Australia's National Science Agency

Inquiry into plastic pollution in Australia's oceans and waterways

House Standing Committee on Climate Change, Energy, Environment and Water

CSIRO Submission 22/806

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Executive Summary

CSIRO welcomes the opportunity to provide input to the House Standing Committee on Climate Change, Energy, Environment and Water inquiry into plastic pollution in Australia's oceans and waterways.

Science and research can inform decision making and policy development in waste avoidance, resource recovery and waste management domains. The comments provided in our submission are based on science and our extensive expertise and long-standing experience in plastic pollution research.

This submission follows many years of research relevant to the topic of plastic pollution in Australia's oceans and waterways. CSIRO science in this domain has been directed towards understanding the types, sources, fate, distribution and impact of plastic pollution across Australian and International waterways and oceans, including terrestrial environments.

Introduction

CSIRO's mission program is responding to national challenges. Through our Ending Plastic Waste Mission (EPW) (https://research.csiro.au/ending-plastic-waste/), we are focussing large scale effort towards addressing the issue of plastic pollution. The EPW Mission is a partnership which works collaboratively with government, universities, businesses and non-government organisations active in the innovation system. The mission aims to dramatically reduce the loss of waste plastic to the environment and increase the recovery of plastic as a resource with impact focussed scientific and collaborative initiatives. We aim to drive Australia's systemic change in plastic pathways through data science, materials, manufacturing, recycling processes and whole of life, circular economy solutions to reduce plastic pollution entering the environment.

The EPW Mission is changing the way we make, use, recycle and dispose of plastics with a goal of an 80 per cent reduction in plastic waste entering the Australian environment by 2030. Our programs of work address the entire life cycle of plastics with targeted interventions to grow a circular economy for plastics and divert plastic waste from landfill:

- Revolutionising packaging and waste systems: recycling, reusing, redesigning and eliminating plastic packaging through better design, materials and logistics.
- Behaviour change and incentives: generating value for plastics through fundamental changes in human behaviour.
- Waste innovation: applying circular economy principles to generate effective solutions for plastics recycling and reuse across the supply chain, including niche industry solutions, decision support systems, and developing value-added products and feedstock from waste plastics.
- Supporting best practice and standards: advising on the development and implementation of standards to support business, industry and the public in reusing and recycling plastics, including guidance of recycled plastic content to improve materials, optimise processes and reduce waste.
- Information for decision-making: applying analytical approaches, Artificial Intelligence/machine learning capabilities and sensor technology to quantify and predict hotspots, applying knowledge to inform policy decisions.

As Australia's national science agency CSIRO undertakes world class research and provides evidence-based advice to government, and as such we do not comment on policy. In our submission, CSIRO seeks to address the Terms of Reference by providing an overview of relevant research, learnings and opportunities gained through our decades of work in this area.

CSIRO response to the Terms of Reference

The environmental impacts of plastic pollution particularly in oceans and waterways

CSIRO has world-leading expertise and experience and is a global leader in the domain of marine debris and ocean pollution, researching sources, distribution and consequences. We are building knowledge and informing decision making by qualitatively and quantitatively measuring the impact of plastic pollution in the environment. Over 80 peer-reviewed journal publications and publicly available reports produced over the past decade may be accessed at this link https://research.csiro.au/marinedebris/publications/peer-reviewed-publications/.

National and international baseline monitoring

Marine debris has been identified as a significant risk to biodiversity, economies, human health, fisheries management, tourism and invasive species transport. Most of the debris that ends up in our oceans originates from land.

CSIRO's research has found that around three quarters of the waste on our Australian coastlines is plastic. To estimate the quantities and sources of marine debris we surveyed the entire Australian coast at 100 km intervals, with help from school groups and citizen scientists (Hardesty et. al., 2017). We found that three-quarters of the marine debris identified was plastic and, although there are some large items, 95 per cent of the items were just a few centimetres or smaller in size.

As part of a national monitoring effort, CSIRO is teaming up with citizen scientists around the country to build a low-cost user-friendly dataset that can enable long-term assessment and monitoring of our litter before it becomes marine debris (https://research.csiro.au/ending-plastic-waste/projects/knowledge-and-data/monitoring/). Collecting information across the landscape rather than only in coastal areas, will identify the sources, movement, distribution and impacts that waste can have on people, wildlife, and sensitive ecosystems. Hence, data is collected not only along our beaches, but in upland and riverine areas. This goal of this project is to provide a national baseline of waste leakage, including hotspots, in the environment around all of Australia. This will provide a core data set against which future measurements can be compared, allowing an evaluation of how effective different policies and community actions are in reducing litter lost to the environment.

Through our global plastic pollution survey (Jambeck et. al., 2015) we have been working with partners around the world to collect on-the-ground data to look at exactly how much litter is in the environment and entering our oceans. This includes many countries listed as the world's top 20 polluters such as China, Bangladesh, Indonesia, Vietnam and the United States. It also includes other countries such as Australia, Peru, South Africa, South Korea and Taiwan.

Marine debris monitoring

Further from our CSIRO research determining that approximately three-quarters of waste along the Australian coast is plastic, it was also found that a significant amount of plastic pollution from our ocean ends up washed up along our coasts, mostly towards the back of the beach where it becomes trapped in vegetation.

Our research (Olivelli et. al., 2020) found that the further back from the beach, the more plastic pollution there is and the bigger the pieces of rubbish. It was also found that onshore wind and waves influence where our plastic pollution on the beach ends up, with waves having much more influence washing the

litter toward the back of the beach. The findings from this study suggest that most plastic makes its way from urban areas into the ocean. It is then transported back onshore through wind and waves and pushed onto land where it stays.

Most debris was identified as from Australian sources, with debris concentrated near urban centres. In coastal and offshore waters, most floating debris is plastic. The density of plastic ranges from a few thousand pieces of plastic per square kilometre to more than 40,000 pieces of plastic per square kilometre.

Entanglement and ingestion

Nearly 700 species of marine life are known to interact with marine debris, many of which are near threatened. In a study identifying which items were responsible for the highest mortality (Roman et. al., 2020), flexible plastic items were responsible for the largest proportion of debris deaths, primarily due to gastric obstructions.

When animals eat plastic, it can block their digestive system, causing a long, slow death from starvation. Sharp pieces of plastic can also pierce the gut wall, causing infection and sometimes death. In 2016, experts identified four main items they considered to be most deadly to wildlife: fishing debris, plastic bags, balloons and plastic utensils. We tested these expert predictions by analysing data from 76 published research papers incorporating 1,328 marine animals (132 cetaceans, 20 seals and sea lions, 515 sea turtles and 658 seabirds) from 80 species.

We examined which items caused the greatest number of deaths in each group, and also the "lethality" of each item defined as how many deaths per interaction. Disproportionately lethal items identified in this study included plastic bags/sheets/packaging, rope/fishing nets, fishing tackle and balloons/latex. Smaller items, including "microplastics," though abundant, were seldom implicated in mortality. Our research also found that it can take just one piece of plastic to kill a turtle (Hardesty and Wilcox, 2015).

Australian and US research (Wilcox et. al., 2016) found fishing gear poses the biggest entanglement threats to marine fauna such as sea turtles, marine mammals, seabirds and whales. Other marine wildlife including sawfish, dugong, hammerhead sharks and crocodiles are also known to get entangled in fishing gear.

Ecotoxicity of plastic in the environment

Plastic pollution in the environment creates both physical and chemical impacts. CSIRO studies have assessed the hazard of biodegradable plastic bags in aquatic systems (Williams et. al., 2016), examined the influence of microplastics on key terrestrial biota in municipal waste organic outputs (Judy et. al., 2019), characterised compostable plastics in green waste (Williams, 2021) and evaluated aspects of the hazard of microplastics released in wastewater (Williams et. al., 2020).

Microplastics can also transport contaminants in the environment including additives from their manufacture or from interacting with contaminants in the environment. Research into hazard characterisation of microplastics in wastewater examined the sorption and desorption of wastewater contaminants and assessed how this can affect the hazard for marine organisms exposed to these microplastics following their discharge into marine ecosystems (Williams, 2020). Although the potential impact was found to be small, other research suggests that weathering of microplastics in aquatic and terrestrial ecosystems may increase the risk through greater release of contaminants from the microplastic.

The effectiveness of Australia's plastics management framework under the National Plastics Plan and related policies to reduce plastic pollution particularly in oceans and waterways

Research on council initiatives and state government policy demonstrate effective practices at several levels.

A recent study (Willis et. al., 2022) has shown local efforts in waste management such as plastic bag bans/levies, reporting hotline, illegal dumping surveillance and local clean-ups have reduced coastal litter by 29 per cent over the last six years. A narrow focus on raising awareness will not work, but when awareness efforts are combined with tools such as incentives and infrastructure such as bins, they become more effective (Willis et. al., 2018).

CSIRO studies on the effectiveness of container deposit schemes compared coastline surveys in states with a container deposit scheme to those without (Schuyler et al, 2018). In both Australia and the US, the proportion of beverage containers found in coastal debris in states without a deposit scheme was about 1.6 times higher than their neighbours. This research found that container deposits reduce the amount of beverage containers on the coasts of both the United States and Australia by 40 per cent.

The effectiveness of community campaigns to reduce plastic pollution particularly in oceans and waterways and encourage the use of alternative materials

Programs such as the partnership between Conservation Volunteers Australia (CVA) and CSIRO allow community members to collect data to understand the scope, scale and types of litter lost to the environment. More than 3,500 volunteers have contributed to CSIRO's national plastic pollution surveys. They have removed more than 9,000 kilos of rubbish. More than 181,200 items were plastic (https://ecos.csiro.au/plastic-pollution-how-much-is-there/).

Global initiatives underway to reduce plastic pollution particularly in oceans and waterways

Participation and coordination with the global community is essential for reducing the prevalence of plastic pollution in oceans and waterways. CSIRO is involved in a number of initiatives such as:

Global plastic: Quantifying flows of plastic and other debris from land-based sources to the ocean uses field sampling and mathematical modelling to document the distribution of plastic in the ocean, on the coast and in the nearshore environment generated by major urban centres and surrounding areas that have been identified as having significant waste mismanagement or losses into the marine environment. CSIRO collaborated with partner organisations in Australia, China, South Africa, South Korea, Peru, Vietnam, Bangladesh, Taiwan, Indonesia, Sri Lanka, USA, Kenya and Seychelles on the first phase of this project (Hardesty et. al., 2017).

CSIRO is now collaborating with the Secretariat of the Pacific Regional Environment Programme (SPREP) and Sustainable Coastlines PNG to run marine litter transects around Port Moresby, Papua New Guinea. More information on this collaboration can be found here: https://research.csiro.au/marinedebris/projects-2/projects/global-plastic-losses-phase-ii/.

Harmonisation of litter monitoring programs: The Coordinating Body on the Seas of East Asia (COBSEA) is partnering with CSIRO to provide technical assistance and capacity building toward harmonized marine litter monitoring programmes. Training on monitoring is organized under the SEA circular project, implemented jointly by the United Nations Environment Programme (UNEP) and COBSEA, with funding

from the Government of Sweden. Regional Guidance on Harmonized National Marine Litter Monitoring Programmes were developed to strengthen and harmonize marine litter monitoring efforts toward preventing and reducing marine litter and its impacts, in line with the COBSEA Regional Action Plan on Marine Litter (RAP MALI). More information on the partnership can be found here: https://research.csiro.au/marinedebris/projects-2/projects/un-cobsea/.

Indo-Pacific Plastics Innovation Network (ippin.org): CSIRO and the Department of Foreign Affairs and Trade (DFAT) are working to design and deliver a series of Plastics Innovation Hub programs across the Southeast Asia region with the purpose of strengthening research collaborations and identifying new approaches to tackling plastic waste. The Hubs convene academia, start-ups, non-governmental organisations, investors, industry, and government to collectively tackle plastic waste by facilitating collaborative spaces to design, support and scale highly impactful solutions.

The Plastics Innovation Hubs in Indonesia and Vietnam are in progress and the Mekong region Hub has gone through a co-design process and is currently under implementation. Future Hubs in Southeast Asia will leverage relevant aspects of the Indonesia and Vietnam design, with incorporation of localised contextual information and stakeholder-specific activity design.

Any other relevant matter

Plastic production and use are predicted to grow exponentially (OECD, 2022). The current pathways for plastics are predominantly linear (https://www.unep.org/interactives/beat-plastic-pollution/). Approximately 99 percent of single use plastic is derived from fossil fuel feedstock with approximately 85 percent of Australian waste plastic ending in landfill (Kikken, 2021). It is widely accepted that the solution to the plastic crisis is a systemic transition to a circular economy for plastics (https://www.unep.org/plastic-pollution).

Research and innovation opportunities and options to grow markets for recycled plastics were identified in the *National circular economy roadmap for plastics, glass, paper and tyres* (Schandl et. al., 2020). The roadmap identifies opportunities across the whole supply chain of how waste can be avoided, and materials can be re-used or recycled. In doing so, it identifies new technologies, products, services and industries that can emerge from taking on a circular economy approach.

Transition to a circular economy for plastics will require new recycling technologies in addition to expanding mechanical recycling capacity. Advanced recycling of plastic waste, also referred to as feedstock, molecular, or chemical recycling, converts plastic waste into its chemical building blocks and back into plastic, or other useful resources such as fuel. CSIRO's report on *Advanced recycling technologies to address Australia's plastic waste* (King et al, 2021) aims to build awareness of advanced recycling technologies, how they apply to different plastic types, and the key factors to enable adoption and scale up of these technologies in Australia.

CSIRO's recent research into global megatrends identifies the new trends, impacts and drivers that have emerged over the last decade, providing a perspective around how these trends may unfold in the coming decades (Naughton et al, 2022). The megatrend towards *leaner, cleaner and greener* solutions recognises the aim to do more with less, achieve carbon neutrality, reduce biodiversity loss and address the global waste challenge. Addressing the plastic pollution problem is clearly evident within that direction with significant impact in all four areas. With plastic's growing GHG footprint it has impacts on adapting to climate change, and the requirements of transparency in decision making, *unlocking the human dimension*, is critical for informed decision making in the transition to a circular economy for plastics that will reduce the impact of plastic on the environment.

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