How reliable are turtles for measuring ocean trash and marine health?

September 25 2018, by Alison Gillespie

Different turtle species occupy different regions of the ocean and different depths of the water, and therefore may encounter different types of trash and plastic. Here, a green sea turtle peaks out of the water near Hawaii where they are considered ancestral deities by some families. Credit: Bo Blinski Master Honu

When a sea turtle turns up dead on the beach, it often makes the news, especially if the death appears to result from plastic debris in the turtle's stomach. Scientists and the public in general are concerned about the increase in ocean trash and the effects of plastics on marine life. Many view the news reports as scientific updates and assume turtles are like canaries in coal mines when it comes to monitoring the health of the ocean and marine life.

But a new study out today identifies an important flaw in these assumptions. Published in the journal *Environmental Science and Technology* by Jennifer Lynch of the National Institute of Standards and Technology (NIST), the work also provides some suggestions for improving the science of turtle research. Her hope is to make ocean garbage data a bit less likely to be trashed.

The facts seemingly point to turtles as being simple indicators of ocean and marine health. Turtles live long lives and inhabit different regions of the globe. Different species feed at different depths of the water, too. Past scientific investigations have also determined that many turtles often like to eat things that are not food, including plastic bits. Half of all the sea turtles living today have likely ingested such debris, according to previous studies. Several turtle species are listed as endangered.

But according to Lynch, turtle work over the last 50 years has often only focused on the presence or absence of debris while neglecting to note the amount of garbage found in each turtle gut. Also missing from many past studies: The weight and size of the turtles in question. And very little has been done to compare trash-ingestion data across species.

"This unfortunately makes many of these past turtle studies worthless to those wanting to know where ocean debris is occurring in large amounts and what species are the most in need of conservation," said Lynch, a marine biologist and the author of the new paper, which examines more

than 100 previous studies. "It can be frustrating."

Lynch said that trash in turtles should really be handled no differently than any other kind of toxicological issue. When doctors determine the risks of environmental toxins on a patient, they base their conclusions on the amount of the substance in question and the patient's attributes such as weight, age and size.

It is hard for some people to imagine plastic as a toxic substance, Lynch said, although for turtles, it very well could be.

"But right now, we don't know the thresholds," she said. "We don't know at what point plastic causes physiological, anatomical or toxicological impacts on these creatures."

Studies shouldn't just report that trash was found in the gut, Lynch explained. Studies should indicate the species, because the different kinds of sea turtles travel in different parts of the oceans. Studies should also show how much trash was discovered in the turtles' digestive systems, and physiological details like whether the animal was a small hatchling or a large adult.

Specifically, she suggests that grams of trash per kilogram of turtle (g/kg) is the metric scientists should be using. That kind of standardization in reporting would reveal how much trash the turtles are encountering, and which species is being most affected by trash. It also could enable analyses on toxicity.

Lynch also noted that much of the data on the topic of turtles and trash is based on autopsies of what were sick or injured animals, which can perhaps throw off data when trying to determine the role of trash in their deaths. "We need to develop noninvasive ways of getting turtle-trash data from healthy individuals," she said.

Collection methods should be standardized to make cross-lab comparisons easy as well, she said. Trash pulled from the gut of a turtle should also always be washed and dried, to remove excess water as well as excrement, vomit and blood from weigh-ins.

To reach her conclusions, Lynch studied scientific reports on debris taken from the stomachs of various sea turtles dating all the way back to 1970. In total, 131 studies were reviewed. Of those, 39 did not provide the kind of data needed for comparisons because they only described the presence of debris and not the amount. And 41 of the studies did not provide the size of the turtle being studied.

One bright note in the meta-analysis came from species reporting. There was enough data on that metric through the decades for her to be able to see that two species are the most at risk for ingestion, given the number of times they have turned up in either rescues or recovery-after-death events with relatively large amounts of garbage in their stomachs. They are hawksbills (Eretmochelys imbricata), a critically endangered species in the Atlantic Ocean that can weigh 150 pounds), and green turtles (Chelonia mydas), an endangered species found in both the Atlantic and Pacific that can weigh as much as 350 pounds.

Once the existing body of research had been adjusted to address the issue of comparative turtle weight, it also became clear that conservation efforts were not being directed towards the geographic areas that were hot spots for debris.

"Monitoring for this problem has been disproportionate in the past, with too small a focus placed on the wrong areas," Lynch said. "A lot of the focus has been on the Mediterranean, but I found that the turtles in the Central and Northwest Pacific and Southwest Atlantic have a much higher rate of ingestion of plastic."

It is important to acknowledge garbage pieces, especially plastic bits, are unnatural and don't belong in the ocean, Lynch noted. Exposure to chemicals in garbage is concerning to scientists because it remains unclear how many of the chemicals found in plastic trash are moving through the food chain and how they affect the health of both wildlife and humans who eat fish or live near the coast. Finding ways to gather more information on the topic is important to many who want to find effective solutions. Turtles also play a large role in the function of the ocean ecosystem, and several species are listed as endangered, so their conservation is of special concern.

But the problem may be easier to measure than other exposure issues, provided that the right data is gathered in future studies. Turtles could eventually provide important clues to where garbage is worst, Lynch said.

"Plastic litter is one of the few contaminants that can be seen with the naked eye," Lynch said. "The work can be painstaking, and sometimes kind of gross. But it only requires simple lab tools and methods and does not really demand expensive chemical instrumentation. If we improve our methodologies and data collection points and standardize our reporting and analysis, we will likely gain more useful info out of the process for managing our oceans and our garbage."

More information: Jennifer M Lynch, Quantities of marine debris ingested by sea turtles: Global meta-analysis highlights need for standardized data reporting methods and reveals relative risk, *Environmental Science & Technology* (2018). DOI: 10.1021/acs.est.8b02848

Provided by National Institute of Standards and Technology