID, to which money could be added through an online account, and then the product—such as dish detergent or dry pet food—could be refilled from a bulk reservoir at designated refill locations. In addition to

reducing plastic packaging needs, this method is more cost-effective, and savings get passed on to the consumer. Moller has found the product to be 30% cheaper than the average Walmart price. Producers benefit because they can keep their focus on manufacturing and save money on packaging.

Although Algramo is still a new company, it holds a promising future as it is developing partnerships with large manufacturers and retailers, such as with Walmart in Chile and a new alliance with Coca Cola.

Key Questions in Discussion:

How can global campaigns be scaled down appropriately to the regional level? How can communities be encouraged to come together and feel ownership over their own version of a global campaign?

- There are many cultural identities within each region, so campaigns cannot be homogenous. The message needs to be appropriately adjusted through communication with communities.
- Behavioral change and financial incentives are important. Community leaders who act as trusted liaisons to the community have been important to Algramo's success. In Chile, for instance, shopkeepers are neighborhood leaders who act as important intermediaries who translate the relevance and importance of individual actions and changes.

What are the constraints of measuring success of the regional action plans and what advice might be offered to the Chairmanship in developing an action plan for the Arctic?

- Specific quantifiable targets need to be incorporated into strategic priorities at a regional level. For example, the marine litter action plan never got to the point of legal adoption; it was endorsed but not enforced. Long-term environment strategy includes language about "substantial" reductions but not a quantified target. Success

criteria does not need to be limited to describing only end goals, but rather a series of intermediate metrics that measure progress.

Since Stamp and Corbin both come from regions where there have been successful regional action plans, how were they able to overcome challenges and determine ways of measuring success?

- Corbin: This was most challenging. One issue was the marine litter action plan never got to the legal obligation level so there is no punitive action for non-compliance. The new document should have tangible benchmarks, and specific priority actions with targets to measure progress. Lack of data is a challenge because it is necessary to know levels of reuse and recycling to be able to measure improvement or lack thereof.
- Stamp: The OSPAR model looks at more qualitative criteria for success. The evaluation process was challenging and there was low confidence in quantitative measures of success.
- Additionally, it should be noted that solutions must be "Arctic-fied" through place-based, culturally appropriate, and respectful practices. The use of simple, clear, and direct language is important so that people of all backgrounds can participate in solution development.

Thematic Session 3: Efforts in the Arctic that can be replicated or scaled up: What are promising case studies of plastic pollution mitigation in the Arctic that may be able to inform the strategy for the regional action plan? How can these Arctic success stories be scaled up or replicated?

- Moderator: **Gunn-Britt Retter**, Head of the Arctic & Environment Unit, Saami Council
- **Becca Robbins Gisclair**, Senior Director of Arctic Programs, Ocean Conservancy
- **Hans Axel Kristensen**, Co-Founder & CEO, Plastix
- **Melissa Nacke**, Environmental Specialist, Association of Arctic Expedition Cruise Operators (AECO)
- **Olafur Kjartansson,** Managing Director, Icelandic Recycling Fund

Becca Robbins Gisclair shared experiences with clean up initiatives and the Global Ghost Gear Initiative (GGGI). The Ocean Conservancy focuses on clean-ups as well as stopping the flow of plastics into the environment through improved waste management and reduction of use. Their flagship event is the annual International Coastal Cleanup. The top ten items collected through these clean-ups are made of plastic, and in 2018 over 23 million pounds of trash was collected. The organization has had success with volunteers using their Clean Swell app, the data from which is then used to identify sites for larger cleanup efforts. The GGGI is a cross-sector initiative which confronts the issue of lost, abandoned, and discarded fishing gear through recovery efforts. Both initiatives have seen success in removing plastic waste from the marine environment and could easily be scaled up.

Melissa Nacke discussed the work of the Association of Arctic Expedition Cruise Operators (AECO) in ensuring an environmentally friendly, responsible, and safe cruise industry in the Arctic. AECO runs a Clean Seas Project that aims to reduce single use plastics on vessels, conduct clean-ups, educate passengers, staff, and crew, and share best practices. In

2018 AECO collected 10,000 tons of waste, and they regularly contribute to research efforts through analysis of collected waste quantification and composition, as well as assessments of potential origin and distribution of that waste. AECO has partnered with the government of Svalbard in the "Clean Up Svalbard" initiative, which includes picking up waste, and reporting the type, quantity, and location of it. The government of Svalbard has sponsored vessels that are sent out to retrieve waste collected by AECO, which has helped to make clean-ups affordable and feasible for the cruise operators. AECO is currently looking to expand this effort to Iceland. AECO has produced guidelines for cleanups and encourages passengers to participate through engaging in cleanups as well as by minimizing products that are brought on board which will then need to be disposed.

A general lack of land-based waste receptacles contributes to the challenge of keeping retrieved waste from re-entering the environment, so AECO is making an effort to assess a zero-waste policy. The expedition cruise industry could foster environmental stewardship since they tend to attract customers who are open to having life changing experiences that also create change in habits and behaviors.

Ólafur Kjartansson discussed the Icelandic Recycling Fund (IRF), which is a collaborative effort between government, fishermen, and the trade industry. IRF uses financial incentives to increase collection of waste, including the explicit funding of collection and recycling. The incentive is funded through a recycling fee on products for producers and importers. This mechanism could be scaled or easily adopted by others.

There are efforts to make fishing nets more durable so they do not break down as easily, but the challenge with that is the nets that end up discarded in the ocean will then persist and act as ghost gear for even longer than usual. The price of nets could incentivize fishermen to keep them in use and make them less easily disposable. Composite plastics cannot be recycled, so the opportunity exists for producers to change that so the life span of plastics used can be extended beyond the one net.

Hans Axel Kristensen emphasized the enormously important role plastics have played, including in the medical industry. However, plastics used in healthcare as well as many other industries have escalated since the 1950s and often have not been designed with recycling in mind. Production of plastic has ramped up in recent years with half of all plastics ever produced having been manufactured in the last 13 years. Three challenging impacts of plastic are their persistence in the environment, the way they degrade into microplastics and nanoplastics, and the carbon footprint of plastic production. Plastix seeks to increase the recyclability of fishing nets—which are often unable to be recycled due to the presence of multiple types of plastic in the one product—through mechanical recycling. They sort plastic products and then break them down into high quality raw materials thereby reducing emissions associated with producing new material, keeping the plastic from entering the environment, and extending the lifecycle of the plastic already in use.

Kristensen discussed the importance of common language in regard to plastics and noted that efforts are being made to create standard definitions for the sake of consistency. He recommended marking and tracking systems for products so composition is clear, and consumers can be allowed to make informed decisions that shift the industry through demand. A variety of stakeholders are needed to address the plastic pollution issue at any significant scale, and the plastics industry could play a larger role in that issue, as well as in meeting the United Nations' Sustainable Development Goals.

Key Questions in Discussion:

Solutions highlighted in this session seem to well-suited to local level partnerships. AECO has made progress through partnerships, and the Icelandic Recycling Fund has been able to get good traction with the Icelandic fishing industry. What are the necessary conditions to scale these kinds of solutions throughout the Arctic?

- Melissa pointed out the critical partnership that AECO has with the government of Svalbard, to work together on the clean-ups and have the government assist in disposing of waste that is collected,

since the ships do not have the capacity to carry it with them. Similar public-private partnerships are necessary for the expansion of these efforts within the larger cruise industry.

- Olafur from the Icelandic Recycling Fund explained how important is has been the raise awareness among fishermen of the problems caused by discarded fishing gear, and the negative impacts this has on fish stocks. Although the government's investment in these programs has been important, simply increasing awareness among the fishing industry could go a long way in beginning to tackle the issue of lost and discarded fishing gear in Arctic waters.

All these examples have an economic and sustainability win-win for the companies and governments who participated. How can the economic up-side of sustainability efforts be better conceptualized to make a case for action on plastic pollution? In what ways could a regional action plan help support this kind of work?

- Policy and demand signals are needed to make it clear there is a market for recycled plastic, and economic incentives would be helpful to encourage the circularity mindset in product development. The circular economy necessarily requires a different way of framing economic decisions. Raising awareness of plastic issues and highlighting possible solutions could be helpful. Having a clear united message of commitment to these ideas by Arctic nation leadership would be helpful to beginning the necessary shift.
- A Regional Action Pan with best practices for industries that are known sources of plastic pollution could help set a clear bar for performance.

Thematic Session 4: Innovations and a path forward to Reykjavik: What are science, technology and industry innovations that may be able to help us address the challenge of plastic pollution? What solutions still need to be developed? How could innovation be spurred through the regional action plan?

- Moderator: **Terzah Tippin Poe**, Lecturer, Sustainability and Environmental Management, Harvard University
- **Bill Cooper**, SVP, Strategy & Corporate Development, Agilyx
- **Kara Lavender Law,** Research Professor of Oceanography, Sea Education Association
- **Philippe Amstislavski**, Associate Professor of Public Health, Department of Health Sciences, University of Alaska-Anchorage
- **Sonia Albein Urios**, Researcher, Sustainability and Industrial Recovery, AIMPLAS

Kara Lavender Law presented on developments in science to study plastic pollution, highlighted current gaps in research, and strategies for moving forward in measuring and monitoring plastic pollution. She discussed research on quantity, location and type of debris in the Arctic environment. Although research is increasing, there are still significant gaps in understanding abundance and distribution of plastic debris. The lack of standardized sampling and analysis methods for seawater, sediment, sea ice, and biota hamper the understanding of the problem. Likely sources of plastic pollution include waste from the land, fishing and aquaculture gear deployed and lost in the Arctic, ocean transport of debris from outside the Arctic, and atmospheric deposition.

There are known chemical and physical impacts of plastics in the marine ecosystem including polymer degradation and the release of additives and contaminants, as well as entanglement and ingestion. These are concerns for wildlife as well as people.

Sonia Albein Urios outlined a circular economy concept for plastics and emphasized the importance of product design to keep re-use in mind. Aimplas works with plastic producers to encourage innovation and ways to keep plastic out of the waste stream for as long as possible. The loss of plastic is the waste of raw material that could be used in new products instead of having to create new plastics.

Before **Philippe Amstislavski** became a researcher at the University of Alaska Anchorage he spent 20 years in public health, which is where he became exposed to the challenges of waste management in the rural Arctic (specifically Russia and Alaska). Lightweight plastics often are not well-contained in garbage dumps, and they end up being blown out onto the tundra and into the larger environment. Since subsistence fishing and hunting activities are critically important to food security and cultures of the Arctic, Amstislavski became concerned about the potential for plastic to contaminate drinking water and the food chain.

Biomaterials that are not based on fossil fuels have an established history amongst Arctic indigenous peoples who have inhabited the region for thousands of years. As biomaterials, Amstislavki's research on mycelium-based packaging products has shown they can be buried when their use has been exhausted, and that they are able to fully re-integrate into a forest ecosystem through biodegradation. He is working on developing a commercially viable mycelium-based biomaterial alternative to polystyrene, particularly for the use of insulating fish as they are shipped from Alaska and for insulation in housing. He has experienced significant challenges in finding funding to support innovative research, and for getting small business logistical support.

Bill Cooper emphasized that fundamentally the solution must rely on ways to keep plastics out of the environment and in the value stream. His company, Agilyx, uses chemical recycling to break plastics down to the molecular level so they can be reconstituted into an array of new products. They are challenged with having a limited number of processing facilities meaning plastics sometimes must be shipped long distances to reach a facility for them to be chemically recycled, which contributes to the carbon footprint of the process.

Key Questions in Discussion:

Looking across the scale techno-optimism to techno-pessimism, how realistic is it that technology can address this problem? What is standing in the way?

- Technology exists for mechanical and chemical plastic recycling, as well as for material alternatives (such as mycelium). One challenge is making alternatives price competitive and scalable, which will take significant investment and systems change. Another challenge is that implementing these solutions will require a shift in current systems. While technology may be able to help solve these problems, technology alone won't get us there, there must be economic incentives and market signals.

Communities in the Arctic are distinct from one another. The challenges of bringing technology to scale in the Arctic is magnified by the remoteness of some communities. The same technological solution that may work well for one community, may not work for another. Without picking winners how can solutions that work locally be elevated and appropriately scaled?

- For initiatives like clean-ups and monitoring, the ability to leverage local knowledge will be indispensable in understanding how the conditions have changed over time.
- For technological solutions it is necessary to engage with communities to make sure the proposed solutions are appropriately matched to local needs. Can local communities be empowered through investment to locally produce solutions? Tackling the plastic pollution problem could well be framed as an opportunity for economic development and job creation.
- Rather than the regional action plan picking winners, the local communities should select solutions that best fit their needs. The Action Plan could be helpful in laying out technological solution options.

Closing Session: What Has Been Learned?

Guiding questions:

- What have been the key policy levers which have surfaced that could contribute to the creation of a regional action plan?
- How can this group continue to collaborate in the development of this research and provide concrete recommendations?
- Where are there still gaps?

Fran Ulmer, Senior Fellow, Arctic Initiative at the Harvard Kennedy School

This is a wicked problem with no easy solution, but it is obligatory to tackle the parts of the problem that can be addressed. The global community has quickly generated massive amounts of plastic without anticipating what it would take to produce it, use it, dispose of it, and/ or reuse it in a responsible way. There is a false perception that waste goes "away" when it disappears, but that is a short-lived perception as microplastics are now ubiquitous in the environment, including in food. There are global sources and solutions, and there are local sources and solutions.

Question for Discussion: "What can Arctic nations do to address plastic pollution in the Arctic Ocean?" Specifically, what can the Arctic Council do? They don't have regulatory authority, but they can convene, focus, assess, motivate, promote research, and/or reach agreements.

Regarding April 2020 symposium:

- Who are the stakeholders that should be consulted?
    - The EU ban on single use plastics means 5 of 8 Arctic states must implement that policy. Creating policy alignment across the Arctic may be an opportunity to leverage.
- How much should precautionary principle factor into planning?

    - There are rising concerns about nanoplastics in fish and implications for the Icelandic fishing industry. The impact on human health of bioaccumulation of plastics in tissue is unknown, but it is a topic that is gaining traction in the public imagination.
    - Although scientific investment to quantify impacts is necessary, enough is known to definitively say plastic pollution is a problem and something must be done.
- How might economic incentives be useful?
    - Tackling plastic pollution has created win-wins for industry and the environment, but it still requires increased investment and systems change. Can the Arctic be a leader in combating plastic pollution and benefit economically from that leadership?

Brainstorm of Ideas for Next Steps Towards a Regional Action Plan:

- The Arctic Council struggles to collaborate with private sector but there is potential to build engagement through the Arctic Economic Council and non-governmental organizations.
- Prevention at sea gear management guidelines could be adapted by AC for vessels.
- Guidelines for aquaculture best practices are another option
- Creating a map of the bioeconomy of Iceland and other Arctic nations could be useful in conveying the financial benefits of healthy environments (for example through tourism, seafood industry, etc)
    - Engagement of cross-sector stakeholders would create more buy-in.
- The benefits of locally sourcing foods from subsistence activities in rural areas generally outweigh the risks, so messaging should avoid being unhelpfully alarmist. Since the Arctic is not homogenous,

solutions should be tailored to meet local needs in a way that is respectful.

    - The promotion of locally sourced foods in Arctic communities (as opposed to processed foods shipped in from other places) could contribute to waste reduction.
    - Access is a big issue and the ability of community members to buy products that don't generate plastic waste should be considered.

- There is a need for funding to support innovation in the Arctic, that is currently a big gap.
    - Response: Regarding the lack of funding to support innovation—two entities could be empowered:
        - » 1. Arctic Council—innovation cuts across its four founding principles. Could create a fund to support young innovators who want to address this issue.
        - » 2. Global Science Ministers—first was at the White House in Sept 2016—second was two years later in Berlin.

There could be great benefit to these two entities picking up these opportunities. Stronger programs in existing structures are needed.

- Mimic a "Hackathon" concept of an event that brings local people together to think this through and generate place-based responses. Arctic communities could have a "Plastithon" or "Climathon."
- Communication and messaging have been mentioned but there is a need to recognize that there is an art to making them effective and expertise is needed in crafting them. One way to communicate is through media and storytelling. Arctic Council should receive guidance on not just conveying facts but telling stories about human resilience, animals, and plants that bring hope, as well as local stories that convey what the issue looks/feels like in Arctic communities.

    - Communication can also be achieved without words (ex. An artist made a pop-out book on plastic with no words, but it conveys the problem; a video game called "Never Alone" was effective with Inuit elders, with the inclusion of Inuit language and concepts).
    - Recommend being deliberate in issue framing—recognizing humanity first and creation of consumer mentality second. A circular economy requires a conceptual move away from continuous consumption with the incorporation of more refill and reuse habits.
    - Youth are key to involve since they have energy for these issues and are stakeholders.
    - Need a thoughtful process to distill complexity to its simplest form that makes it easier to communicate to the general public. Need small, doable steps that anyone can take.
- Industry engagement is important to have from an early point in the process and not merely as an afterthought. Same thing with engagement from local communities and indigenous people.
- The Plastic Policy Playbook from Ocean Conservancy provides a toolbox for different levels of government and might be a useful tool.
- Another lesson from the Caribbean marine litter action plan that could be useful for the marine litter action plan for the Arctic is to make the plan flexible; provide short, medium, and long-term actions; use some successes as easy wins.

Final wrap-up: This issue will require a variety of approaches and coordinated responses. Both the public and private sectors should address this question: what can be done that could make progress toward reducing plastics in the Arctic Ocean.


Magnus Johannsson
David A. Balton
Halla Logadóttir
Fran Ulmer

Appendix 3: Thanks & Acknowledgements

October 2019 Workshop Participant List

Harvard's Belfer Center and the Wilson Center would like to thank the following workshop participants and contributors for their valuable time, efforts, and contributions to our October 2019 workshop:

- Alice Rogoff, Founder, Publisher and Editorial Director, *Arctic Today*
- Amanda Sardonis, Associate Director, Environment and Natural Resources Program (ENRP), Harvard Kennedy School Belfer Center for Science and International Affairs
- Becca Robbins Gisclair, Sr. Director, Ocean Conservancy Arctic Programs
- Bill Cooper, SVP, Strategy & Corporate Development, Agilyx
- Charlotte Dyvik Henke, Environmental Engineering Student at Harvard University, Class of 2021
- Christopher Corbin, Senior Programme Officer, Ecosystems Division, United Nations Environment Programme (UNEP)
- Cristine Russell, Adjunct Lecturer in Public Policy and Senior Fellow, Environment and Natural Resources Program, Harvard Kennedy School Belfer Center for Science and International Affairs
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- Deenaalee Hodgdon, Anthropology and Public Policy Student, Brown University, Class of 2020.
- Dr. Douglas Causey, Professor of Biological Sciences and Principal Investigator of the Department of Homeland Security Arctic Domain Awareness Center of Excellence

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- Gunn-Britt Retter, Head of Arctic and Environmental Unit of the Saami Council
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- Hans Axel Kristensen, Co-founder & CEO, PLASTIX
- Hrönn Ólína Jörundsdóttiris, Chief Infrastructure Officer (CIO), Matís
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- Dr. John P. Holdren, Teresa and John Heinz Professor of Environmental Policy, Harvard Kennedy School of Government, Co-Director, Science, Technology, and Public Policy Program and Co-Director, Arctic Initiative, Harvard Kennedy School Belfer Center for Science and International Affairs
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- José Manuel Moller, CEO & Founder, Algramo
- Julia Cohen, MPH, Co-Founder & Managing Director, Plastic Pollution Coalition
- Dr. Kara Lavender Law, Research Professor. Sea Education Association
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- Margrét Cela, Project Manager, Centre for Arctic Studies, University of Iceland
- Martina Müller, Associate Economics Affairs Officer, United Nations
- Dr. Melanie Bergmann, Senior Deep-Sea Researcher, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research
- Melissa Nacke, Environmental Specialist, Association of Arctic Expedition Cruise Operators (AECO)
- Nancy Wallace, Director, National Oceanic and Atmospheric Administration Marine Debris Program
- Nicholas Austin, Foreign Service Officer, U.S. Department of State
- Ólafur Kjartansson, Managing Director, Icelandic Recycling Fund (IRF)
- Peter Murphy, Alaska Coordinator, NOAA Marine Debris Program

- Philip Stamp, Deputy Secretary, Secretariat to the OSPAR Commission
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