Turtles and Plastic

THE CASE FOR MORE ACTION

By EMILY DUNCAN

Pollution has been identified as a major, global-scale threat to sea turtles for decades, and the oceans are now experiencing a relatively novel and dangerous type of pollutant: highly persistent plastic. Over the past 65 years, the global annual production of plastic has grown from 1.5 million to 299.0 million metric tons. Of this, it is estimated that between 4 million and 12 million metric tons enter the oceans every year. The abundance and distribution of plastic pollution at sea are increasing, both in the form of large pieces of plastic, known as macroplastics, and as pieces of plastic smaller than five millimeters in diameter (less than a quarter inch), known as microplastics. Microplastics originate as fibers shed from clothing when it is washed; as microbeads used in cosmetic products; and as pieces of larger plastic items that break down into ever-smaller pieces as a result of wave action, exposure to ultraviolet light, and physical abrasion.

Plastics threaten many forms of marine wildlife through ingestion, entanglement, and the degradation of habitats and ecosystems. Sea turtles are of particular concern because their complex life histories, highly mobile behaviors, and use of numerous marine habitats expose them to harm from plastic pollutants through many different pathways.

INGESTION

Ingestion of plastic by sea turtles is an ever-growing problem and is now a global phenomenon that affects all seven species. It is unknown whether ingestion is accidental (the plastics are mixed with prey items) or selective (the plastic items are specifically targeted by turtles). Because turtles are primarily visual feeders, the colors and shapes of ocean plastics are likely to be important factors in determining the probability of ingestion. Ingestion rates are also likely to differ dramatically among life stages and species. Six of the world's seven sea turtle species undergo a period of pelagic drifting with currents that transport hatchlings to highly productive foraging hotspots. These are the same oceanic processes that also concentrate floating anthropogenic debris, thus creating a spatial overlap of plastics and young turtles that could be acting as an ecological trap.

As they grow, many species begin to develop more specialized diets. Carnivorous species such as the loggerhead, Kemp's ridley, olive ridley, and flatback risk indirectly ingesting microplastics by consuming contaminated prey items. Other species risk ingesting plastics that resemble their prey. For example, clear, soft plastics resemble the natural structure and behavior of sea grasses and gelatinous prey, which are important food sources for green turtles and leatherback turtles, respectively. Plastic ingestion can be lethal, causing blockages, internal injuries, and lacerations. Adverse sublethal effects can also take place, such as dietary dilution in which the stomach is filled with nonfood items that can lead to starvation, malnutrition, and impaired immunity.

The large surface area to volume ratio of microplastics also has the potential to attract hydrophobic contaminants—such as polychlorinated biphenyls, known as PCBs—that can be released into the animal's tissues when ingested. The sheer scale and diversity of possible effects of plastic ingestion on marine turtles make this topic one that is in urgent need of further research.

ENTANGLEMENT

Beyond ingestion, entanglement in marine debris can cause severe injuries such as abrasions and loss of limbs, and it also can cause turtles to drown or can reduce their ability to move and avoid predators. There have been many reports of turtles becoming entangled in marine debris originating from packaging as well as in lost fishing gear (ghost nets). Those forms of plastic pollution may persist in the environment for many years, during which they will affect unknown numbers of animals. Eventually the debris becomes biofouled—that is, covered in microorganisms, plants, or animals—which attracts ocean grazers and predators such as sea turtles, which can become entangled.

Large knowledge gaps exist about the severity of this threat, and the sources of entangling plastic pollutants are difficult to trace because of their widespread distribution and movements within ocean currents. Many individual cases of debris entanglement are probably not published. Therefore, rates of entanglement—especially those involving land-based sources, as opposed to ghost fishing gear—are possibly greatly underestimated.

HABITAT DEGRADATION

The presence of plastic in marine environments may lead to the degradation of key habitats used by sea turtles. Nesting beaches, for instance, are frequently sinks for marine debris. As a result, nesting females may have difficulty ascending to lay their eggs, or debris could act as obstacles for emerging hatchlings. Moreover, the physical properties of nesting beaches, particularly the permeability and temperature of sediments, are known to be altered by the presence of plastic fragments. Such alterations could ultimately have implications for sex ratios, which are influenced by nest conditions, and for nest success rates when pollution is severe.

Sea turtles use a variety of aquatic habitats, both near the coast and in the open ocean, that may be adversely affected by the presence of plastics. For example, plastic pollution could reduce the health of coral reefs by causing suffocation, abrasion of polyp tissue, shading from light, and sediment accumulation. The aggregation of both macroplastics and microplastics on oceanic fronts has the potential to decrease the quality of such vital habitats by altering the abundance of available food.

AT LEFT: Microplastic particles are found on a coastal cleanup in the Ha'apai Islands, Tonga. Plastic is now found throughout the world's oceans and in beach sands everywhere.

5 THINGS YOU CAN DO TO REDUCE OCEAN PLASTIC POLLUTION

1	**REFUSE, REUSE, RECYCLE**—Know that change starts with you. Reduce the amount of plastic that ends up in the ocean by refusing single-use plastics, reusing other plastic items, and recycling plastics that cannot be reused.
2	**CLEAN UP**—Help remove plastics from the ocean, and prevent them from getting there in the first place by participating in or organizing a cleanup of your local beach or waterway.
3	**SUPPORT BANS**—Many municipalities around the world have enacted bans on single-use plastic bags, takeout containers, and bottles. You can support the adoption of such policies in your community.
4	**SPREAD THE WORD**—Tell your friends and family about how they can be part of the solution, or host a viewing party for one of the many documentaries about plastic pollution.
5	**STAY INFORMED**—Learn more about ocean plastic pollution through *SWOT Report*, news stories, documentary films, and scientific articles (similar to the one that this article was based on and that was published in *ICES Journal of Marine Science* in 2015; see http://dx.doi.org/10.1093/icesjms/fsv165).

URGENT ACTION NEEDED

Research is urgently needed to better understand plastic pollution and its many effects on marine turtles. I and other authors published a comprehensive review of the published literature about the impact of ocean plastic pollution on sea turtles in *ICES Journal of Marine Sciences* in 2015 (see reference in box above). The review highlights the research needs in a number of disciplines, ranging from ecology to pathology. A number of worthy lines of investigation could aid in understanding the magnitude of the problem and could serve as building blocks for pursuing solutions.

To fully comprehend ingestion and entanglement risk, for instance, researchers must collect data over a variety of geographic, species, and life-stage scales, which would culminate in a global-scale metadatabase. Those data could be further complemented by (a) research to classify the sizes and types of plastics ingested by turtles to reveal patterns of selectivity, (b) oceanographic modeling to highlight hotspots of vulnerability, and (c) investigations into the presence and possible trophic transfer of microplastic particles and contaminant burdens within food webs. Key turtle habitats should also be studied, including quantifying plastic distributions and densities on nesting beaches and conducting experimental research into the effects on sex ratios and nest success.

While we work to advance our understanding of this important threat to turtles and their ocean habitats, we must also do whatever we can as individuals to reduce ocean plastic pollution by influencing the actions of governments, businesses, and other individuals. Change starts with each of us remembering to act in our day-to-day lives by refusing, reducing, reusing, and recycling plastics and by ensuring that our elected officials and the businesses we support through our purchases get the message to do the same. ■