# Ocean Plastics

*What the packaging industry can do*

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PACKAGING CONSORTIUM pac

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# Introduction

The critical problem of plastic pollution is now recognized worldwide. Scientists and the media increasingly report on rising levels of plastic waste in our oceans, corporations continue to announce significant sustainability commitments concerning plastic packaging, new signatories support the G7 Ocean Plastics Charter, and governments are introducing new policy frameworks to curb plastic waste. While plastic packaging is not the sole cause of ocean plastic waste and marine litter, the packaging industry is positioned to lead significant change. This paper will discuss the realities of our aquatic environments, and present solutions that packaging producers can use to support healthier aquatic ecosystems.

# Why Focus on Plastic?

Plastic has enriched our lives in many ways. It is durable, stable, affordable, and enables the creation of important items, from heart valves to eyeglasses. It also protects products for consumption, ensuring safety, reducing contamination, and extending shelf life while improving fuel efficiency in transport due to its light weight. The rise of plastic use across various industries over the past 50 years can be attributed to these qualities, yet it is many of these qualities that make plastic such a threat to our oceans and freshwater bodies.

The volume of plastic being dumped into the ocean is expected to double to two dump-truck loads every minute by 2030 (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016). Plastics have been detected in water taken from all oceans (Andrady 2017) and in Arctic sea ice (Obbard et al. 2014). Freshwater systems are not free from contamination either; plastics have been detected in the Great Lakes (Eriksen et al. 2013), Lake Winnipeg (Anderson et al. 2017), and even remote areas such as northern Mongolia (Free et al. 2014). Plastic poses threats to marine animals, who can become entangled in it or mistake it for food, causing suffocation or gut obstruction.

Common plastics are synthetic and do not easily break down. In water, plastics physically fragment through UV-photo-oxidation, embrittlement and physical stress, but those small bits and pieces are still plastic. These pieces have the potential to harbour unique and even pathogenic bacteria (e.g. Kirstein et al. 2016), and introduce various chemical additives that are harmful to marine biota (Gallo et al. 2018). Owing to its stability and durability, plastic that has fragmented is likely to persist for hundreds to thousands of years (Barnes et al. 2009).

Unlike plastic, glass materials are made of a mineral called silica that is common in nature. If glass enters the aquatic environment, it will physically disintegrate into sand, and, because it is chemically inert, it will not react with other elements. Most metals used in packaging, such as steel and aluminum, will dissolve into their elemental components in ocean water on the scale of decades to centuries, depending on the type of metal (NOAA 1998). Paper and cardboard weather rapidly in the ocean, as they are composed primarily of organic substances, which are biodegradable. NOAA estimates that un-waxed papers, such as cardboard and newspapers, degrade completely in two weeks to two months, while waxed cardboard containers will take about three months. While all materials have environmental impacts, plastic is building up in water, sediments and living organisms, due to its inability to biologically decompose.

# Types of Plastic in Aquatic Environments

Scientists categorize plastics by size as either plastic debris or microplastics.

## Plastic Debris

Plastic debris is visible to the human eye; it's large and often found in a recognizable form, whether it be a food package or a fishing net. The Great Canadian Shoreline Cleanup's annual Dirty Dozen report provides insights into the types of debris found on Canadian shorelines. While shoreline debris is not the sole indicator of aquatic debris, it does provide insights into consumer behaviour, littering trends, and the types of items that may enter waterways, whether, for example, through wind carrying shoreline litter into a nearby lake, or rainfall carrying street litter into storm drains that empty into the ocean.

## Canada's dirty dozen list

Last year's 12 most collected items of litter.

| | | | |
|---|---|---|---|
| 1. Tiny Plastic or Foam | 333,289 | 7. Plastic Bags | 22,724 |
| 2. Cigarette Butts | 244,734 | 8. Miscellaneous Packaging | 18,465 |
| 3. Plastic Beverage Bottles | 50,285 | 9. Straws & Stirrers | 17,654 |
| 4. Food Wrappers | 47,466 | 10. Foam materials | 17,527 |
| 5. Plastic Bottle Caps | 38,624 | 11. Beverage Cans | 17,337 |
| 6. Paper Materials | 22,877 | 12. Rope (1 piece = 1 meter) | 11,365 |

GREAT CANADIAN Shoreline Cleanup®
OCEAN WISE & WWF

The Great Canadian Shoreline Cleanup, a partnership between Ocean Wise and WWF Canada, has been cleaning up Canadian shorelines for over 25 years. In 2017, it coordinated more than 1,800 clean-ups along nearly 3,000 km of Canadian shoreline. Visit www.shorelinecleanup.ca to learn more.

## Microplastics

Microplastics are less than 5mm in size and are categorized as either primary or secondary microplastics. Primary microplastics are deliberately manufactured and include things like microbeads and the plastic production pellets also known as nurdles. Secondary microplastics result from the breakup of larger plastic items, like plastic bags and food packaging.

The Ocean Wise Environmental Microplastics Facility studies microplastics to understand their source, type and fate. Their studies are conducted by collecting samples (seawater, sediment, stomach contents), analyzing the sample contents using a microscope, and then using Fourier-Transform Infrared Spectroscopy (FTIR) to identify material type. This information, coupled with sample type and collection location, helps researchers piece together a fuller picture of the issue.

While many studies continue in this area, some significant findings have been published, including the joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), which reported in 2015 that, based on published studies at the time, the most commonly found types of microplastics were polyethylene (PE), polypropylene (PP), polystyrene (PS), nylon, polyester and acrylic. Another 2015 study by Ocean Wise's Dr. Peter Ross, published in the international journal *Archives of Environmental Contamination and Toxicology*, drew the connection between individual species and plastic, reporting that microplastic particles were found in two key species of zooplankton in the Northeast Pacific Ocean (Desforges et al. 2015). This is a significant finding, since zooplankton are at the base of the food web, and are a key food source for invertebrates like B.C. salmon. Dr. Ross's team continues to monitor the issue, reporting in 2014 up to 9,200 suspected microplastic particles per cubic meter in the northeast Pacific Ocean (Desforges et al. 2014).

### Research Process:

1. Sample collection
2. High-powered microscope
3. The Northwest Pacific Ocean under a microscope
4. Larger particles pulled out of a seawater sample
5. FTIR identifies down to 5-10 microns
6. FTIR outputs a curve

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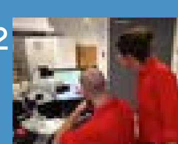
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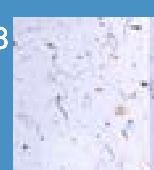
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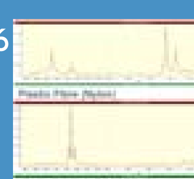

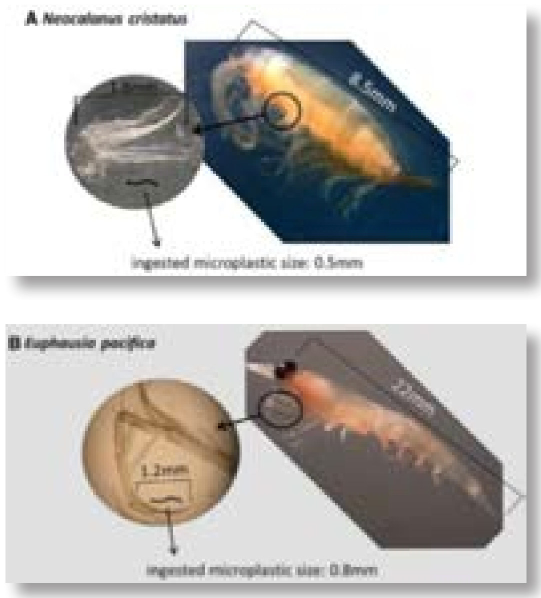


Published in the international journal *Archives of Environmental Contamination and Toxicology*, Dr. Ross and his co-authors, Jean-Pierre Desforges and Moira Galbraith, report on microplastic particles found in two key species of zooplankton found in the Northeast Pacific Ocean: copepods and euphausiids. The findings show plastic in one out of every 34 copepods, and in one in every 17 euphausiids. This raises troubling questions about species that rely on these invertebrates for food, such as B.C. salmon.

# What the Packaging Industry Can Do

## Advancing the Circular Economy

Packaging producers do not intend their packaging to enter aquatic environments – litter is either the consequence of an end user's behaviour, or the lack of available waste management infrastructure to handle the material in that end user's geography. But that does not mean that the packaging community cannot effect change in the consequence of the 32% plastic collection leakage (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016) and drive towards a circular economy, where materials can flow in a continuous loop. Here is how we start moving toward this model.


The Circular Economy is a restorative and regenerative model whereby materials flow in a continuous loop.

### 1. Optimize packaging design

Assess how the packaging will be used. Take a holistic approach and consider the impacts throughout the entire product lifecycle. Some products are consumed in-home, whereas others are consumed in less controlled environments, or on-the-go, where there is less predictable access to waste bins and thus, an increased chance of litter (Wever et al. 2010). In these cases, small-format packaging and lightweight 2D items (e.g., closures, tear-offs, sachets, and items smaller than 40-70mm) are problematic because they are difficult to capture and are more likely to leak out into the natural environment (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2017). Redesigning small-format packaging and avoiding small or loose components, such as caps and lids, can help reduce leakage. For example, tethering the cap for beverages sold in polyethylene terephthalate (PET) and high-density polyethylene (HDPE) bottles, in order to 'leash the lid,' allows both bottles and caps to be recycled.

Strike the right balance between under-packaging and over-packaging. Under-packaging compromises not only the product, but also all the natural resources that went into making it. Over-packaging creates unnecessary waste. Optimize packaging by using the right product-to-packaging ratio and by removing unnecessary layers or components of the package.

'Leash the lid' is not a new packaging concept. In the mid-1970s, the aluminum beverage can transitioned from detached pull-tabs (shown top left) to redesigned stay-on-tabs that we still see today (shown top right). Could there be a similar design evolution for today's plastic beverage bottles?

## 2. Choose materials wisely

Choosing the right packaging materials can reduce the consequence of leakage and support the circular economy. While packaging producers explore alternatives to conventional plastic, there has been increasing interest in biodegradable and compostable alternatives and additives.

There are few scientific studies that test materials marketed as compostable or biodegradable in the aquatic environment. However, the few studies to date on the environmental performance of common bio-based plastics including polyhydroxyalkanoate (PHA) and polylactic acid (PLA) indicate such materials can degrade poorly and require specific environmental conditions to do so. For instance, PLA had a weight loss of 2.5% in a simulated marine environment over 600 days (Pelegrini et al. 2016), while PHA degradation was shown to be dependent on water's inorganic composition, temperature, the PHA's chemical structure (Voinoya et al. 2008) as well as the ability of bacteria to secrete specific extracellular PHA depolymerases (Kunioka et al. 1989). It is important to note that there is need for clarification of international standards on definitions, testing protocols, and appropriate usage of biodegradable or compostable materials so that these materials are used correctly and to the right advantage (Thompson, 2006; European Bioplastics, 2016). Furthermore, additives that add biodegrading qualities to conventional plastic resins are problematic. "Oxo-degradable" or "oxo-biodegradable" additives introduced to conventional plastic resins attempt to mimic biodegradation, but lead to fragmentation that increases microplastics and degrades the quality of plastics that could be otherwise recycled (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016). Given these realities, biodegradable and compostable alternatives and additives are not considered solutions to ocean plastic (UNEP, 2015; Vaughan, 2016; Greene, 2018).

## 3. Use recycled content and ocean plastic

Incorporating recycled content into packaging supports and strengthens recycling programs that are critical to the circular economy. Recycling relies on strong end markets where there is steady demand and value for recycled materials. There are numerous industry associations and available resources that can help engage packaging producers in establishing stronger end markets and reprocessing infrastructure, such as the Association of Plastic Recyclers' Recycling Demand Champions campaign.

There are also examples in the marketplace of companies that use a percentage of recycled ocean plastic debris in their packaging. Plastic debris collected from aquatic environments can be separated from non-plastic debris and re-processed to form plastic pellets that can be incorporated into new packaging. Re-purposing debris is costly because it is difficult to sort such a wide range of mismatched sizes and colours of so many plastic resins. Ocean plastics are usually blended with other recycled materials in order to maintain packaging quality and stability. Although using ocean plastic is not a scalable solution and does not address smaller microplastic pollution, it does help to increase consumer awareness of the issue, and it provides support to cleanup projects working to conserve shorelines and aquatic environments.


Lush engages with local environmental partners to collect ocean-bound plastics from shorelines down the West Coast, and through a test amount, have determined they can blend about 5% ocean-bound plastic with other post-consumer recycled material to create the brand's iconic black pots. Lush uses ocean-bound plastic when it's available and hopes to one day incorporate it into their packaging as standard, long term.

P&G's Head & Shoulders bottle, typically designed using white HDPE, was redesigned to incorporate 25% recycled ocean plastic for launch in France. Because ocean plastic varies in colour and quality, P&G formulated a package design that would allow the desired percentage of recycled content without compromising the package's performance or its ability to be recycled.

## 4. Drive closed loop systems

Find a way to ensure that packaging can work in current collection systems. If the packaging cannot be collected, it will not be recycled or reused. While there is a variety of collection systems (e.g., depot, curbside recycling, bottle return programs, in-store drop-offs, mail-in incentives), it is important to ensure that each package works in an available collection system.

When designing for reuse, the environmental benefit comes from multiple uses (Lewis et al. 2010), so significant education is key to ensuring that the package can be collected and fed back into the loop after its useful life. For example, The Beer Store boasts a 97.5% return rate of all refillable beer bottles sold in Ontario. These bottles are reused an average of 15 times before being recycled into new glass bottles (The Beer Store, 2017).

If designing for recycling, common packaging resins and formats are more likely to be accepted at curbside collection or deposit return programs, due to the ease of identification and sorting. Reducing the complexity of a package also supports closing the loop, as multiple material packages or components can be difficult to separate. Ensuring that a package container can hold a 3D shape may also improve its recyclability, by making certain that it is sorted correctly, and by preventing it from entering the paper stream (RRS, 2015).

## 5. Communicate proper disposal

At present, packaging labels and messaging on proper product disposal can be difficult for consumers to follow. Increasing the visibility of anti-littering messaging on products can help promote positive behaviour change, as can simple instructions on how to correctly dispose of the used packaging (e.g., "empty and replace cap," "remove contents before recycling").

Ultimately, labelling must comply with federal green marketing guidelines, and qualify environmental benefit claims such as "recyclable" or "compostable" (Canadian Competition Bureau, 2008). Packaging claims like "hyper-compostable" and "ocean-friendly" have started to find their way into the market. These claims are extremely misleading, since there is currently no global standard that defines these terms. Packaging is not designed for disposal in the ocean, so claiming that it is ocean-friendly may cause an end user to think there is no consequence to disposing of a package in or near these environments. It is critical to label properly, provide clear disposal guidelines, and avoid false labels or graphics that confuse consumers.

## 6. Support cleanup and prevention

While cleanups will not alone solve the issue, corporate involvement in them provides an excellent opportunity to educate employees on the issue and gives an opportunity to experience and understand litter first-hand. Involvement can be as simple as

When marketing and communicating about disposal it is important to watch the usage of **"Bio-based," "Biodegradable"** and **"Compostable."** These terms are often confused by consumers, and can result in incorrect disposal. The meanings of these terms are described below.

**Bio-based**
Bio-based materials are derived from living organisms, such as corn or sugarcane. Bio-based plastics, or simply bioplastics, can be either recyclable (e.g., PET, HDPE) or compostable (e.g., PHA) or sometimes both (e.g., PLA). If marketing for bio-based packaging, be careful that it is not confused with the term "biodegradable," which can lead to the incorrect disposal of the package.

**Biodegradable**
Biodegradable means that a material can break down in the natural environment and marketers must be able to prove that the entire product or package will completely break down and return to nature within one year or less. Since it is incredibly difficult to meet this criterion, an unqualified claim of biodegradability would be considered greenwashing.

**Compostable**
Compostable means that a material can break down under specified composting conditions. Compostability claims need to be qualified as the packaging must meet standards that allow it to be composted (e.g., Biodegradable Products Institute (BPI) certification, ASTM standards). Marketers should also qualify a claim if the packaging is intended for industrial composting facilities, especially if the facilities aren't available to the majority of consumers.

an employee cleanup event organized through a group like the Great Canadian Shoreline Cleanup. Involvement may also involve sponsorship of a cleanup group, or even funding for industry-appropriate projects like Circulate Capital, which has brought together intergovernmental organizations, associations, consumer packaged goods companies, and plastic manufacturers to finance waste management infrastructure in Asia to prevent ocean plastic and to further close the loop.

# Conclusion

With global plastic production projected to rise, and plastic packaging representing the major share of this leakage into aquatic environments (World Economic Forum, Ellen MacArthur Foundation and McKinsey & Company, 2016), our oceans and freshwater bodies need us to act more decisively than ever before. While packaging producers cannot solve the global plastic pollution crisis alone, they are uniquely positioned to advance the circular economy to reduce the consequence and scale of packaging's impact. The packaging industry has an opportunity to lead unprecedented collaboration throughout the value chain, where scientists, policymakers, producers, consumers, and other stakeholders can fuel momentum and drive long-lasting, meaningful change.

If you would like more information about this, or if you have any questions, please contact:

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