



MENACE *or* HYPE

WHAT'S NEXT IN UNDERSTANDING OCEAN PLASTIC POLLUTION?

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A green turtle mistakes a plastic bag for food off the coast of Florida, U.S.A. © Ben J. Hicks/benjicks.com

SCALE OF THE MENACE

In 2009, Dr. Nicholas Mrosovsky, an iconic sea turtle specialist, declared that a new menace to sea turtles had arisen: plastic pollution. Yet, despite a growing number of studies citing the negative interactions between marine turtles and ocean plastics and the abundant media coverage of dead or suffering turtles and their polluted habitats, the big picture effects of such plastic pollution on marine turtles remain largely unknown. Is plastic truly a *menace* to turtle populations, or has it been overhyped?

We conducted a global review of published studies relating to plastics and their effects on sea turtles over the past half century (published in *Endangered Species Research* 43: 234–52) in which we show that such effects (typically from ingestion or entanglement) have yet to be adequately assessed. At the time of our review, only seven studies had considered the effects of plastic pollution on marine turtle populations; five studies needed more data to draw definitive conclusions, two lacked evidence showing any effects, and none of the seven were able to definitively link plastics with sea turtle declines or even with reductions in growth at the population scale. The findings stand in stark contrast to myriad studies that document the negative effects that ocean plastic pollution imparts on individual animals, from drowning to starvation, gastrointestinal damage, malnutrition, physical injury, reduced mobility, and physiological stress.

Critical questions were left unanswered in our review. We know that plastic kills marine turtles, but does it kill enough turtles to cause population declines or to impede population growth? As marine habitats face increasing amounts of plastic pollution over time, population-level impacts may increase and become easier to detect, but only if researchers exert meaningful efforts toward measuring those impacts. That said, no amount of study will be able to detect all possible population-level effects from plastic pollution given the challenging nature of such broad-scale monitoring; underreporting is to be expected. This challenge to threats assessment in the oceans is not uncommon. For example, fisheries bycatch is generally underreported in fleets operating without extensive observer coverage.

UNDERSTANDING THE MENACE

Notwithstanding the challenges, it is crucial that researchers, managers, and communicators understand plastic pollution in a population-level context so that they can more effectively prioritize the limited conservation resources that address competing threats. The following research priorities will help improve researchers' understanding of how plastic affects marine turtles:

- **Engage in controlled studies.** Controlled studies, in the wild and in the laboratory, can improve researchers' understanding of how plastic ingestion and entanglement affect marine turtles, though such studies in the lab would require great attention to animal welfare concerns. Such studies could control the amounts and types of plastic ingested, including chemical-laden plastic, while tracking weathering, dosage, and other components of ocean plastics. Researchers can concurrently track changes in feeding, weight, growth rates, and other behaviors of turtles with regard to plastic interactions.
- **Report both positive and negative results.** Researchers should report not only when plastic is present in marine turtles (positive results) but also when it is not (negative results). Presenting only the former can result in gross overestimations.

- **Standardize plastic collection techniques.** Differences in plastic collection techniques from dead (e.g., necropsy) or live (e.g., esophagus lavage or feces) animals can make it difficult to draw meaningful comparisons within and among studies. For example, a turtle that is found dead (e.g., stranded) with plastic in its stomach may have been sick and not feeding normally due to its compromised health, potentially contributing to its having consumed plastic.
- **Study sublethal effects.** It is important to better understand how sublethal effects (those that do not immediately kill) may influence the health, reproduction, and survival of marine turtles. For example, studies are needed to learn more about how the drag from entanglement in plastic influences turtles' ability to swim or how plastic in the stomach of a turtle affects its growth. A handful of exemplar studies have suggested tracking animals after they have interacted with plastic so researchers can understand survival probability, growth rates, reproductive output, and health status for individual animals. With advances in tagging technology, it will become easier to assess how sublethal effects may influence marine turtle health, survival, and reproduction.
- **Model the turtle exposure to plastic pollution.** It is essential to understand how many turtles interact with plastic. Modeling the level of exposure to plastic pollution could represent the spatiotemporal overlap between plastic pollution and marine turtle distributions. As the effects on individuals become known, this modeling could be scaled up to help us better understand such effects at population levels.

MENACE, HYPE, AND OPPORTUNITY

Is plastic truly a *menace* to marine turtles, or has it been overhyped? Without question, plastic causes pain and suffering in marine turtles and is clearly a serious animal welfare issue, making it a menace to *individual* marine turtles. However, scientific evidence to suggest broad-scale effects on marine turtle *populations* is still lacking, in contrast to other well-known threats facing marine turtles.

The powerful visual imagery of plastic pollution that is widely circulated by the media elicits visceral emotional responses in people, representing an enormous opportunity to connect more people to ocean conservation and broader sustainability issues. Yet such stories, though well-intentioned, may be inadvertently misleading. In a 2002 editorial in the *Marine Turtle Newsletter*, Mrosovsky wrote, "Perhaps worse are the insidious consequences of enveloping conservation biology in exaggeration and unsubstantiated assertions.... Hype perniciously downgrades precisely what one should wish to encourage in scientists: an overriding respect for the truth." It is thus incumbent upon the marine turtle community to do a better job assessing and communicating the effects of this emerging threat. We think Mrosovsky would agree, the possible menace of plastic notwithstanding. •