

AN Ocean That's No Longer Wild

Tagging project aims to help conserve sharks and rays

by Lonny Lippsett

Like most fathers, Simon Thorrold plays tag with his young daughter. But Thorrold, a biologist at Woods Hole Oceanographic Institution, also plays tag with 30-foot-long whale sharks, like this one looking straight at you.

Give us a brief status report on sharks in the ocean.

There are about 500 species of sharks in the world's oceans, and a number of them are in trouble, for many reasons, but the main reason is the increased demand for sharkfin soup in Asia.

What are the numbers?

Estimates are as high as 100 million caught and killed per year, but certainly tens of millions of sharks are killed annually—most of those just for fins, bodies simply tossed over the side and never used. A colossal waste. The finning is pretty indiscriminate: whale sharks, basking sharks, hammerheads, blue sharks. I've seen some of that in the Dubai fish market, for instance, literally hundreds of whole sharks lined up. This industrial level of fishing is unprecedented in human history, and shark populations simply can't handle it.



A conversation with WHOI scientist Simon Thorrold





Whale sharks, the largest known fish species, open their large mouths to graze on microscopic marine plants and animals. They are often accompanied by smaller fish that are perhaps seeking protection or dining on scraps.

Why are they particularly vulnerable?

It's a function of their biology. Sharks are more like large mammals than like fish. Unlike cod, which might release three or four million eggs in a single spawning episode, many sharks have no more than ten pups per litter, with gestation periods of one to two years between giving birth. Sharks take years before they can even reproduce. That's typically not a problem for animals at the top of the food chain, because they don't get eaten and can live long lives. But industrial fishing has radically changed the situation.

What do we know about sharks or other large fish in the sea?

Even though the sharks, rays, tuna, and swordfish roaming our oceans are large, spectacular, and commercially important, we know remarkably little about them. That impedes our ability to conceive and implement effective conservation strategies for these species, and more generally, to understand how they function in ocean ecosystems, and how the removal of these apex predators would affect those ecosystems.

Why have these fish remained so unknown?

It's very difficult working with any animal in the ocean. It's hard enough counting whales, but at least whales come to the surface regularly. These large fish don't, and that makes it much more difficult to actually count them. So we don't even have solid numbers for the size of their populations. We're missing the very basics: where they spawn, where they pup, what they eat, how old they get, where juveniles, females, and males go at different times of the year.

There's a real knowledge gap, but the development of pop-up satellite archival transmitting (PSAT) tags has been a game-changer. These PSAT tags allow us to tag a fish once and collect information for the next six months to a year.

How do they work?

We plant an anchor with a tag attached into muscle tissue just below the dorsal fin. After months or a year, the tag is programmed to release from the fish. It floats to the surface and, via an antenna, starts sending data recorded by the tag to a satellite, and then relays the information back to computers on our desks at the Oceanographic. The tag measures temperature, depth, and light levels of the waters the fish swam in. All these combine to give us a three-dimensional view of the movements of the sharks or tunas. We've already learned some interesting things.

Such as?

For example, we've now tracked basking sharks traveling from Cape Cod, where they spend the summer, down to the

Caribbean, where they've never been reported. Why? Because they are in Caribbean waters at depths of 500 to 1,000 meters where we had no way of seeing them. We have now tracked large devil rays in the Atlantic diving to 2,000 meters, and if you can believe it, swimming down at 12 to 14 miles per hour, presumably to feed.

Swordfish also dive much deeper than we anticipated. They're at 800 meters during the day, then almost as soon as the sun sets, they rise to between 50 to 200 meters, where they spend all night; then at sunrise, they dive immediately back down to 800 meters—on a daily basis. These big animals are doing really amazing things that we're only just beginning to understand. I think they're connecting the surface ocean to much deeper ocean habitats in a way that we really hadn't considered before.

So the tags give us a window into the details of how these animals are living in their ocean habitat, where they go when and why. But to understand that at the level of a population, rather than individuals, we need to get out significant numbers of tags.

Presumably that's the premise of the WHOI Fish Ecology Lab's TOTEM Project? What does that stand for?

Tagging of Oceanic Teleost and Elasmobranch Megafauna. Teleosts are bony fish such as tuna and swordfish. Elasmobranchs are cartilaginous fish such as sharks and rays.

The project is a way to try to provide a scientific basis for the preservation of the few bits of wild ocean that we have left. It's a significant effort to generate the kinds of knowledge we would need to conserve the remaining apex predators in the world's ocean.

That effort doesn't come cheaply. The tags are around \$4,000 apiece, and the animals are rare, so it takes time on the water to find them to tag them. The goal is to tag these big fish to learn details about their movement, their basic ecology, and where they fit into oceanic ecosystems. All that information can be fed directly into management strategies to sustain these fish. If we fish them down, we will unavoidably change the ecosystem they're a part of.

What is the role of these fish in the ocean ecosystem?

They do the same things that lions do in Africa and tigers do in Asia. They are the top predators and basically keep a rein on the populations of animals at trophic levels below them. If you take out a trophic level, it can increase the abundance of animals at the level below and reduce biodiversity down the line.

Healthy ecosystems have a diversity of species, which makes them resilient and able to adapt to changes that come along. And right now, we have an ocean that is changing in the face of climate changes on our planet. In order to protect what we have and to guarantee a future for the ocean as we know it today, we need to conserve the current diversity that we have.



It's just another day in the Dubai fish market in the United Arab Emirates. The demand for shark fins for soup threatens many species.



Photographer Nuno Sá captured this image of the underside of an 8-foot-long Chilean devil ray (*Mobula tarapacana*) on Ambrosia Seamount off the island of Santa Maria in the Azores.

With increased shark sightings off Cape Cod recently, can tags help us learn something to help avoid attacks on people?

There have been increased sightings of white sharks around Cape Cod for the past three or four years, but in all honesty, we don't know if that increase in sightings actually reflects a real increase in the numbers of white sharks around here. It may be simply that we're looking more now than we have before. How concerned we should be about these increases is something we need to know rather quickly, to reduce the likelihood of problems. With an array of tagging technologies, we can begin to answer all kinds of questions, such as: How many white sharks are there? What exactly are those white sharks doing when they're here? How often do they return?

What are some of the difficulties in tagging?

First, you never know when or where you're going to find an animal to tag. There's also the problem of handling the fish in ways that don't hurt them or influence their behavior. Quite a lot of work has gone into minimizing the amount of stress that you might subject the animals to.

The tagging itself depends on the species. Our favorite method is actually jumping in the water with them. What happens is that one of us will grab a pole spear, mask, snorkel, and fins, jump in the water, and literally swim one of the rays down, for example, before planting a tag on the dorsal side of one of the wings.

For those of us who will never tag a manta ray, would you describe what it's like?

If you can imagine being surrounded by four-meter rays where you can see perhaps 40 to 50 meters in unbelievably crystal-clear water. Then you're taking a breath, diving to ten meters before you can get close enough to one of these rays to actually deploy the tag. There's no feeling quite like a successful deployment of a tag, especially of a relatively rare animal that you know you're lucky just to see.

I could play people the best whale shark video that they've ever seen, and I think they would say, "That's pretty cool." But if I can get someone in the water with the whale shark for 30 seconds, that is so much better. There's nothing like getting people to actually see these animals in their own environment, to have a sort of connection that is simply impossible any other way.

What would our ocean look like without these large fish?

It's an ocean without some of our most charismatic animals. It is an ocean with reduced diversity, that has lowered resilience to some of the climate change impacts that we've already started to see and will be seeing a lot more of as we move forward. It's an ocean that is no longer wild, in a real sense. Imagine the U.S. West, without grizzly bears, without wolves. It becomes a very different environment, in terms of how humans experience it.

Is the clock ticking?

We still have reasonably intact wild ocean ecosystems, but we're getting really close to the tipping point where we will no longer be able to maintain them. We've got perhaps ten years in which a concentrated effort to conserve these large apex predators will ensure their survival for the next 200 years. The action needs to happen now. If you care about a wild ocean, if you care about having your children be able to see large sharks, large tunas, actually in the wild doing their natural thing, the time to act is now. ▲

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Nuno SA



Dr. Jorge Fontes at the Institute of Marine Research at the University of the Azores dives to a whale shark to affix a tag that will record and relay data on the shark's movement to scientists.