Choked, Strangled, Drowned:

THE PLASTICS CRISIS UNFOLDING IN OUR OCEANS

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Executive Summary

In 2019, news outlets across the world reported on a beaked whale that died after ingesting more than 88 pounds of plastic.[1] It had starved, and its digestive acid, unable to break down the compacted mass filling its stomach, had begun eating away at the animal from the inside out. But not all incidents like this make the news.

Many tragedies in the ocean go unobserved, and the ones caused by plastic are no different. The plastics crisis is deep, wide and pervasive, affecting ecosystems and animals in ways we are only beginning to understand. In this report, Oceana has compiled for the first time the available data on plastic ingestion and entanglements in marine mammals and sea turtles in U.S. waters. This begins to paint a picture of an unfolding disaster: the flood of plastics into our oceans and the devastating impact it is having on marine life.

Just like the beaked whale incident, this report is a partial snapshot of a staggering problem. Oceana surveyed dozens of government agencies, organizations and institutions that collect data on the impact of plastic on marine mammals and sea turtles in the United States. We found records of almost 1,800 animals from 40 different species swallowing plastic or becoming entangled in it.

The biggest problem we found was animals consuming plastic. This was the story in 90% of the cases we examined. This happens because animals can mistake plastic for food or inadvertently swallow plastic while feeding or swimming. The result is that it can obstruct their digestion or lacerate their intestines, and all of this can interfere with their ability to feed and obtain the nourishment they need. These problems can lead to an animal's starvation and death.

When animals become entangled in plastic, they can drown, choke to death or suffer physical trauma, such as amputation and infection. Entanglement can also lead to malnutrition when it prevents their ability to feed properly.

The animals reflected in this report are far fewer than the true number of sea turtles and marine mammals that consume or become

Key Findings

- Of the 1,792 animals that swallowed or became entangled in plastic, 861 were sea turtles (including all six U.S. species) and 931 were marine mammals (from 34 different species).
- Eighty-eight percent of the nearly 1,800 animals were species listed as endangered or threatened with extinction under the Endangered Species Act.
- From 2009 to 2018, there were, on average, 170 observed instances of plastics impacting marine mammals and sea turtles every year.
- Plastics affected animals at all life stages, from recently hatched sea turtles to seal mothers with actively nursing pups.
- Some sea turtle groups consumed plastic up to three times more often than average for their species.[2,3,33]
- Some marine mammals, such as the northern fur seal, consumed plastic up to 50 times more often than average for eared seals.[4,5,33]
- In the cases where plastic ingestion was the likely cause of or contributor to death, seven involved just one piece of plastic.
- Plastics ranged in size and type, from microplastics that were perforating the gastrointestinal tract of a baby sea turtle to DVD cases and huge plastic sheets that had been swallowed by whales.
- Bags, balloons, recreational fishing line, sheeting and food wrappers were the most common types of identifiable plastics consumed by these animals.
- Plastic packing straps, bags and balloons with strings were the most common items entangling the animals.

entangled in plastic in U.S. waters. Not every animal is reported, and many animals are too decomposed to determine why they died. Those not observed and reported to sea turtle and marine mammal stranding response networks likely far outnumber the nearly 1,800 animals we report on here. These networks rely heavily on reports from the general public and have limited resources for recovering and examining animals.

Marine mammals and sea turtles already face a plethora of problems: pollution, habitat loss and destruction, harmful or deadly encounters with commercial fishing gear, vessel strikes, illegal poaching, harmful algal blooms and a host of climate-driven changes, such as sea level rise and warming oceans, which can affect food supply and habitat.[6–8] The added danger from plastic pollution is one more stressor these animals, especially the threatened and endangered ones, cannot afford to suffer.

If we do not reduce the amount of plastic flowing into the oceans, the problems documented here will get worse. Scientists now estimate that 15 million metric tons of plastic wash into the ocean every year.[9] That equates to about two garbage trucks' worth of plastic entering the ocean every minute. This will increase. Plastic production is expected to quadruple by the year 2050,[10] and if nothing changes, the amount of plastic entering the ocean is projected to triple by 2040.[11]

The struggling populations of threatened sea turtles and marine mammals cannot bear the often deadly impacts posed by a material that is, in many cases, unnecessary and too often used for just a few moments before being discarded. Plastic is designed to last forever yet so much of it goes toward producing items that are used only once. This makes it an obvious target for policies aimed at reducing harmful ocean pollution. The unnecessary use of non-medical single-use plastics is a habit we must break in order to prevent undue risks to endangered and threatened marine animals.

Recommendations

We need to stop the flow of plastic going into the ocean. To achieve that, Oceana has the following recommendations:

- Companies must reduce the production of plastic, especially unnecessary single-use plastic.
- Companies must offer consumers plastic-free choices.
- National, state and local governments must pass policies to reduce the production and use of single-use plastic.
- Companies and governments must move to establish widespread use of reusable and refillable containers and packaging.
- Federal agencies tasked with protecting endangered and threatened species and their habitats, including NOAA Fisheries and the U.S. Fish and Wildlife Service, need to improve, standardize and require reporting of all plastic interaction cases.
- Congress must defend and fully fund implementation of the Endangered Species Act and the Marine Mammal Protection Act, laws that are vital to monitoring, maintaining and restoring the health of vulnerable marine animal populations.

Photo Credit: Cat Uden/ Oceana

Introduction

Since the 1950s, production of throwaway plastics has grown exponentially.[10] To keep up production and profits after the end of World War II, plastic manufacturers turned to making disposable plastic products and convinced consumers that a throwaway lifestyle was easy and convenient. But when people began to realize that the resulting plastic waste was becoming a problem, some states began proposing laws that would limit production.

To head this off, the plastics industry embarked on a massive public relations campaign that would shift the blame for the problem they were causing to the individual consumer.[12] Industry emphasized the need to increase recycling, but this was always a false solution. As of today, only 9% of all the plastic waste that has been produced has been recycled.[13] The industry successfully changed the narrative around plastic pollution by diverting attention to consumers' role in both causing and solving the problem. And so, plastic production continues to grow to this day.[12]

The U.S. government listed plastic as an ocean pollutant as early as 1968.[14] Scientific reports first noted small plastic pellets loaded with contaminants turning up in ocean surveys of fish and water in the 1970s.[15,16] More recent studies have shown that the buildup of plastic pollution in the ocean water column and in sediment over time has closely mirrored the exponential growth in plastic production since the 1950s.[17,18]

Single-use packaging — which includes plastic beverage bottles, bags and food containers — makes up the largest share of plastic production.[13] These lightweight disposable materials are designed to last forever, but most are thrown away after only one use. Waste systems are unable to keep up with the level of production, and many of these products end up polluting land and waterways before eventually making their way into the ocean.

Scientists now estimate that companies produce roughly 400 million metric tons of plastic annually[13] and that an average of 15 million metric tons of plastic waste wash into the ocean every year.[9] That is about two garbage trucks' worth of plastic entering the ocean every minute.

Today, plastic is everywhere. It is found floating on the ocean's surface and in its deepest depths, throughout the water column, melting out of Arctic sea ice, buried in coastal sands where sea turtles nest and even in sea spray delivering

Photo Credit: David Jones/ Just One Ocean

plastic pollution back to land.[19–24] All of the top 10 items found during beach cleanups worldwide are single-use plastics.[25] Plastic production is expected to quadruple between 2014 and 2050,[10] and if nothing changes, the amount of plastic entering the ocean is projected to triple by 2040.[11]

Plastic pollution is a persistent problem. When plastic enters the ocean, it does not biodegrade. It breaks up into smaller and smaller pieces, eventually becoming microplastics (particles smaller than 5 millimeters), and is consumed by even the tiniest marine animals.[26] Now microplastics have been found in every part of the marine food chain, including the seafood we eat.[27–29]

Scientists are still trying to understand the ecological and health impacts of microplastics. But marine plastic pollution can come in all sizes, and more immediately understood is the damage caused by the larger pieces that have not yet broken up into smaller pieces. Plastic bags, sheeting (like those used in construction), straps and wrappers can entangle or be swallowed by many types of marine animals — weakening, injuring and even killing them.

This report, for the first time, compiles data from 2009 to early 2020 about plastic impacts on protected marine species and paints a picture of the very real and growing problem of plastic pollution in the ocean. The incidents detailed here are merely the tip of the iceberg and should be considered a gross underestimate of the U.S. problem. These are only the impacts we have documented, those that we can see. Also, though not fully addressed by this report, the pervasiveness of smaller microscopic plastics in our environment may be doing harm we do not yet fully understand.

Photo Credit: Florida Fish and Wildlife Conservation Commission

Photo Credit: Carlo Leopoldo Bezerra Francini/ Shutterstock

Plastic Impacts on Marine Animals

Ever since the production of throwaway plastics began, we have known they were harmful to marine life. One of the first recorded instances of plastic impacting animals was in the late 1950s. Observers blamed a mass die-off of green sea turtles on plastic bags thrown from a Costa Rican wharf.[30] This case was included in the first international workshop on marine debris, convened in 1984 at the urging of the U.S. Marine Mammal Commission (MMC) because of growing threats from plastic pollution to marine life.[31] Eighty percent of marine debris is plastic, though the term technically includes any solid, persistent man-made material disposed of or abandoned in the marine environment.[32]

Since then, experts have continued to examine marine debris impacts on marine life and have documented a growing threat posed by plastic pollution to many species. A 2020 review shows more than 900 species — including seabirds and fish — are affected by plastic consumption and entanglement (not including fishing gear entanglement). This is three times a 1997 estimate of 297 species being affected.[33,34]

The most commonly documented large marine animals impacted by plastic are sea turtles, seabirds and marine mammals, like dolphins, seals and whales. Oceana focused this report on marine mammals and sea turtles because of the availability of stranded animal data, which are collected due to mandates from environmental laws like the Marine Mammal Protection Act (MMPA)[a] and the Endangered Species Act (ESA) (see Appendix 2).[b] The data in this report represent an incomplete picture of the effects of plastic ingestion and entanglement in sea turtles and marine mammals, but perhaps can partially pull back the curtain on a much bigger problem.

Photo Credit: NOAA Fisheries

Why the U.S. Collects Plastic Ingestion and Entanglement Data

Both the MMPA and the ESA are bedrock environmental laws that empower and compel government agencies to protect marine mammals and endangered species. Reporting human interactions with these animals is part of the protection effort, and without these laws, we would know much less about the dangers facing marine animals in the United States.

These laws established a variety of networks and monitoring practices to ensure that protection and recovery of these species would continue. The Marine Mammal Health and Stranding Response Program and the Sea Turtle Stranding and Salvage Network, managed by NOAA Fisheries, are systems of state and local government agencies, nongovernment organizations, aquariums, universities and other groups that collect data on animals found dead or distressed. Similar stranding networks, managed by the U.S. Fish and Wildlife Service, respond to the Florida manatee. In some cases, these groups rescue or rehabilitate injured animals (see Appendix 2).

Because marine mammals and sea turtles are protected in U.S. waters, human impacts, including marine debris impacts, must be assessed in order to craft adequate recovery and management plans for these animals.[35,36] Indeed, federal authorities have determined that marine debris (e.g., plastic) ingestion and entanglement are threats to the recovery of all threatened and endangered sea turtles in the United States, and among the highest-priority threats to the Northwest Atlantic loggerhead sea turtle.[37–44]

A standardized description, collection and analysis of plastic ingestion would provide more conclusive information about how vulnerable populations are being harmed, and how that changes over time.[75,33,45,46] Scientists then should be able to establish a baseline of consistent data to measure progress in protecting animals from plastics. An expert group, convened by the federal government, could develop such criteria and standardize plastic data collection and reporting.

Photo Credit: The Sea Turtle Hospital at University of Florida Whitney Laboratory under FWC permit MTP228

How Plastics Harm Marine Animals

Most evidence of plastic impacts on marine mammals and sea turtles comes from animals that are found dead, sick, injured or distressed on shore or in the water. But not all animals in these dire conditions are discovered or reported, and not all of the ones that are found receive a thorough examination.

For example, an estimated 2% of deceased dolphins and whales are documented.[47] That means for every dolphin that is found dead, it is possible 50 others died without being counted or examined. Also, not all dead animals receive complete necropsies, which are animal dissections to determine the cause of death. Necropsies are often hampered by decomposition, and relatively few necropsy results are systematically reported or published.[36,48] These limitations make it difficult to truly understand just how many animals are being harmed by plastic in the ocean.[c]

Some plastic ingestion cases are uncovered in live animals undergoing rehabilitation following a rescue. It may take days or weeks for swallowed plastic to pass through a sea turtle's body, if it does at all.[49] While some swallowed plastic may pass through an animal with little apparent effect, consumption of plastic can be fatal when it obstructs or blocks feeding, leading to starvation. It can also kill an animal if it perforates the digestive track, leading to infections or internal bleeding.[50]

Even when animals do not die, swallowing plastic can impair their feeding, suppress reproductive hormones, increase susceptibility to disease and potentially transfer toxic chemicals from the plastic to the animal.[50] Swallowing plastic can also lead to abnormal swimming behavior if material that floats ends up in an animal's gastrointestinal tract.[51] The floating material can prevent them from being able to effectively dive and feed. In a weakened state, these impaired animals are more susceptible to being unintentionally caught in fishing gear, attacked by predators and struck by boats.[51]

When a dead animal is found with plastic in its gut or gastrointestinal tract, it can be difficult to determine whether that plastic directly caused the death. Confirming plastic as the cause of death is often easier with entanglement than with ingestion cases.[27] Entanglements can kill animals by drowning or strangling them. They can also amputate body parts, cause infections and impair feeding and foraging.[27,52] Finally, the cumulative stress of plastic ingestion or entanglement paired with chemical buildup is likely having an effect on the overall health of animals, but this is extremely difficult to measure.

Photo Credit: Matthew Chauvin under NOAA/NMFS permit no. 16632

Oceana's Review of Plastic Impact Data

Federal agencies have collected data on sea turtles and marine mammals ingesting or becoming entangled in plastic for decades. Apart from one earlier assessment of U.S. Atlantic and Gulf Coast sea turtles impacted by marine debris in 1994,[36] there have been no recent evaluations of how many sea turtles and marine mammals have been impacted by plastic in U.S. waters until now.

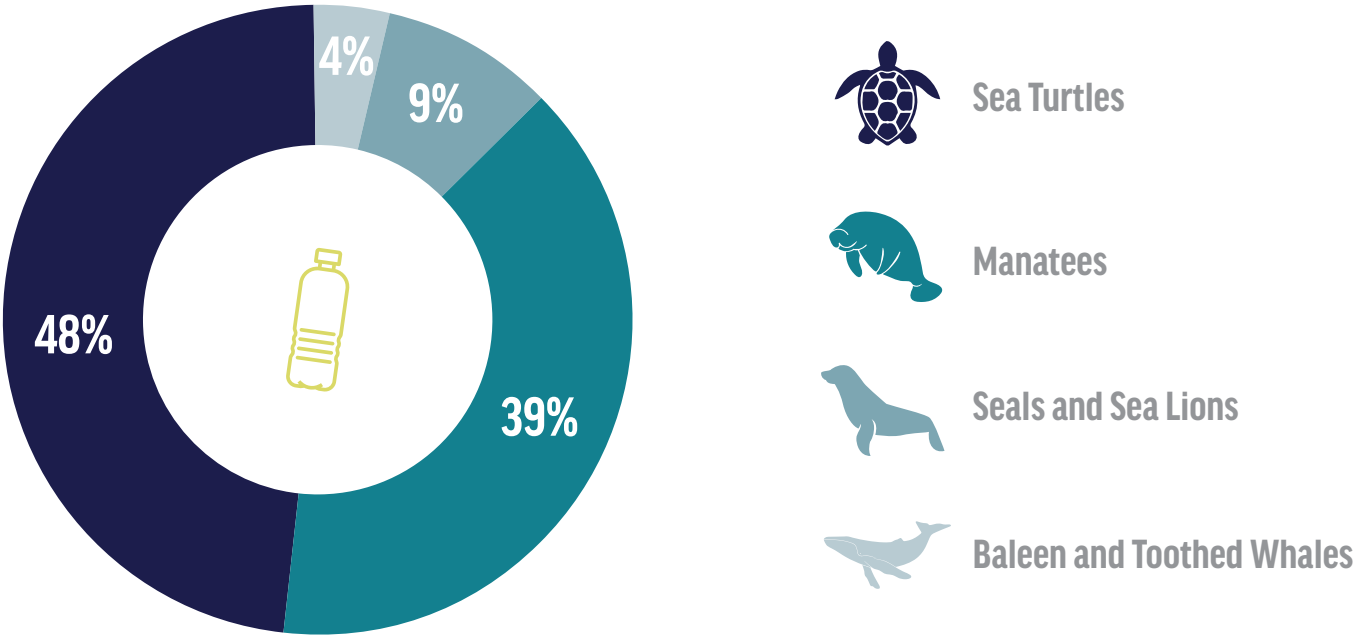
Oceana asked 51 marine life organizations and government agencies between December 2019 and May 2020 for data on sea turtle or marine mammal plastic ingestion and entanglement. This outreach included federal government agencies as well as local stranding and rehabilitation centers.

Of the organizations and federal agencies contacted, 13 provided data that were incorporated into this report. NOAA Fisheries (796 cases) and the Florida Fish and Wildlife Conservation Commission, permitted by U.S. Fish and Wildlife Service, (700 cases) sent comprehensive datasets for sea turtles and marine mammals, including manatees. Non-federal sources included 167 cases from state and other wildlife organizations. We also included data (129 cases) from relevant published literature on sea turtles[2,3,53] and marine mammals[4] found in U.S. waters in our analysis (see Appendix 1).

Oceana compiled 1,792 cases of documented plastic consumption or entanglement in sea turtles and marine mammals (excluding commercial fishing gear entanglements, consistent with other scientific reviews[33,34]) in 21 states along the U.S. coast, mostly from 2009 to 2018. Our dataset includes limited information on cases from 2019 and early 2020, but those were not included in any yearly averages calculated over the 10-year period from 2009 to 2018. The cases were nearly evenly divided between sea turtles (48%) and marine mammals (52%), and three-quarters of the marine mammal cases involved the threatened Florida manatee (Figure 1) (see also Appendix Table 1).

FIGURE 1

Marine Animals That Ingested or Became Entangled in Plastic Included in This Report



See Appendix 1 and Appendix Table 1 for more detail.

> **We know [plastics] entangle; they smother or are ingested by marine animals. I'm just becoming concerned and wonder how it will impact individual species, food chains, ecosystems and, as you zoom out, biodiversity overall.**

ELITZA GERMANOV
MARINE MEGAFAUNA FOUNDATION

Photo Credit: Nova Southeastern University, Broward County Sea Turtle Conservation Program

Photo Credit: Peter Bennett

Findings

This report is the first broad compilation of available data on the impacts of plastic on marine mammals and sea turtles in U.S. waters. Although it is an underestimate of the full scope of the problem, the data we gathered paints a grim picture.

From 2009 to 2018, there were, on average, 170 observed instances of plastics impacting marine mammals and sea turtles every year. Ninety percent of the cases involved animals swallowing plastic, with entanglement in plastic making up the remaining 10%. The data we collected identifies 40 different marine species (see Appendix Table 1).

The ESA and MMPA require the collection of these data and provide the opportunity for Oceana and others to analyze it. Of the cases Oceana compiled, 88% — or 1,577 individual animals from 13 species — are listed as threatened or endangered under the ESA. One additional species (26 animals) is listed as vulnerable to extinction by the International Union for Conservation of Nature (IUCN) and considered depleted by the MMC; another four species (long-beaked dolphin and beaked whale species) are listed as "data deficient" by the IUCN (seven animals) (Table 1).

"Data deficient" means that so little is known about a species that a conservation threat cannot be determined. Some scientists argue that these data-deficient species should be reclassified by the IUCN as "assumed threatened," as a precautionary measure (Table 1).[54] These numbers are concerning as all marine animals play valuable roles in ocean ecosystems.

> **And that's what we're finding: single-use plastics that are just everywhere.**
>
> **KELLY THORVALSON**
> *SOUTH CAROLINA AQUARIUM*

Table 1. Endangered, Threatened, Vulnerable, Depleted and Data-Deficient Species Included in This Report*

Common Name *Scientific Name*	Cases	Endangered Species Act Listing	Other Listing
Manatees			
Florida (West Indian) manatee *Trichechus manatus latirostris*	700	**Threatened** (Entire range)	**IUCN:** Endangered (Global populations) **MMPA:** Depleted (Entire range)
Sea Turtles			
Green sea turtle *Chelonia mydas*	346	**Endangered** (Central South Pacific; Central West Pacific; Mediterranean) **Threatened** (Central North Pacific; East Pacific; North Atlantic; South Atlantic; East Indian-West Pacific; North Indian; Southwest Indian; Southwest Pacific)	**IUCN:** Endangered (Global populations)
Loggerhead sea turtle *Caretta caretta*	261	**Endangered** (North Pacific Ocean; Mediterranean Sea; Northeast Atlantic Ocean; North Indian Ocean; South Pacific Ocean) **Threatened** (Northwest Atlantic Ocean; South Atlantic Ocean; Southeast Indo-Pacific Ocean; Southwest Indian Ocean)	**IUCN:** Critically endangered (Global populations)
Kemp's ridley sea turtle *Lepidochelys kempii*	151	**Endangered** (Entire range)	**IUCN:** Critically endangered (Global populations)
Hawksbill sea turtle *Eretmochelys imbricata*	28	**Endangered** (Entire range)	**IUCN:** Critically endangered (Global populations)
Olive ridley sea turtle *Lepidochelys olivacea*	37	**Endangered** (Mexico's Pacific Coast breeding populations) **Threatened** (All other populations)	**IUCN:** Vulnerable (Global populations)
Leatherback sea turtle *Dermochelys coriacea*	37	**Endangered** (Entire populations) **Candidate** (Northwest Atlantic population)	**IUCN:** Vulnerable (Global populations)
Seals and Sea Lions			
Hawaiian monk seal *Neomonachus schauinslandi*	4	**Endangered** (Entire range)	**IUCN:** Endangered (Global populations) **MMPA:** Depleted (Entire range)
Guadalupe fur seal *Arctocephalus townsendi*	7	**Endangered** (Entire range)	**IUCN:** Least concern (Global populations) **MMPA:** Depleted (Entire range)
Steller sea lion *Eumetopias jubatus*	4	**Endangered** (Western DPS) **Not listed** (Eastern DPS)* **populations east of 144° west longitude*	**IUCN:** Near threatened (Global populations) **MMPA:** Depleted (Western DPS) Strategic (Western DPS)
Northern fur seal *Callorhinus ursinus*	26	**Not listed**	**IUCN:** Vulnerable (Global populations) **MMPA:** Depleted (Pribilof Island/Eastern Pacific stock)

Table 1. Endangered, Threatened, Vulnerable, Depleted and Data-Deficient Species Included in This Report*

Common Name *Scientific Name*	Cases	Endangered Species Act Listing	Other Listing
Baleen Whales			
Sei whale *Balaenoptera borealis*	2	**Endangered** (Entire range)	**IUCN:** Endangered (Global populations) **MMPA:** Depleted (Entire range)
Humpback whale *Megaptera novaeangliae*	1	**Endangered** (Cape Verde Island/Northwest Africa; Western North Pacific; Central America; Arabian Sea) **Threatened** (Mexico) **Delisted due to recovery** (West Indies; Hawaii; Brazil; Gabon/Southwest Africa; Southeast Africa/Madagascar; West Australia; East Australia; Oceania; Southeastern Pacific)	**IUCN:** Least concern (Global populations) **MMPA:** Depleted (Western North Pacific; Central North Pacific; California/Oregon/Washington
Toothed Whales			
False killer whale *Pseudorca crassidens*	1	**Endangered** (Main Hawaiian Islands)	**IUCN:** Near threatened (Global populations) **MMPA:** Depleted (Main Hawaiian Islands)
Long-beaked common dolphin *Delphinus capensis*	2	**Not listed**	**IUCN:** Data deficient (Global populations)
Common bottlenose dolphin *Tursiops truncatus*	16	**Not listed**	**IUCN:** Least concern (Global populations) **MMPA:** Depleted (W. N. Atlantic Central Florida Coastal; W. N. Atlantic Northern Florida Coastal; W. N. Atlantic Northern Migratory Coastal; W. N. Atlantic South Carolina-Georgia Coastal; W. N. Atlantic Southern Migratory Coastal)
Spinner dolphin *Stenella longirostris*	2	**Not listed**	**IUCN:** Least concern (Global populations) **MMPA:** Depleted (Eastern Stock)
Blainville's beaked whale *Mesoplodon densirostris*	1	**Not listed**	**IUCN:** Data deficient (Global populations)
Gervais' beaked whale *Mesoplodon europaeus*	3	**Not listed**	**IUCN:** Data deficient (Global populations)
Sowerby's beaked whale *Mesoplodon bidens*	1	**Not listed**	**IUCN:** Data deficient (Global populations)

**Note: Threat ranking for some species has changed between 2009 and early 2020. For example, the ESA ranking changed from endangered to threatened for the Florida manatee in 2017, the North Atlantic green sea turtle in 2016 and Mexico distinct population segment humpback whale in 2016. See https://ecos.fws.gov/ecp/report/species-reclassified for more detail.*

Table 2. Identifiable Plastic Items Ingested or Causing Entanglement Included in This Report

Item	Case Type	Animal Type	# Cases	Percentage
Recreational Fishing line		Marine mammal	479	95%
		Sea turtle	27	5%
	Entanglement		1**	<1%
	Ingestion		505	99%
		Total cases	**506**	
Strap/Band *Note: Over 50% of these cases were packing straps.*		Marine mammal	94	92%
		Sea turtle	8	8%
	Entanglement		85	83%
	Ingestion		17	17%
		Total cases	**102**	
Bag		Marine mammal	43	54%
		Sea turtle	37	46%
	Entanglement		12	15%
	Ingestion		68	85%
		Total cases	**80**	
Balloon[1]		Marine mammal	12	16%
		Sea turtle	63	84%
	Entanglement		5	7%
	Ingestion		70	93%
		Total cases	**75**	
Sheeting		Marine mammal	2	7%
		Sea turtle	28	93%
	Entanglement		0	0%
	Ingestion		30	100%
		Total cases	**30**	
Mesh Bag[2]		Marine mammal	1	4%
		Sea turtle	24	96%
	Entanglement		23	92%
	Ingestion		4	16%
		Total cases	**25**	
Food Wrapper		Marine mammal	8	38%
		Sea turtle	13	62%
	Entanglement		0	0%
	Ingestion		21	100%
		Total cases	**21**	

**Includes packing strap, elastic band, plastic belts, fan belt, zip tie and bungee cord. **Monofilament entangled with black plastic bag.*

[1] Balloon material not specified but included in requested data received for "plastic." [2] Cases do not match total cases because some animals both ingested and became entangled in mesh bags.

Additional Items Found:

- Beverage bottles
- Bottle caps
- Bubble wrap
- Buckets
- Chairs
- Children's gliding toy
- Dental flosser
- Forks
- Plastic Easter grass
- Polystyrene cups
- Polystyrene pieces
- Sandwich bags
- Sponges
- Straws
- Swim goggles
- Toothbrushes

Photo Credit: 4ocean

Plastics impacting marine animals range in size, shape and type, from plastic buckets to food wrappers to plastic bags. The most commonly found ingested plastics were, however, unidentifiable varied pieces – from thin, flexible, clear film to thicker, rigid, colored pieces.

The most common types of identifiable plastics ingested were recreational fishing line, plastic sheeting, bags, balloons and food wrappers. The most common plastics identified in entanglements were packing straps, bags and balloons with ribbon. We found large variations in how swallowed plastic was described and counted (see Appendix 1), which prevented us from better understanding the relative impacts of plastic among species, among locations and over time. For example, the most common descriptor was simply "plastic" found in the gastrointestinal tract.

> **"It's just a grim future if we continue with increasing plastic production, and I know that the U.S. has big plans for plastic manufacturing here. But I see other countries across the globe banning single-use plastics. So I just hope that we wake up and get on the right side of this."**
>
> **KELLY THORVALSON**
> *SOUTH CAROLINA AQUARIUM*

In the cases where plastic ingestion was the likely cause of or contributor to death, seven involved just one piece of plastic. These potentially fatal items included plastic bags, food wrappers, sheeting and recreational fishing line. The leading suspected cause of death by plastic was intestinal blockage. The cause of death was not supplied in the data Oceana gathered with the exception of several cases.

Certain distinct groups of sea turtles and marine mammals in this dataset consumed plastics far more frequently when compared to global averages for their species (see Appendix 1).[33] For example, some sea turtle groups consumed plastic up to three times more often than average for their species.[2,3] Some marine mammals, such as the northern fur seal, consumed plastic up to 50 times more often than average for eared seals.[4,5] The higher plastic consumption rate for certain sea turtle and marine mammal groups in the United States is cause for grave concern for these protected and threatened species.

We found plastic in marine animals across all life stages from young to adult, including nursing mother-and-pup pairs. Over 20% of sea turtle cases with plastic ingestion were recently hatched turtles — only a few days to a few months old. Younger sea turtles are very vulnerable already since their survival rates are low. Plastic ingestion was observed in recently hatched sea turtles with the egg tooth still present. The egg tooth is a hard projection used to help the sea turtle break out of the shell, and it falls off shortly after a sea turtle hatches.[55] This means these newly hatched animals ingested plastic within days of making the strenuous crawl to the ocean and into the open water.

Plastic has also been found to affect nursing mothers. In California, a northern elephant seal nursing a dependent pup was found with a packing strap around her neck. Similarly in Oregon, a harbor seal with a nursing pup had a packing strap tightly entangled around her neck.

Photo Credit: Raftography Sustainable Coastlines Hawaii

Findings by Species

Sea Turtles

Sea turtles found in U.S. waters suffer from a host of stressors, including changing climate, harmful or deadly encounters with commercial fishing gear, illegal harvest, loss of nesting habitat from coastal development, vessel strikes and disease. The growing threat of plastics in the ocean is one more stressor that these threatened and endangered animals cannot afford.

Sea turtles play vital roles throughout the ocean, including cycling nutrients needed to maintain healthy seagrass beds and seafloor ecosystems, improving nesting-beach stabilization by adding nutrients needed for vegetation growth, enhancing diversity of coral reefs and keeping jellyfish populations in check.[56] It is therefore important to ecosystem functioning to sustain healthy populations of these vital species, which remain under threat from multiple stressors.

In this report, 861 sea turtles from all six species found in U.S. waters swallowed or became entangled in plastic between 2009 and early 2020 (Table 3). Of these, about one-fifth, or 178, were recently hatched turtles — a few days to a few months old.[d] In 1994, NOAA recorded 243 sea turtles impacted by plastic ingestion or entanglement with non-fishery plastic items along the U.S. Atlantic and Gulf of Mexico coasts between 1980 and 1992,[36] bringing the total number of documented sea turtles in the United States affected by plastic since 1980 to well over 1,000. Both our dataset and the earlier NOAA study identify the U.S. Southeast Atlantic and Gulf of Mexico as areas where sea turtles are most heavily affected by plastic, and also where most sea turtles were found dead or injured (Figure 2).

While loggerhead sea turtles were reported to have the most cases of plastic ingestion in the 1994 assessment, we found more cases of green sea turtles in the data we compiled. Then, as now, comparisons between species and time periods are difficult because of a lack of standardized reporting, and the fact that not all necropsy findings on plastic ingestion are reported to NOAA Fisheries' database.[36,e] While all sea turtle species are affected by plastic pollution, we chose to highlight four of the species found in U.S. waters.

Photo Credit: Clearwater Marine Aquarium

Photo Credit: Gumbo Limbo Nature Center Inc.

Plastic Found in Sea Turtle Fecal Matter

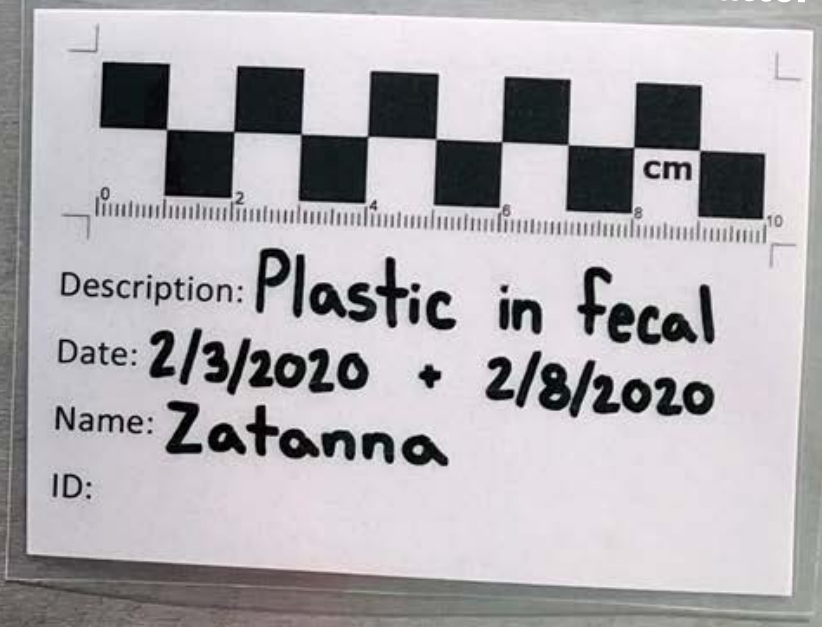
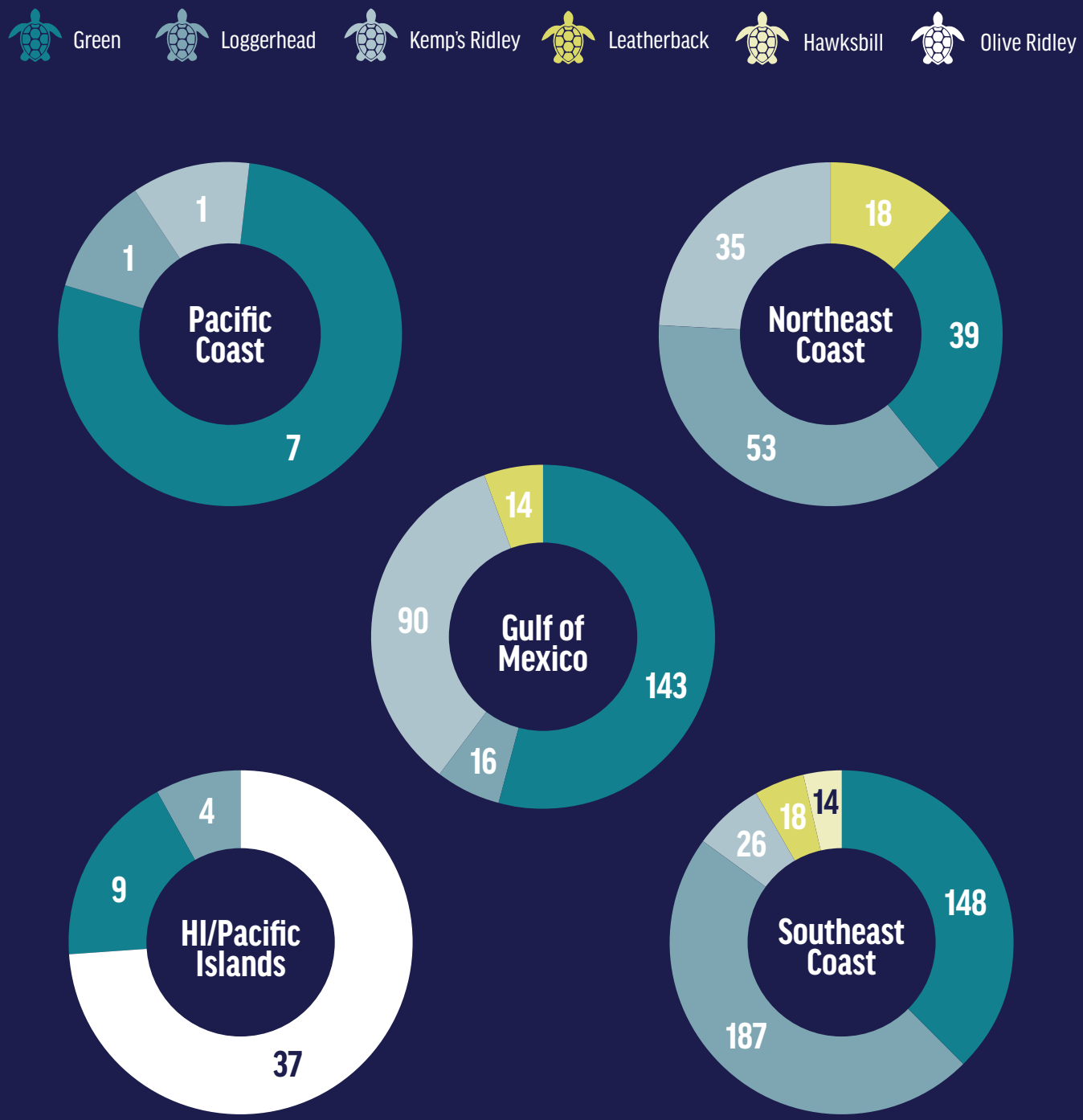


FIGURE 2

Where Sea Turtle Species Were Found Entangled In or Ingesting Plastic Included in This Report



NOTE: Northeast Coast: from ME to VA; Southeast Coast: from NC to Atlantic Coast FL; Gulf of Mexico: Gulf Coast FL to TX; Pacific Coast: AK, WA, OR, CA; HI/Pacific Islands: Hawaii and American Samoa.

Green Sea Turtles

In Florida, a juvenile green sea turtle was found with a black plastic ring around its body. This entanglement led to a severe deformity, and the animal was struck by a boat and later euthanized. In one recently hatched green sea turtle in Florida, multiple pieces of plastic ranging in size from 0.1 to 0.5 centimeter were found in its gastrointestinal tract, perforating its small intestine. In Texas, a green sea turtle was found with a polystyrene foam cup stuck on its left front flipper. There are hundreds more documented cases like these, as green sea turtles comprised the highest number of cases compiled (Table 3).

Green sea turtles typically live along coastal habitats in temperate regions worldwide, but they can migrate long distances to return to nesting or foraging sites.[57] Of all the sea turtles impacted by plastics in this dataset, 40% were green sea turtles, with 346 cases documented in 12 states.

Loggerhead Sea Turtles

In Florida, a recently hatched sea turtle was found with two plastic balloons in its gastrointestinal tract, causing a blockage that potentially contributed to the animal's death. In South Carolina, a sea turtle center found almost 60 pieces of plastic that a loggerhead defecated during its rehabilitation. In Georgia, a loggerhead sea turtle had a plastic woven bag running down its gastrointestinal tract, from its mouth, through the stomach and into the intestines. The intestines were beginning to constrict, which can have serious and potentially deadly consequences.

Loggerheads were the second most commonly affected sea turtle species (Table 3). Loggerheads made up 30% of our sea turtle cases, with 97% of those involving consumption of plastic. Sixteen states have reported cases of plastic consumption in loggerhead sea turtles. Of these consumption cases, half were recently hatched turtles.

A conversation with

KELLY THORVALSON

Kelly Thorvalson is the conservation programs manager at South Carolina Aquarium. She has greatly expanded the program's sea turtle rescue capabilities over the past 15 years.

"We have a graph that shows the number of sea turtles that come in with plastics in their GI tracts, and for the first maybe 10 or 12 years, we had two turtles. And then in the last five years, we've had 30. So it's just been this really dramatic increase.

One had something like 60 pieces of plastics in its GI tract. That was the most we had seen in any animal. It's just such a common occurrence now in our patients that it's alarming.

It's just worse than ever. The trash on the beach is worse than ever.

I notice it on the roadways, and if you look around your community, you'll see more trash than ever. And it's because of the brilliant marketing of the plastics industry. They have developed single-use plastics for every use. And that's what we're finding: single-use plastics that are just everywhere.

It's just a grim future if we continue with increasing plastic production, and I know that the U.S. has big plans for plastic manufacturing here. But I see other countries across the globe banning single-use plastics. So I just hope that we wake up and get on the right side of this. We have to figure out how to slow down the plastics manufacturing. I know that's a tall order, but I think it can be done. We just have to keep waking people up."

Kemp's Ridley Sea Turtles

In the Gulf of Mexico, Kemp's ridleys have been found entangled in plastic mesh bags, with multiple cases noting swallowing of some of the bag as well — possibly from the turtles biting at the plastic in an attempt to remove the material from their flippers. In Rhode Island, a Kemp's ridley was found entangled in a wrapper from a case of plastic water bottles. The animal was disentangled and released. In Florida, a Kemp's ridley was found entangled in a plastic bag that had become filled with sand. The plastic bag had wrapped around the animal's neck, and scientists believe the animal drowned due to the weight of the bag or suffocated from the entanglement.

The Kemp's ridley is among the most endangered sea turtle species in the world, listed as endangered under the ESA and critically endangered by the IUCN. Kemp's ridleys make up more than 17% of the cases of plastic impacts — the third highest in our data.

Eleven percent of the Kemp's ridley cases were entanglement as opposed to consumption — the second highest percentage among other sea turtle species in this report.[f]

Leatherback Sea Turtles

In Maine, scientists examining a dead leatherback found that plastic sheeting in its stomach contributed to its death. One leatherback in New York was found with a 13-gallon plastic bag in its gastrointestinal tract. In North Carolina, a 2-foot-long plastic bag was found in a leatherback, along with a jellyfish and balloons. In California, a leatherback was found with plastic sheeting in its gastrointestinal tract.

Leatherback sea turtles are at risk of eating plastic bags and plastic sheeting, which they can mistake for jellyfish, their preferred food. A third (32%) of the leatherback cases reported here involved plastic bags, sheeting, balloons or wrappers.

Table 3. Sea Turtle Species That Ingested or Became Entangled in Plastic Included in This Report

Common Name	Total #	Recently Hatched, Number (%)*	U.S. Nesting Hotspots
Green	346	30 (9%)	Texas, Southeast Atlantic
Loggerhead	261	137 (52%)	Florida (largest), Texas, Mississippi, Southeast Atlantic
Kemp's Ridley	151	5 (3%)	Texas, Mississippi
Leatherback	37	0	Southeast Atlantic
Hawksbill	28	6 (21%)	Texas/Mexican border
Olive Ridley	37	0	No nesting in U.S.
Unknown	1		
Total	861		

*Age class not recorded for 619 out of 861 sea turtle cases received (72%).
**See https://oceana.org/reports/us-sea-turtles-comprehensive-overview-six-troubled-species.

Note: Data for olive ridley sea turtles, which rarely strand in the U.S., come exclusively from reviewed literature included in our database.[2]

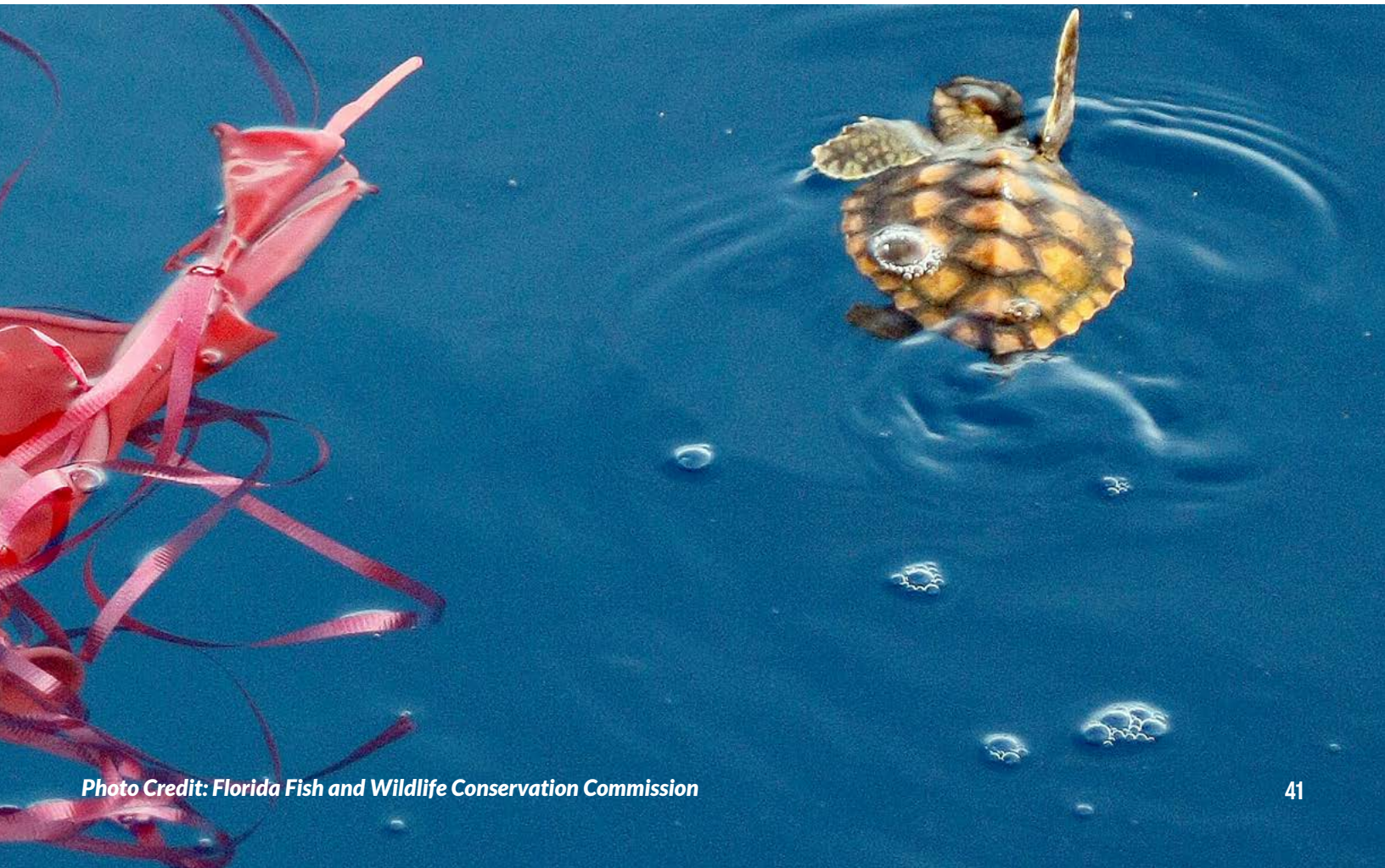


Photo Credit: Florida Fish and Wildlife Conservation Commission

Marine Mammals

Marine mammals are a diverse group of animals that serve as valuable indicators of ocean health. Many live long lives in coastal waters, grazing at the ocean surface, and some occupy the top of the food chain.[58,59] But these characteristics make them susceptible to human-caused stressors, like vessel strikes, fisheries interactions, habitat degradation, climate change, noise pollution, toxic algal blooms, oil spills and environmental contaminants.[7] Plastic is a relatively new and unnecessary stressor added to this already long list.

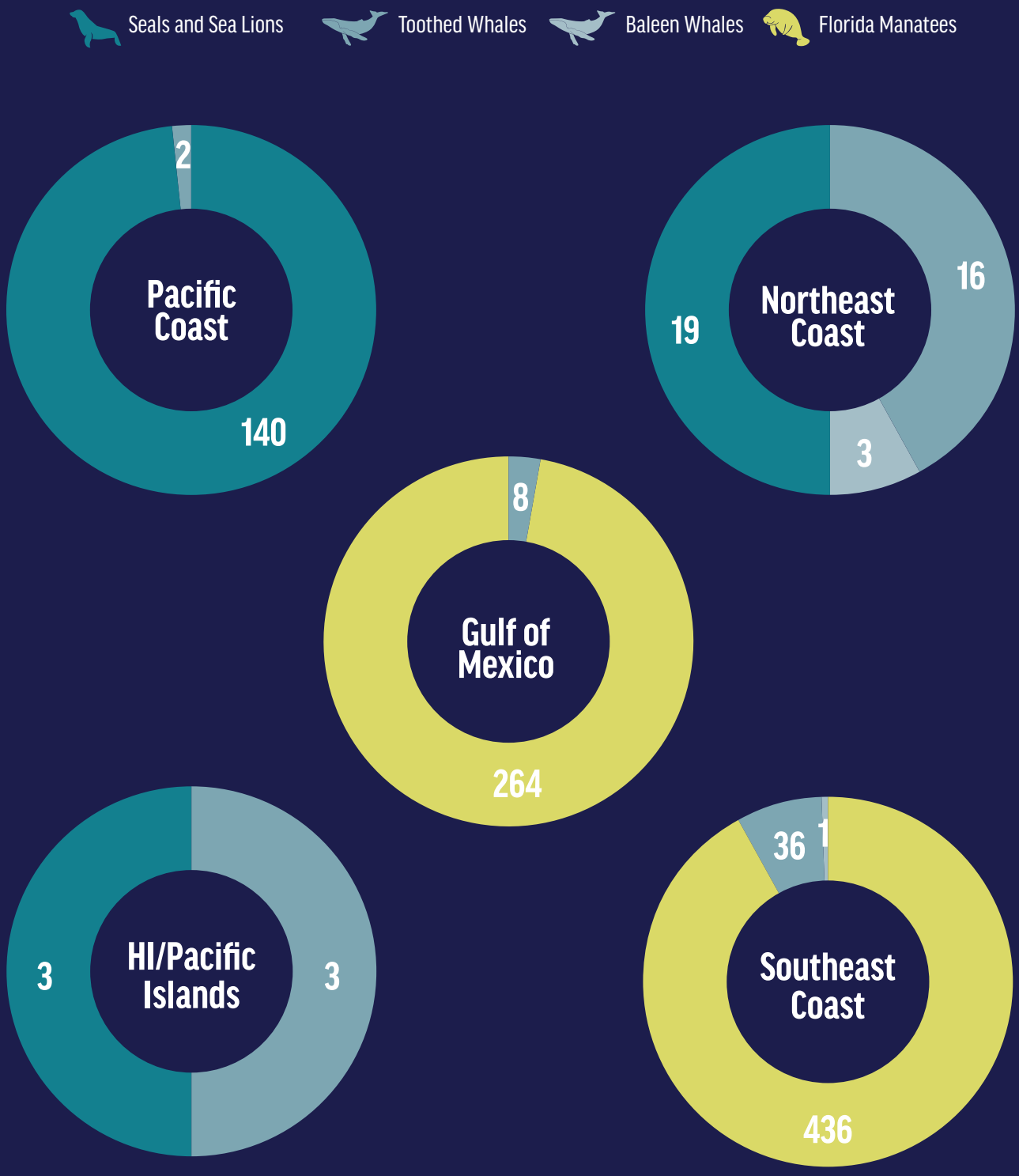
Marine mammals are crucial in sustaining productive ocean ecosystems. Their ecological roles include maintaining a balanced food web through prey consumption, providing nutrients to deep ocean waters, sequestering carbon dioxide and maintaining seagrass beds and vegetation.[60–62]

Oceana compiled more than 930 cases of marine mammals ingesting or getting entangled in plastics in U.S. waters between 2009 and early 2020 (Table 4). These cases included 34 different species of marine mammals, including whales, dolphins, seals, sea lions and manatees. Fifty-two percent of the cases were documented on the East Coast of the United States, 32% in the Gulf of Mexico, 15% on the West Coast and 1% in Hawaii and the U.S. Pacific Islands. While manatees make up a significant portion of these marine mammal cases,[g] it is evident that plastic is impacting a wide range of marine mammals (Table 4).

Photo Credit: Kristal Talbot

FIGURE 3

Where Marine Mammal Groups Were Found Ingesting or Being Entangled in Plastic Included in This Report



NOTE: Northeast Coast: from ME to VA; Southeast Coast: from NC to Atlantic Coast FL; Gulf of Mexico: Gulf Coast FL to TX; Pacific Coast: AK, WA, OR, CA; HI/Pacific Islands: Hawaii and American Samoa.

A conversation with

BRANDON BASSETT

Brandon Bassett is a biologist at the Florida Fish and Wildlife Conservation Commission who responds to manatee strandings.

"Generally 10% or 12% of manatee carcasses have some sort of marine debris in them.

In one case, a manatee died from ingesting a large amount of plastic bags and other plastic. Imagine a ball of plastic bags in the stomach, about the size of a cantaloupe, and then a bunch of plastic bags that were wrapped and almost like a rope that was about 3 feet long. On the other end of that was another ball of even more plastic bags that was maybe about half the size of a cantaloupe, and that was in the intestine. That whole mass ended up killing the animal. Stuff like that can lead to not only death, but significant and unnecessary suffering.

Manatees are the only herbivorous marine mammal, and they occupy an important place in the ecosystem. The consequences of the species going extinct are not known.

[Plastic pollution] is an ongoing and increasing global problem due to the persistent nature of plastic, the volume of production and use, and the lack of effective waste management to address the issue. Plastic continues to accumulate and so do its impacts. The full implications of plastics in the environment are not fully understood, especially when you begin to explore the field of microplastics and their impacts on smaller organisms, and consequently the larger organisms that feed on them.

Plastics aren't just in the ocean; they have also been found in all water bodies and even throughout the terrestrial environment. The long-term effects regarding wildlife and human health are continuing to be studied, but are not yet fully understood."

Manatees

Plastic consumption is a growing concern for threatened manatee populations,[5] which have been found to consume a variety of plastic items. In one case, a single manatee ingested a plastic straw, bag, string and recreational fishing line. Another case revealed a manatee had ingested a plastic balloon, ribbon, bag and fishing line.

Entanglements can also be harmful. One rescued manatee was stuck in a plastic strap with a severe, 10-centimeter wound that suggested the entanglement had persisted for roughly two years. Authorized personnel rescued the animal and took it to a rehabilitation center where they treated the wound.

In our data review, 700 Florida manatees suffered from plastic entanglement or ingestion between 2009 and 2018. Of the cases we compiled, nearly all (99%) had swallowed plastic, mostly plastic fishing line.[h] In dozens of cases, this was a significant factor in the animal's death. In addition to those reported here, the Florida Fish and Wildlife Conservation Commission has examined thousands of manatees and found that between 10% and 12% had ingested or become entangled in plastic.[5]

Florida manatees live in shallow coastal waters of the southeastern United States, including both the Atlantic and Gulf coasts of Florida, and they often enter brackish or freshwater areas. Manatees are almost exclusively plant-eaters and graze in seagrass beds and other coastal areas with floating vegetation.[63]

Data for the well-studied and monitored Florida manatee were the most detailed and complete, comprising nearly 40% of the cases we compiled (Figure 1). This could be because Florida manatees live in estuaries and coastal regions and primarily feed on bottom vegetation where debris can settle or on floating vegetation

where debris can become entangled, as compared to other marine mammals and some sea turtle species, which feed higher in the water column or may live in offshore environments (B. Bassett, pers. comm.) (see also Appendix 1).

Seals and Sea Lions

In New York, a juvenile gray seal was found with a plastic sandwich bag wrapper around its neck, which cut into the animal's tissue. In Hawaii, animal-rescue professionals removed a water bottle from the snout of an endangered Hawaiian monk seal. In Oregon, a California sea lion was found with a plastic band wrapped so tightly around its neck that it seemed to be having difficulty breathing.

Seals, fur seals and sea lions live in coastal waters on both the East and West coasts. Eighty-nine percent of the seals and sea lions impacted by plastic were fur seals, sea lions and elephant seals on the West Coast (see Appendix Table 1). Seventy-eight percent of the West Coast cases of plastic entanglements were with a strap or band; in most cases, these were packing straps, and most of the animals entangled were fur seals and sea lions.

Baleen Whales

In Virginia, a female sei whale swallowed a DVD case, which lacerated her stomach and led to gastric ulcers, harming her ability to find food.[64] Also in Virginia, a necropsy on a minke whale revealed a plastic bag in its stomach, though it is unclear if the bag contributed to the death of the animal. While many more are likely affected, due to limitations described earlier, only four baleen whales are included in this report.

Fourteen species of baleen whale swim throughout the oceans, from the poles to the tropics. They feed by filtering water and food through their baleen — large, flat, keratin plates that act as a filter. Experts are growing

A conversation with

ELITZA GERMANOV

Elitza Germanov is a researcher with the Aquatic Megafauna Research Unit at Murdoch University in Perth, Australia, and a senior scientist with the U.S.-based conservation organization Marine Megafauna Foundation. She studies human-caused threats to large marine species and their habitats. Germanov's current research looks at the effects of marine debris on large filter-feeding fish, like manta rays and whale sharks, and she previously co-authored a paper that looked at microplastics affecting baleen whales.

"When I first started digging into the topic, I realized it goes back to the '70s, when we first started to record plastic in the marine environment. And now we find it pretty much everywhere we look. That includes from the tropics to the poles, coastal areas, pelagic areas and from the surface all the way down to the deepest parts of our oceans. It's in plankton. It's in coral, baleen whales, apex predators. It's everywhere.

We know [plastics] entangle; they smother or are ingested by marine animals. I'm just becoming concerned and wonder how it will impact individual species, food chains, ecosystems and, as you zoom out, biodiversity overall.

We need to realize that the ocean sustains a delicate balance that we have with the various ecosystems on our planet. And everything is really interconnected. So when the health of our ocean is diminished, it will impact humans — initially through coastal livelihoods and food sustainability, but also through loss of our natural heritage, biodiversity and our resilience to climate change."

Photo Credit: AK Dept. Fish & Game, under federal permit #358-176

concerned that microplastics may clog the baleen, which can impede feeding and suppress a whale's immune system.[65–70] Microplastics have been found in sei and minke whales.[68]

Toothed Whales

Toothed whales, a diverse group of species found in all oceans, include dolphins, porpoises, beaked whales and sperm whales. Some of these predators were hunted nearly to extinction for their oil and meat during the heyday of commercial whaling that lasted from the 17th to early 20th centuries. Today, these animals still face a host of threats, including plastic pollution.

In Florida, a spotted dolphin was found with a resealable sandwich bag caught between its airway and throat. In New York, a Risso's dolphin was found with several single-use plastic bags and a black construction bag in its gastrointestinal tract. In California, a long-beaked common dolphin was found with a food wrapper lodged in its esophagus. In Rhode Island, several plastic items were found in the stomach of a striped dolphin. In North Carolina and Florida, bottlenose dolphins were found with children's plastic ring toys entangled around their heads.

In our report, 14 species of dolphins, or 70% of the species found in the United States, were impacted by plastics. There are 37 different species of oceanic dolphins.[71] Twenty of these species are commonly found in U.S. waters,[72] each having distinct behaviors, foraging techniques and distributions.

Despite being rarely seen, the 20 cases of plastic ingestion noted in pygmy sperm whales were the largest number of toothed whale cases that we compiled (Table 4). In Georgia, a pygmy sperm whale — a deep-diving animal — had swallowed a large piece of plastic sheeting. The scientists who examined this animal believed that the plastic impacted its gastrointestinal tract, and that this caused its death. In South Carolina, a large black plastic bag was found in the stomach of a deceased pygmy sperm whale. In New Jersey, a plastic bag was the only item found in the stomach of a dead pygmy sperm whale.

Photo Credit: Jackson Kowalski/Pacific Whale Foundation

Table 4. Marine Mammals That Ingested or Became Entangled in Plastic Included in This Report

Common Name	Total Cases
Manatees	
Florida (West Indian) Manatee	700
Eared Seals	
Sea Lion, California	66
Seal, Guadalupe Fur	7
Seal, Northern Fur	26
Sea Lion, Steller	4
True Seals	
Seal, Gray	8
Seal, Harbor	8
Seal, Harp	9
Seal, Hawaiian Monk	3
Seal, Northern Elephant	31
Baleen Whales	
Whale, Humpback	1
Whale, Minke	1
Whale, Sei	2
Toothed Whales	
Dolphin, Atlantic White-Sided	1
Dolphin, Atlantic Spotted	1
Dolphin, Common Bottlenose	16
Dolphin, Common, Short-Beaked	1
Dolphin, Common, Long-Beaked	2
Dolphin, Spinner	2
Dolphin, Striped	2
Dolphin, White Beaked	1
Dolphin, Risso's	2
Porpoise, Dall's	1
Porpoise, Harbor	1
Whale, Dwarf Sperm	1
Whale, Blainville's Beaked	1
Whale, Cuvier's Beaked	2
Whale, False Killer	1
Whale, Gervais' Beaked	3
Whale, Melon-Headed	1
Whale, Pilot, Long-Finned	1
Whale, Pilot, Short-Finned	2
Whale, Pygmy Sperm Whale	20
Whale, Sowerby's Beaked	1
Total Marine Mammals[1]	931

[1]*Includes two unknown mammal species (one pilot whale, one dolphin).*

Photo Credit: Q. Gibson, University of North Florida, under the authority of NMFS LOC No. 14157

Photo Credit: Gumbo Limbo Nature Center Inc.

Conclusion

Oceana compiled hundreds of cases of plastic ingestion and entanglement in the United States. Some of these interactions are harming or even killing marine mammals and sea turtles, most of which are already threatened with extinction. We know this is an incomplete picture, and over the period we examined, far more animals were likely harmed in ways that were never documented. We also know that if nothing is done to reduce the ever-increasing flow of plastic into our oceans, these problems will get worse.

Marine mammals and sea turtles already face a host of problems: habitat loss and destruction, harmful or deadly encounters with commercial fishing gear, vessel strikes, illegal poaching, oil pollution, harmful noise from oil exploration and other activities, light pollution, toxic chemicals that build up in the food chain, disease and climate-driven changes in ocean levels and temperatures disrupting the availability of food and habitat, to name a few.

Now add to that list the plastics that are pouring into our oceans at an unprecedented rate. Some of the many stressors listed above, including plastic, may have additive effects on marine animals and in many cases ultimately threaten their survival.[50,73,74] In situations where populations are endangered or threatened, this could be an existential problem.

From these case studies we know that plastic pollution is threatening marine life in ways that are easy to see and identify. Less understood is the impact of microplastics as they move throughout marine ecosystems and food chains, but scientists are beginning to unravel these unknowns.

These animals cannot afford to be increasingly harmed by a material often used to create unnecessary single-use packaging and products. Plastic is designed to last forever, yet so much of it is used only once. This makes it an obvious target for policies aimed at reducing harmful ocean pollution.

Recommendations

We need to stop the flow of plastic going into the ocean. To achieve that, Oceana has the following recommendations:

- Companies must reduce the production of plastic, especially unnecessary single-use plastic.
- Companies must offer consumers plastic-free choices.
- National, state and local governments must pass policies to reduce the production and use of single-use plastic.
- Companies and governments must move to establish widespread use of reusable and refillable containers and packaging.
- Federal agencies tasked with protecting endangered and threatened species and their habitats, including NOAA Fisheries and the U.S. Fish and Wildlife Service, need to improve, standardize and require reporting of all plastic interaction cases.
- Congress must defend and fully fund implementation of the Endangered Species Act and the Marine Mammal Protection Act, laws that are vital to monitoring, maintaining and restoring the health of vulnerable marine animal populations.

How to Report Marine Animals in Distress

Stranded animals are injured, sick, unable to return to the water or are deceased onshore or floating in the water. However, seals will commonly rest or breed on beaches and sea turtles will come up on shore to nest and, in certain areas, rest on shore. Always allow trained personnel to respond to wildlife.

Please visit the NOAA Fisheries website for the local animal stranding organization in your area: fisheries.noaa.gov/report

If you see an injured or deceased animal on land or in the water, please call your local responding organization or the federal regional hotline in that area to be directed to the correct authority. Regional hotlines are listed below:

NORTHEAST:
Phone: 866.755.6622

SOUTHEAST:
Phone: 877.942.5343

WEST COAST:
Phone: 866.767.6114

ALASKA:
Phone: 877.925.7773

HAWAII:
Phone: 888.256.9840

FOR MANATEES IN FLORIDA:
Phone: 888.404.3922

ALWAYS KEEP 150 feet between you and the animal — for your safety as well as the safety of the animal. **DO NOT ATTEMPT** to push an animal back in the water. It is always important to know who responds to marine animals in the area in which you live or are visiting. Various cities and towns will have designated responding authorities and organizations for both marine mammals and sea turtles.

For more information on how to safely view marine animals, please visit the NOAA Fisheries viewing guidelines: fisheries.noaa.gov/topic/marine-life-viewing-guidelines

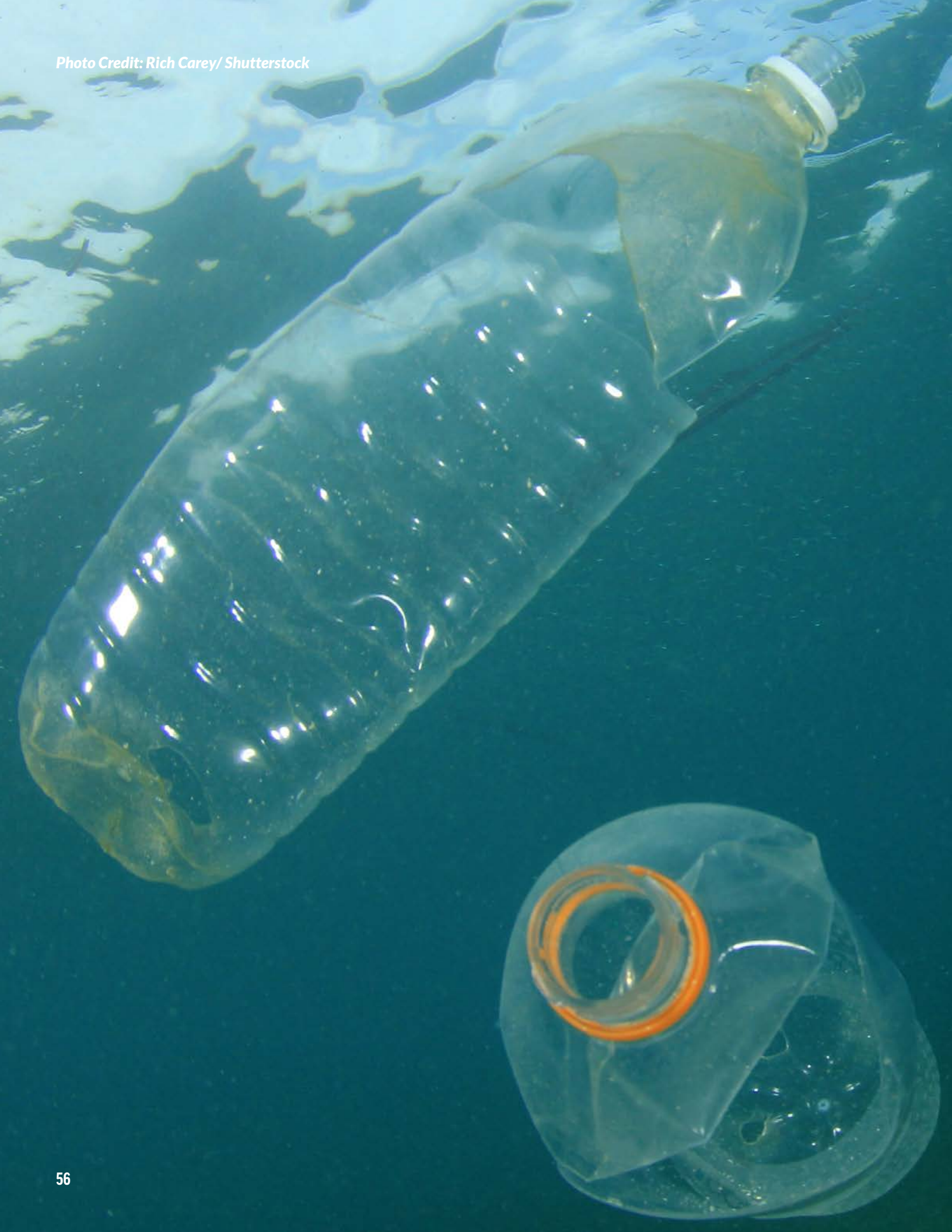


Photo Credit: Rich Carey/ Shutterstock

Acknowledgments

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Oceana would also like to thank two anonymous reviewers for their helpful contributions during the development and review of this report.

Oceana highlights and sincerely thanks all the many dedicated staff and volunteers who work tirelessly to respond to marine life stranding events and protect vulnerable species, some of which are included in this report. Oceana is very grateful to Catherine Eastman, the sea turtle program manager at UF Whitney Laboratory Sea Turtle Hospital; The Gulfarium C.A.R.E. Foundation; Sanibel-Captiva Conservation Foundation; Georgia Department of Natural Resources, Wildlife Resources Division; Kelly Thorvalson and the South Carolina Aquarium; National Aquarium; Virginia Aquarium and Marine Science Center; Marine Education, Research & Rehabilitation Institute, Inc.; Maxine Montello and the New York Marine Rescue Center; Rosemary Seton and Sean Todd of Allied Whale, College of the Atlantic; New England Aquarium; National Marine Fisheries West Coast Region; Southwest Fisheries Science Center; NOAA Fisheries Marine Mammal Stranding Network; Florida Fish and Wildlife Conservation Commission; and the National Sea Turtle Stranding and Salvage Network Coordinator in the Southeast Fisheries Science Center (East Coast and Gulf of Mexico data) for their important contributions to the report.

And we would like to give sincere thanks to the many Oceana team members who helped with this report, including Kelly Coyne, Dustin Cranor, Ben Enticknap, Lara Levison, Kathryn Matthews, Nancy Pyne, Jacqueline Savitz and Jon Warrenchuk.

Appendices

Appendix 1 -Detailed methods

Oceana reached out to 51 marine life organizations and government agencies between December 2019 and May 2020 to ask for data on sea turtle or marine mammal plastic ingestion and entanglement. Thirteen organizations — including federal government agencies, as well as local stranding and rehabilitation centers — provided data.

We asked organizations and agencies to share cases involving plastic debris that was found to impact sea turtles or marine mammals either through ingestion or entanglement. Consistent with several large reviews of plastic impacts, this report excluded commercial fishing gear entanglement cases and focused mainly on ingestion and entanglement with other types of plastic.[33,34,45]

Ingestion was defined as an animal ingesting a plastic item that could be found from the mouth to the colon/anus or within the feces of animal. Ingestion was determined through a visual exam where plastic could be seen protruding from the mouth/esophagus, through a necropsy (animal autopsy) where plastic could be seen within the gastrointestinal tract, through defecation of plastic during the rehabilitation process, or within the vomit of a stranded or rehabbed animal. Ingestion cases included plastic fishing gear — such as monofilament, braided line or plastic lures with no fishing line attached — but excluded cases that involved fishing hooks with lines attached.

Entanglement was defined as a plastic item wrapped around the body, including the rostrum, dorsum, flippers, fins, tail and peduncle. This was often determined by a visual exam. Plastic entanglements did not include fishing gear. However, an intertwined mass of fishing gear and other plastic items was included to account for all non-fishery plastic items.

Some organizations we reached out to were unable to provide data due to lack of personnel, inability to easily gather data, impending published literature or the data requested was not available (i.e., the organization did not have plastic cases). Later, the COVID-19 pandemic prevented some organizations from following through with our requests. In total, we included 167 cases collected from state, wildlife organizations and marine animal rehabilitation centers.

NOAA Fisheries, also known as the National Marine Fisheries Service, sent comprehensive datasets for sea turtles and marine mammals. Stranding organizations are required to submit certain data to NOAA Fisheries and the U.S. Fish and Wildlife Service (FWS).

We contacted and obtained sea turtle data (560) from the national coordinator for the Sea Turtle Stranding and Salvage Network (STSSN) for plastic interactions, including ingestion and entanglement, for the requested time periods from 2009 to 2018. Requested data included overall number of plastic debris cases, if plastic was ingested or entangled, how plastic ingestion was determined (e.g., necropsy, visual, etc.), if the entanglement was removed, the type of plastic found, how many plastic items were present and any photos, if available. The data received included the animal ID number, the date (year, month, day) of stranding, the species of the sea turtle, the state the animal stranded in and a description of the case. Additional sea turtle cases (60) were compiled using the online STSSN weekly reports. The data collected from this online database were primarily from 2019. The NOAA Stranding Network West Coast Region (WCR) sent data for sea turtle plastic ingestion and entanglements that were assessed from 2009 to 2019 (10). All data were thoroughly reviewed to confirm plastic was present through ingestion or entanglement. Certain cases could not be included in our dataset as plastic could not be confirmed or non-plastic debris was present instead. Of the 631 sea turtle cases received from the STSSN and WCR, 594 were retained in our database.

A marine mammal data request was sent to MMHSRP.NationalDB@noaa.gov for a data query of the Marine Mammal Health and Stranding Response Program's National Stranding Database. Data requested included all marine mammal species, date of initial observation, location of stranding, condition at initial observation, date of examination, condition code of animal at Level A examination, sex, age class and evidence of plastic interaction for all marine mammals in Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, California, Oregon, Washington, Alaska and Hawaii.

Human interaction cases were received from NOAA Fisheries with additional data fields for over 6,000 cases, and after thorough review, 202 cases of plastic ingestion or entanglement were identified and included in our dataset. The Florida Fish and Wildlife Conservation Commission sent comprehensive data (700) for the Florida manatee (1/2009-6/2018), which is managed by FWS. We also included data (129) from relevant published literature on sea turtles[2,3,53] and marine mammals[4] inhabiting or found in or near U.S. waters in our analysis.

Of the data we received and reviewed, some cases reported only the presence of undefined "plastic." Plastic ingestion is reported in a variety of ways in the published literature and also in this dataset, and can include counts of plastic items, descriptions of plastic items by color, functional type (e.g., bag) and/or type of plastic, measurements of plastic items in two or more dimensions, total weight of all plastic, relative weight of plastic to other stomach contents, amount, weight or volume of plastic in relation to animal size or weight. Some organizations report only the total number of individual species found with plastic, while others report individual species found with plastic in relation to all of the same species examined (e.g., including negative findings or the "percent frequency of occurrence of plastic ingestion" for a species, see below). We did not receive the latter type of data from government data queries. Experts recommend reporting data in a more standardized and complete way to allow for fuller assessment of plastic impacts.[33,45,46,75]

Frequency of Occurrence of Plastic Ingestion

Kühn and van Franeker (2020) recently amassed all studies that reported the total number of individuals in a marine species found with plastic ingested out of all individuals of the same species examined for plastic ingestions (e.g., including negative findings) and then calculated a global average for this "frequency of occurrence of plastic ingestion" for each available species of sea turtle, marine mammal and seabird.[33] The calculated average frequency of occurrence of plastic ingestion of a species included studies of all types of plastic ingested, from micro- to megaplastic. Because of the inclusion of microplastic in their species averages, we felt it was appropriate to use these averages to compare to microplastic ingestion studies from Duncan et al and Donohue et al.[3,4] Kühn and van Franeker hoped that this list would serve as a useful tool for scientists to quickly gain insights in what is known about plastic ingestion or entanglement in a specific species, noting that "it is the frequency of occurrence within a species that is relevant in terms of potential harm to populations or species."

Very few of the data we received or reviewed stated the frequency of plastic ingestion out of all species examined (e.g., we didn't get "negative data" on species examined where no plastic was found). Published literature included in our dataset (129 cases) provided this level of detail, as well as one other dataset for post-hatchling sea turtles in Florida, part of which have been published[76] where 86% of those examined had ingested it (C. Eastman, pers. comm). For other sea turtles in this dataset, 80% to 100% of the loggerhead, green and olive ridley sea turtles examined in the heavily plastic-contaminated waters around Hawaii and American Samoa[2] had ingested it. When examining microplastic ingestion by sea turtles stranded in North Carolina, 100% of the green, leatherback, loggerhead and Kemp's ridleys examined had ingested it.[3] These sea turtle percentages were compared to Kühn and van Franeker global averages for these species (32% average for all sea turtle species; range 22% to 47% for each individual species).

For marine mammals, 50% of the northern fur seals examined in Alaska and Washington had consumed plastic,[4] compared to less than 1% for the average frequency of ingestion for the Otariidae family of eared seals on a global level calculated by Kühn and van Franeker. For the Florida manatee, 10% of all those examined had ingested plastic, compared to the global average of 6% for the manatee family.[5,33]

Sample Bias

The data compiled here are no doubt the subject of several types of sample bias that preclude gathering firm conclusions and comparisons among species, locations and time periods about plastic impacts. For example, the dependence on stranding events and mortality to gather information on population or individual impacts, the irregular reporting of stranded animals to federal authorities due to lack of human access to certain stranding locations or knowledge on how to report a stranded animal to their local stranding organization, the lack of a necropsy investigation for plastic ingestion for all stranded animals due to funding or other constraints, the lack of reporting of necropsy data on plastic ingestion to relevant authorities, the easier access to certain species or groups of animals due to life history traits (e.g., the manatee) or abundance and funding level of stranding response teams, all of which may result in selective reporting and accounting for plastic impacts.

Appendix 2: Authorities

Endangered Species Act, Marine Mammal Protection Act and Stranding Networks

Why are data collected?

The Marine Mammal Protection Act (MMPA) of 1972 protects all marine mammals in U.S. waters, including whales, dolphins, seals and manatees. It recognizes the importance of marine mammals to the oceans and seeks to restore or maintain populations at healthy and productive levels.[77] The MMPA prohibits activities that "harass, hunt, capture or kill" any marine mammal or attempt to do so.[j] The MMPA authorizes NOAA Fisheries to manage whales, dolphins, porpoises, seals and sea lions, and authorizes FWS to manage manatees, polar bears, sea otters and walruses.[k] Marine mammals may be listed under the Endangered Species Act (ESA); however, when populations recover to a non-threatened ESA status, they are still federally protected under the MMPA.[l]

NOAA Fisheries mandates the collection of human interaction data, not only for

such cases as plastic entanglement and ingestion, but also for gunshot wounds, harassment and vessel strikes on stranded marine mammals; and NOAA Fisheries requires that this information be submitted to the agency for each stranded animal.[78]

The Marine Mammal Health and Stranding Response Program is a network of organizations that partner with NOAA Fisheries to respond to and investigate marine mammal strandings.[m]

All six sea turtle species found in U.S. waters are protected under the ESA of 1973, which protects and conserves threatened and endangered species, and the areas they need to survive and recover.[n] Under the ESA, NOAA Fisheries has lead responsibility over sea turtles in the marine environment, while FWS has lead responsibility for them on nesting beaches.[79] Under ESA authority, NOAA Fisheries' STSSN, established in 1980, responds to and collects data on strandings of marine turtles along the U.S. Gulf of Mexico and Atlantic coasts.[80] The network encompasses the coastal areas of the 18-state region from Maine to Texas and includes portions of the U.S. Caribbean. WCR handles strandings on the West Coast of the U.S. In the Hawaiian and the U.S. Pacific Islands, the Marine Turtle Biology and Assessment Program rescues, rehabilitates and studies stranded sea turtles since 1990.[81]

Who collects/owns these data?

Stranding networks are established in all coastal states and are authorized through NOAA Fisheries (marine mammals) or FWS and other designated agencies (sea turtles) through permitting agreements.[o] Stranding network members that are permitted include professionals and volunteers from nonprofit organizations, aquaria, universities and state and local governments who are trained in stranding response, animal evaluation and administration of animal care.[80,81,82] NOAA Fisheries oversees, coordinates, participates in and authorizes response activities and provides training to stranding network personnel through national or regional coordinators for animals under their jurisdiction.

Through permitting, NOAA Fisheries and FWS retain control over marine mammals that are in captivity and in the wild. As laid out in stranding agreements, NOAA Fisheries maintains a National Stranding Database consisting of data obtained from responses to marine mammal strandings by stranding network participants in addition to the National Marine Mammal Tissue Bank database that contains all relevant data on marine mammal tissues that have been collected and stored. In cases of possible human interaction, stranding network participants must collect and make available to NOAA Fisheries any gear, debris or other objects that may be evidence of human interaction from a stranded marine mammal.

Additionally, the FWS has control over what happens to captive sea turtles and their data.[83] Authorized facilities must report any sea turtle deaths in captivity. Reported stranding data are then published by the STSSN. The FWS's Standard Conditions for Care and Maintenance of Captive Sea Turtles, a copy of the necropsy report (including all gross, histopathological and laboratory findings) must be sent to the STSSN coordinator, as well as the stranding form provided by the person from the STSSN who placed the animal with the facility.

Appendix 3: What happens when an animal strands?

A stranded animal is defined as a marine animal that is found dead on land or in the water, is in need of medical attention due to injury or illness or is unable to return to its native habitat.[35]

1. Reporting

Stranding organizations rely on the public for notification of an animal that is in need of assistance. Typically, an agency's hotline or phone number is called by members of the public who observe a stranded animal. The organization will collect information from this individual, including a photograph of the animal, and help to assess location of animal, species, condition of animal (injury, alive/deceased, etc.), size and physical description (E. Linske, pers. comm.).[84]

2. Response Assessment

Based on the information and any images the public sends to the stranding organization, the responding organization will determine the appropriate response for the animal. Responses will be initially broken down into live and deceased animal responses (E. Linske, pers. comm.). See NOAA Fisheries website for further details about this section.[35]

- Live Animal Response

  - Monitoring: Live animals may be monitored if there is no immediate need to intervene or act. These animals can be in their natural habitat and are not considered to be stranded or in need of assistance — they are just sighted animals. An example would be a seal resting on shore. If an animal is exhibiting signs of distress, such as the animal being sick or injured, yet is not distressed to an extent of serious concern by the stranding organization or there is no rehabilitation space available, the animal will be monitored and reassessed continuously. Often, a field team from the stranding organization will be sent out to get additional photographs and conduct a more thorough assessment of the animal's behavior during this time.

  - Collection: Live and deceased animals can be collected from the stranding location, which may lead to a variety of outcomes.

    - Relocation: An animal can be collected and relocated to an area that is safer for the animal or closer to its natural habitat or to a deeper body of water. Each animal is assessed on a case-by-case basis (E. Linske, pers. comm.).
      - Marine mammals may be relocated for reasons including:
        1. If an animal is too close to roadways, train tracks or bike paths;
        2. If an animal is a significant distance from its natural habitat, including the beach, the ocean or deep water;
        3. If an animal is in an area of water that is blocked off or difficult to access; or
        4. If an animal is in an area that is commonly walked or traveled by individuals.

    - Rehabilitation: An animal may be collected and brought to a rehabilitation center for long-term care. Rehab spots for animals are limited, especially for marine mammals. Often rehabilitation is not available due to high demand, length of the rehabilitation process and the minimal number of marine mammal rehabilitation centers.

    - Euthanasia: An animal in severe distress, such as a substantial injury, may be collected and euthanized. These decisions are made with significant consideration and are the last choice for the stranding response team. These animals are typically brought back to a facility and necropsied.

- Deceased Animal Response

Note: Description of "Level A-C" data refers to recording mammal data only.

  - Level A Examination:

    - Level A data are basic information collected by the response team for marine mammals, such as decomposition level of the animal or the condition code, location of stranding, date and if a necropsy was conducted, and organizations may collect basic morphological data, such as length and girth of animal. Disposition of the animal should be noted as well, whether the animal was left at site or collected for further examination. All deceased marine mammals are required to have Level A information collected.

    - Sea turtles will have basic data collected on the STSSN form.[85]

  - Necropsy: A deceased animal may be collected for a necropsy, or animal dissection, to determine the cause of death. Animals are often only collected for a necropsy if viable samples can be retrieved, as the animal cannot be too decomposed. If an animal is too large to be moved for a necropsy, one will be conducted on the beach to determine the cause of death. Often this occurs with large whales or dolphins. During a necropsy, level A, B and C data may be collected on the animal (E Linske, pers. comm.).[35,86]

    - Level A Data: While reporting whether a necropsy was performed is required on the Level A form and is made available to the public upon request, the results of the necropsy for Level B and C level data are proprietary with few exceptions.[86]

    - Level B Data: Level B data include additional information collected during a necropsy examination, such as details about the stranding and life history of the animal. Information collected includes weather and tide conditions, stranding behavior, health assessments and life history samples, such as teeth, stomach contents and reproductive organs.[86]

    - Level C Data: Level C data include further information collected in addition to Level A and B data, such as results from tissue sample collection. These tissue samples are sent out for histopathology, toxicology and parasitology, and the data are then analyzed for further determination into cause of death.[86]

3. Response Team

Based on the information reported in the initial phone call to the stranding organization, the appropriate response type is decided upon and a field team is formed. These teams can include staff, including biologists and veterinarians, interns, volunteers, fellows and field volunteers. Each type of animal, species and the condition of the animal will determine how many individuals and who responds to the animal. Certain cases will require more advanced skills.[35]

Appendix Table 1 on next page

APPENDIX TABLE 1

MARINE MAMMALS

Common Name	Scientific Name	Total Cases	Atlantic Coast, NE	Atlantic Coast, SE	Gulf of Mexico	Pacific Coast and Alaska	Hawaii and Pacific Islands
Toothed Whales							
Dolphin, Atlantic White-Sided	*Lagenorhynchus acutus*	1	1	0	0	0	0
Dolphin, Atlantic Spotted	*Stenella frontalis*	1	0	1	0	0	0
Dolphin, Bottlenose	*Tursiops truncatus*	16	1	9	6	0	0
Dolphin, Common, Short-Beaked	*Delphinus delphis*	1	0	0	0	1	0
Dolphin, Common, Long-Beaked	*Delphinus capensis*	2	2	0	0	0	0
Dolphin, Spinner	*Stenella longirostris*	2	0	0	0	0	2
Dolphin, Striped	*Stenella coeruleoalba*	2	2	0	0	0	0
Dolphin, White Beaked	*Lagenorhynchus albirostris*	1	1	0	0	0	0
Dolphin, Risso's	*Grampus griseus*	2	2	0	0	0	0
Porpoise, Dall's	*Phocoenoides dalli*	1	0	0	0	1	0
Porpoise, Harbor	*Phocoena phocoena*	1	1	0	0	0	0
Whale, Dwarf Sperm	*Kogia sima*	1	1	0	0	0	0
Whale, Blainville's Beaked	*Mesoplodon densirostris*	1	0	1	0	0	0
Whale, Cuvier's Beaked	*Ziphius cavirostris*	2	0	2	0	0	0
Whale, False Killer	*Pseudorca crassidens*	1	0	0	1	0	0
Whale, Gervais' Beaked	*Mesoplodon europaeus*	3	0	3	0	0	0
Whale, Melon-Headed	*Peponocephala electra*	1	0	1	0	0	0
Whale, Pilot, Long-Finned	*Globicephala melas*	1	1	0	0	0	0
Whale, Pilot, Short-Finned	*Globicephala macro-rhynchus*	2	0	1	0	0	1
Whale, Pygmy Sperm Whale	*Kogia breviceps*	20	1	18	1	0	0
Whale, Sowerby's Beaked	*Mesoplodon bidens*	1	1	0	0	0	0
Baleen Whales							
Whale, Humpback	*Megaptera novaeangliae*	1	0	1	0	0	0
Whale, Minke	*Balaenoptera acuto-rostrata*	1	1	0	0	0	0
Whale, Sei	*Balaenoptera borealis*	2	2	0	0	0	0
Eared Seals							
Sea Lion, California	*Zalophus californianus*	66	0	0	0	66	0
Seal, Guadalupe Fur	*Arctocephalus townsendi*	7	0	0	0	7	0
Seal, Northern Fur	*Callorhinus ursinus*	26	0	0	0	26	0
Sea Lion, Steller	*Eumetopias jubatus*	4	0	0	0	4	0

APPENDIX TABLE 1

MARINE MAMMALS

Common Name	Scientific Name	Total Cases	Atlantic Coast, NE	Atlantic Coast, SE	Gulf of Mexico	Pacific Coast and Alaska	Hawaii and Pacific Islands
True Seals							
Seal, Gray	*Halichoerus grypus*	8	8	0	0	0	0
Seal, Harbor	*Phoca vitulina*	8	2	0	0	6	0
Seal, Harp	*Phoca groenlandica*	9	9	0	0	0	0
Seal, Hawaiian Monk	*Neomonachus schauinslandi*	3	0	0	0	0	3
Seal, Northern Elephant	*Mirounga angustirostris*	31	0	0	0	31	0
Manatees							
Florida (West Indian) Manatee	*Trichechus manatus latirostris*	700	0	412	288	0	0
				Total Marine Mammals[1]	931		
Sea Turtles							
Sea Turtle, Green	*Chelonia mydas*	346	39	148	143	7	9
Sea Turtle, Loggerhead	*Caretta*	261	53	187	16	1	4
Sea Turtle, Kemp's Ridley	*Lepidochelys kempii*	151	35	26	90	0	0
Sea Turtle, Leatherback	*Dermochelys coriacea*	37	18	18	0	1	0
Sea Turtle, Hawksbill	*Eretmochelys imbricata*	28	0	14	14	0	0
Sea Turtle, Olive Ridley	*Lepidochelys olivacea*	37	0	0	0	0	37
				Total Sea Turtles[2]	861		
				Total ALL	1,792		

[1]Includes two unknown/unidentified marine mammal species: unknown pilot whale species, unknown dolphin genus/species; [2]Includes one unknown sea turtle species
NE states: from ME to VA; SE states: from NC to Atlantic FL coast; GOM states: Gulf Coast FL to TX; Pacific Coast states: CA, OR, WA, AK; HI and Pacific Islands include waters around Hawaii and American Samoa

Endnotes

[a] Marine Mammal Protection Act: 16 U.S.C. § 1361 et seq.
[b] Endangered Species Act: 16 U.S.C. § 1531 et seq.
[c] See further details on sample bias in Appendix 1.
[d] Hereafter, unless otherwise noted, all sea turtle case studies are for sea turtles older than post-hatchling.
[e] See further details on sample bias in Appendix 1.
[f] This calculation includes post-hatchling sea turtles; if excluded, the percentage increases to 13% for non-post hatchlings.
[g] See further details on sample bias in Appendix 1.
[h] Plastic entanglement data (1%) do not include fishery entanglements which are a dire problem for the manatee.
[i] See further details on sample bias in Appendix 1.
[j] 16 U.S.C. § 1362(13)
[k] 16 U.S.C. § 1362(12)(A).
[l] 16 U.S.C. § 1361 et seq.
[m] 16 U.S.C. § 1421.
[n] 16 U.S.C. § 1531.
[o] 16 U.S.C. § 1421; 50 C.F.R. § 222.310(a).

References

01. Irfan U (2019) The alarming trend of beached whales filled with plastic, explained. In: *Vox*. Available: https://www.vox.com/2019/5/24/18635543/plastic-bags-whale-stomach-beached. Accessed Jun 25, 2019.

02. Clukey KE, Lepczyk CA, Balazs GH, Work TM and Lynch JM (2017) Investigation of plastic debris ingestion by four species of sea turtles collected as bycatch in pelagic Pacific longline fisheries. *Marine Pollution Bulletin* 120: 117–125. doi: 10.1016/j.marpolbul.2017.04.064

03. Duncan EM, Broderick AC, Fuller WJ, et al. (2019) Microplastic ingestion ubiquitous in marine turtles. *Global Change Biology* 25: 744–752. doi: 10.1111/gcb.14519

04. Donohue MJ, Masura J, Gelatt T, *et al.* (2019) Evaluating exposure of northern fur seals, Callorhinus ursinus, to microplastic pollution through fecal analysis. *Marine Pollution Bulletin* 138: 213–221. doi: 10.1016/j.marpolbul.2018.11.036

05. Reinert T, Spellman A and Bassett B (2017) Entanglement in and ingestion of fishing gear and other marine debris by Florida manatees, 1993 to 2012. *Endangered Species Research* 32: 415–427. doi: 10.3354/esr00816

06. Oceana EU Threats to Sea Turtles. In: *Oceana EU*. Available: https://eu.oceana.org/en/threats-sea-turtles. Accessed Jul 23, 2020.

07. Fair PA and Becker PR (2000) Review of stress in marine mammals. *Journal of Aquatic Ecosystem Stress and Recovery* 7: 335–354.

08. NOAA Fisheries (2020) Green Turtle | NOAA Fisheries. In: *NOAA*. Available: https://www.fisheries.noaa.gov/species/green-turtle. Accessed Jul 23, 2020.

09. Forrest A, Giacovazzi L, Dunlop S, *et al.* (2019) Eliminating Plastic Pollution: How a Voluntary Contribution From Industry Will Drive the Circular Plastics Economy. *Frontiers in Marine Science* 6: 627. doi: 10.3389/fmars.2019.00627

10. Fabres J, Savelli H, Schoolmeester T, Rucevska I and Baker E (2016) Marine Litter Vital Graphics | GRID-Arendal. UN - Environment, GRID-Arendal.

11. Lau WWY, Shiran Y, Bailey RM, *et al.* (2020) Evaluating scenarios toward zero plastic pollution. *Science* : eaba9475. doi: 10.1126/science.aba9475

12. Young R (2020) Frontline. Plastic Wars.Public Broadcasting Service.

13. Geyer R, Jambeck JR and Law KL (2017) Production, use, and fate of all plastics ever made. *Science Advances* 3: e1700782. doi: 10.1126/sciadv.1700782

14. Dubach HW and Taber RW (1968) Questions about the Oceans. Washington, D.C.: U.S. Naval Oceanographic Office.

15. Carpenter EJ, Anderson SJ, Harvey GR, Miklas HP and Peck BB (1972) Polystyrene Spherules in Coastal Waters. *Science* 178: 749. doi: 10.1126/science.178.4062.749

16. Carpenter EJ and Smith KL (1972) Plastics on the Sargasso Sea surface. *Science* 175: 1240–1241. doi: DOI: 10.1126/science.175.4027.1240

17. Brandon JA, Jones W and Ohman MD (2019) Multidecadal increase in plastic particles in coastal ocean sediments. *Science Advances* 5: eaax0587. doi: 10.1126/sciadv.aax0587

18. Ostle C, Thompson RC, Broughton D, et al. (2019) The rise in ocean plastics evidenced from a 60-year time series. *Nature Communications* 10: 1622. doi: 10.1038/s41467-019-09506-1

19. Allen S, Allen D, Moss K, *et al.* (2020) Examination of the ocean as a source for atmospheric microplastics. Mukherjee A, editor *PLOS ONE* 15: e0232746. doi: 10.1371/journal.pone.0232746

20. Chiba S, Saito H, Fletcher R, *et al.* (2018) Human footprint in the abyss: 30 year records of deep-sea plastic debris. *Marine Policy* 96: 204–212. doi: 10.1016/j.marpol.2018.03.022

21. Choy CA, Robison BH, Gagne TO, *et al.* (2019) The vertical distribution and biological transport of marine microplastics across the epipelagic and mesopelagic water column. *Scientific Reports* 9: 7843. doi: 10.1038/s41598-019-44117-2

22. Duncan EM, Arrowsmith J, Bain C, *et al.* (2018) The true depth of the Mediterranean plastic problem: Extreme microplastic pollution on marine turtle nesting beaches in Cyprus. *Marine Pollution Bulletin* 136: 334–340. doi: https://doi.org/10.1016/j.marpolbul.2018.09.019

23. Lavers JL and Bond AL (2017) Exceptional and rapid accumulation of anthropogenic debris on one of the world's most remote and pristine islands. *Proceedings of the National Academy of Sciences* 114: 6052–6055. doi: 10.1073/pnas.1619818114

24. Peeken I, Primpke S, Beyer B, *et al.* (2018) Arctic sea ice is an important temporal sink and means of transport for microplastic. *Nature Communications* 9 doi: 10.1038/s41467-018-03825-5

25. Ocean Conservancy (2019) The Beach and Beyond. Washington, D.C.

26. Cole M, Lindeque P, Fileman E, *et al.* (2013) Microplastic Ingestion by Zooplankton. *Environmental Science & Technology* 47: 6646–6655. doi: 10.1021/es400663f

27. Gall SC and Thompson RC (2015) The impact of debris on marine life. *Marine Pollution Bulletin* 92: 170–179. doi: 10.1016/j.marpolbul.2014.12.041

28. Hale RC, Seeley ME, La Guardia MJ, Mai L and Zeng EY (2020) A Global Perspective on Microplastics. *Journal of Geophysical Research: Oceans* 125 doi: 10.1029/2018JC014719

29. Provencher JF, Ammendolia J, Rochman CM and Mallory ML (2018) Assessing plastic debris in aquatic food webs: what we know and don't know about uptake and trophic transfer. *Environmental Reviews* : 1–14. doi: 10.1139/er-2018-0079

30. Balazs GH (1985) Impact of ocean debris on marine turtles: entanglement and ingestion. In: Shomura RS, Yoshida HO, editors *Proceedings of the Workshop on the Fate and Impact of Marine Debris*.Honolulu, Hawaii: Southwest Fisheries Center.

31. Shomura RS and Yoshida HO (1985) Proceedings of the workshop on the fate and impact of marine debris, November 27-29, 1984, Honolulu, Hawaii. Southwest Fisheries Center: NOAA.Report No.: NOAA-TM-NMFS-SWFC-54.

32. IUCN (2018) Marine plastics. In: *IUCN Issues Brief*. Available: https://www.iucn.org/resources/issues-briefs/marine-plastics. Accessed Jul 23, 2020.

33. Kühn S and van Franeker JA (2020) Quantitative overview of marine debris ingested by marine megafauna. *Marine Pollution Bulletin* 151: 110858. doi: 10.1016/j.marpolbul.2019.110858

34. Laist DW (1997) Impacts of Marine Debris: Entanglement of Marine Life in Marine Debris Including a Comprehensive List of Species with Entanglement and Ingestion Records. In: Coe JM, Rogers DB, editors In: *Marine Debris: Sources, Impacts, and Solutions*. New York, NY: Springer New York.

35. NOAA Fisheries (2019) Understanding Marine Wildlife Stranding and Response | NOAA Fisheries. In: *NOAA*. Available: https://www.fisheries.noaa.gov/insight/understanding-marine-wildlife-stranding-and-response. Accessed Jun 8, 2020.

36. Witzell WN and Teas WG (1994) The impacts of anthropogenic debris on marine turtles in the western North Atlantic Ocean. Available: /paper/The-impacts-of-anthropogenic-debris-on-marine-in-Witzell-Teas/4332fce337d1b2ec02a55244b703eb9eaebd4278. Accessed Jun 9, 2020.

37. NOAA Fisheries, USFWS and SEMARNAT. (2011) Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys kempii): SECOND REVISION. 177p.

38. NOAA Fisheries and USFWS (1991) Recovery Plan for the U.S. Population of Atlantic Green Turtle.

39. NOAA Fisheries and USFWS (1993) Recovery Plan ' for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico.

40. NOAA Fisheries and USFWS (1998) Recovery Plan for US Pacific Populations of the Olive Ridley Turtle. 62p.

41. NOAA Fisheries and USFWS (1998) Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas).

42. NOAA Fisheries and USFWS (1998) Recovery Plan for US Pacific Populations of the Hawksbill Turtle. 95p.

43. NOAA Fisheries and USFWS (2008) Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta), Second Revision. Silver Spring, MD: National Marine Fisheries Service.

44. NOAA Fisheries and USFWS (2013) Leatherback Sea Turtle (Dermochelys coriacea) 5-Year Review: Summary and Evaluation. Silver Spring, MD: U.S. National Marine Fisheris Service and Fish and Wildlife Service.

45. Lynch JM (2018) 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* 52: 12026–12038. doi: 10.1021/acs.est.8b02848

46. Matiddi M, Vandeperre F, Claro F, *et al*. (2019) Data Collection on Marine Litter Ingestion in Sea Turtles and Thresholds for Good Environmental Status. *Journal of Visualized Experiments*: 147: e59466. doi:10.3791/59466

47. Williams R, Gero S, Bejder L, et al. (2011) Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident: Low probability of cetacean carcass recovery. *Conservation Letters* 4: 228–233. doi: 10.1111/j.1755-263X.2011.00168.x

48. Alexiadou P, Foskolos I and Frantzis A (2019) Ingestion of macroplastics by odontocetes of the Greek Seas, Eastern Mediterranean: Often deadly! *Marine Pollution Bulletin* 146: 67–75. doi: 10.1016/j.marpolbul.2019.05.055

49. Valente AL, Marco I, Parga ML, *et al*. (2008) Ingesta passage and gastric emptying times in loggerhead sea turtles (Caretta caretta). *Research in Veterinary Science* 84: 132–139. doi: https://doi.org/10.1016/j.rvsc.2007.03.013

50. NOAA Marine Debris Program (2014) Report on the Occurrence and Health Effects of Anthropogenic Debris Ingested by Marine Organisms. 19p.

51. Nelms SE, Duncan EM, Broderick AC, *et al*. (2016) Plastic and marine turtles: a review and call for research. *ICES Journal of Marine Science: Journal du Conseil* 73: 165–181. doi: 10.1093/icesjms/fsv165

52. NOAA Fisheries (2020) National Report on Large Whale Entanglements Confirmed in the United States in 2018. 18p.

53. White EM, Clark S, Manire CA, *et al*. (2018) Ingested Micronizing Plastic Particle Compositions and Size Distributions within Stranded Post-Hatchling Sea Turtles. *Environmental Science & Technology* 52: 10307–10316. doi: 10.1021/acs.est.8b02776

54. Parsons ECM (2016) Why IUCN Should Replace "Data Deficient" Conservation Status with a Precautionary "Assume Threatened" Status—A Cetacean Case Study. *Frontiers in Marine Science* 3: 193. doi: 10.3389/fmars.2016.00193

55. Sea Turtle Conservancy Information About Sea Turtles: General Behavior.

56. Wilson EG, Miller KL, Allison D and Magliocca, M (2010) Why Healthy Oceans Need Sea Turtles. Washington, D.C.: Oceana.

57. Read TC, Wantiez L, Werry JM, *et al*. (2014) Migrations of Green Turtles (Chelonia mydas) between Nesting and Foraging Grounds across the Coral Sea. Hays G, editor *PLoS ONE* 9: e100083. doi: 10.1371/journal.pone.0100083

58. Bossart GD (2011) Marine Mammals as Sentinel Species for Oceans and Human Health. *Veterinary Pathology* 48: 676–690. doi: 10.1177/0300985810388525

59. Parks SE, Warren JD, Stamieszkin K, Mayo CA and Wiley D (2012) Dangerous dining: surface foraging of North Atlantic right whales increases risk of vessel collisions. *Biology Letters* 8: 57–60. doi: 10.1098/rsbl.2011.0578

60. Bowen W (1997) Role of marine mammals in aquatic ecosystems. *Marine Ecology Progress Series* 158: 267–274. doi: 10.3354/meps158267

61. World Economic Forum (2019) Whales are vital to curb climate change - this is the reason why. In: *World Economic Forum*. Available: https://www.weforum.org/agenda/2019/11/whales-carbon-capture-climate-change/. Accessed Jul 24, 2020.

62. UNEP (2010) Regional Management Plan for the West Indian Manatee (Trichechus manatus) compiled by Ester Quintana-Rizzo and John Reynolds III. Kingston, Jamaica.: UNEP Caribbean Environment Programme.Report No.: CEP Technical Report No. 48.

63. Marine Mammal Commission Florida Manatee. In: *Species of concern*. Available: https://www.mmc.gov/priority-topics/species-of-concern/florida-manatee/. Accessed Jul 23, 2020.

64. Groc I (Jan 8, 2015) How a DVD Case Killed a Whale. *National Geographic News*.

65. Bakker J, Wangensteen OS, Chapman DD, *et al*. (2017) Environmental DNA reveals tropical shark diversity in contrasting levels of anthropogenic impact. *Scientific Reports* 7 doi: 10.1038/s41598-017-17150-2

66. Fossi MC, Panti C, Guerranti C, *et al*. (2012) Are baleen whales exposed to the threat of microplastics? A case study of the Mediterranean fin whale (Balaenoptera physalus). *Marine Pollution Bulletin* 64: 2374–2379. doi: 10.1016/j.marpolbul.2012.08.013

67. Germanov ES, Marshall AD, Bejder L, Fossi MC and Loneragan NR (2018) Microplastics: No Small Problem for Filter-Feeding Megafauna. *Trends in Ecology & Evolution* 33: 227–232. doi: 10.1016/j.tree.2018.01.005

68. Guzzetti E, Sureda A, Tejada S and Faggio C (2018) Microplastic in marine organism: Environmental and toxicological effects. *Environmental Toxicology and Pharmacology* 64: 164–171. doi: https://doi.org/10.1016/j.etap.2018.10.009

69. Lusher AL, Hernandez-Milian G, O'Brien J, *et al*. (2015) Microplastic and macroplastic ingestion by a deep diving, oceanic cetacean: The True's beaked whale Mesoplodon mirus. *Environmental Pollution* 199: 185–191. doi: 10.1016/j.envpol.2015.01.023

70. Simmonds MP (2012) Cetaceans and Marine Debris: The Great Unknown. *Journal of Marine Biology* 2012: 1–8. doi: 10.1155/2012/684279

71. Jefferson TA and LeDuc R (2018) Delphinids, Overview. In: *Encyclopedia of Marine Mammals*. Elsevier.

72. Whale & Dolphin Conservation, USA How many species of dolphins are there? In: *Whale & Dolphin Conservation USA*. Available: https://us.whales.org/whales-dolphins/how-many-species-of-dolphins-are-there/. Accessed Jul 23, 2020.

73. CBD (2016) Marine Debris: Understanding, Preventing and Mitigating the Significant Adverse Impacts on Marine and Coastal Biodiversity. Montreal: Secretariat on the Convenion on Biological Diversity. 78p.

74. Fossi MC, Panti C, Baini M and Lavers JL (2018) A Review of Plastic-Associated Pressures: Cetaceans of the Mediterranean Sea and Eastern Australian Shearwaters as Case Studies. *Frontiers in Marine Science* 5 doi: 10.3389/fmars.2018.00173

75. Provencher JF, Bond AL, Avery-Gomm S, *et al*. (2017) Quantifying ingested debris in marine megafauna: a review and recommendations for standardization. *Analytical Methods* 9: 1454–1469. doi: 10.1039/C6AY02419J

76. Eastman CB, Farrell JA, Whitmore L, *et al*. (2020) Plastic Ingestion in Post-hatchling Sea Turtles: Assessing a Major Threat in Florida Near Shore Waters. *Frontiers in Marine Science* 7: 693. doi: 10.3389/fmars.2020.00693

77. GAO (2009) Improvements Are Needed in the Federal Process Used to Protect Marine Mammals from Commercial Fishing. U.S. Government Accountablity Office.Report No.: GAO-09-78.

78. Moore, KT and Barco, SG (2013) Handbook for Recognizing, Evaluating, and Documenting Human Interaction in Stranded Cetaceans and Pinnipeds. U. S. Department of Commerce,. 102p. Report No.: NOAA-TM-NMFSSWFSC-510.

79. NOAA Fisheries (2019) NOAA Fisheries and U.S. FWS Memorandum of Understanding on Sea Turtles | NOAA Fisheries. In: *NOAA*. Available: https://www.fisheries.noaa.gov/resource/document/noaa-fisheries-and-us-fws-memorandum-understanding-sea-turtles. Accessed Sep 4, 2020.

80. NOAA Fisheries (2020) Sea Turtle Stranding and Salvage Network | NOAA Fisheries. In: *NOAA*. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtle-stranding-and-salvage-network. Accessed Sep 4, 2020.

81. NOAA Fisheries (2020) NOAA PIFSC - About the Marine Turtle Biology and Assessment Program. Available: https://origin-apps-pifsc.fisheries.noaa.gov/marine_turtle/about_us.php. Accessed Sep 4, 2020.

82. NOAA Fisheries (2020) West Coast Marine Mammal Stranding Network | NOAA Fisheries. In: *NOAA*. Available: https://www.fisheries.noaa.gov/west-coast/marine-mammal-protection/west-coast-marine-mammal-stranding-network. Accessed Sep 4, 2020.

83. USFWS (2019) U.S. FISH AND WILDLIFE SERVICES' STANDARD CONDITIONS FOR CARE AND MAINTENANCE OF CAPTIVE SEA TURTLES. Available: https://www.fws.gov/northflorida/SeaTurtles/Captive_Forms/20191113_%20FWS_Sea_Turtle_Care_and_Maintenance_final.pdf Accessed Jun 7, 2020

84. NOAA Fisheries (2020) Marine Life in Distress | NOAA Fisheries. In: *NOAA*. Available: https://www.fisheries.noaa.gov/topic/marine-life-distress. Accessed Sep 1, 2020.

85. USFWS (2016) SEA TURTLE STRANDING AND SALVAGE NETWORK – GROSS NECROPSY REPORT. U.S. Fish and Wildlife Service.Report No.: FWC Form STSSN-4, Sea Turtle Stranding and Salvage Network Gross Necropsy Report 6/16, Rule 68E-1.004.

86. NOAA Fisheries (2020) NOAA EXAMINERS GUIDE, 2020 Revision. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/level-data-collection-marine-mammal-stranding-events. Accessed Jun 6, 2020.

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