

*Jennifer Stock:* Does anyone know what an ocean sunfish looks like? Well, they're pretty darn cool. Let me just tell you, they're basically a huge pizza turned on its side, swimming through the ocean with two big fins and pretty much no tail fin. So, if you're intrigued, you may want to do a quick search on the internet, if you can, or go to a library and see what an ocean sunfish looks like. They are very cool.

You can't help but wonder how they got to be this shape and Tierney will be filling in many of the details of their incredible natural history and what she's been learning through her research. I'd like to welcome Dr. Tierney Thys, a marine biologist and filmmaker who has been studying the ocean sunfish since 2000. After earning her undergraduate degree in biology from Brown University in Rhode Islands, Tierney decided to dedicate her career to studying the ocean. She went on to earn a doctorate in biomechanics where she focused on the mechanics of swimming muscles in fish. In addition to publishing research and compiling a book on molas, Tierney is the science editor at Sea Studios Foundation, a documentary film company based in Monterey, California.

Tierney was elected as a National Geographic emerging explorer in 2004 and nominated for a Pew fellowship in marine conservation. She is a submersible pilot, a certified diver, and private land and sea pilot. I saw Tierney present a talk about six years ago and became completely curious as to the amazing natural history of the ocean sunfish. I'm thrilled to welcome Tierney to Ocean Currents. Welcome, Tierney. You're live on the air.

*Tierney Thys:* Thank you, Jennifer. It's a pleasure to be with you. I love the other guests you've had on. It's a great show you've got going.

*Jennifer Stock:* Thank you. Well, I'm so thrilled. I've been so excited to have you on the show because the mola is my favorite fish and I think you share that with me.

*Tierney Thys:* I think there's quite a few people in the world who would say that as well.

*Jennifer Stock:* Wonderful. So, first, what attracted you to studying the ocean sunfish?

*Tierney Thys:* Well, I think it's really its odd shape and the way it presents itself. You know, you look at a tuna and you look at a shark and they pretty much say what they're about. It's written all over their body.

They're about speed. They're about strength. They're about stamina, streamlining and then you look at a mola and for you listeners who don't know what a mola looks like, it's pretty much just like a great big swimming head with fins attached to it and it goes out into the open ocean and it doesn't really have a tail, so to speak.

So, you...from...if you're looking in terms of form and function, it's a rather counter-intuitive design for an open-ocean vessel.

*Jennifer Stock:* So, there are three species of molas and that was something I had no idea about when I went to your talk. Can you describe what these three species are? Are they (in) all in the world's oceans or do they vary geographically?

*Tierney Thys:* Yeah, well they are believed to be three species in the family of molidae and the most common one and the one that we see the most of here on the California coast is the mola mola and there's also the masturus lanceolatus and that looks like a mola mola except it's got a little bit more of a nubbin at the end of its tail. Its skin is a little smoother and it has some behavioral difference. Those two molas get to be very large. They get in the thousand pound range.

The mola mola is the world's heaviest bony fish. So, it gets to be over five thousands pounds and the masturus is right close on its heels. The other species in the molidae family is ranzania laevis and that's the slender mola and it doesn't get to be more than about two feet. The mola mola and the masturus get to be about, you know, upwards of...they can be ten feet long, but the ranzania is quite small and they're pretty speedy fish and that one is located more tropically whereas the other ones are more circum-global.

*Jennifer Stock:* I see and they do quite a bit of a weight increase from when they're in their small planktonic stages. How fast do they grow and what do they eat when they're that small?

*Tierney Thys:* Well, those are all really good questions. It's a difficult one to answer in terms of wild growth rate for molas because they're not a commercial fish. So, it's difficult to tag them, track them for a long period of time in the wild and then recapture them, which is how many of the wild growth studies are done. We do know that they, from the hatching size of their little egg into the full adult form, they increase...they can increase in weight 60 million times and now, that's puts the mola as the vertebrate growth champion of the world. So, that would be like, you know, if a human had a baby, that baby would grow up to weigh as much as six Titanics.

*Jennifer Stock:* Oh my gosh.

*Tierney Thys:* Yeah. It's a pretty amazing transformation.

*Jennifer Stock:* So, they may not be the biggest or the fastest fish and be very obvious in what their role is, but they certainly have a growth championship to honor and a weight championship to honor.

*Tierney Thys:* Yeah...yeah and they...primarily their diet is believed to be jellyfish and so, they have to eat quite a lot of jellies to reach that large size because, you know, jellyfish are pretty much, mostly water and 100 grams of moon jelly actually equals about four calories.

*Jennifer Stock:* Oh my gosh. So, that's a lot, lot of jellies.

*Tierney Thys:* It's a lot of jellies to put on that kind of bulk. We do know from captive growth studies that they are capable of growing very fast when given a rich diet and there was one mola in the Monterey Bay Aquarium that put on around 800 pounds in a little more than 14 months.

*Jennifer Stock:* I was just recently at the Monterey Bay Aquarium and I have to say, the mola there is looking a little chunky.

*Tierney Thys:* Yeah. Well, that mola \*cough\*...sorry....has been a great display animal. It's really taken well to the tank and I think they've certainly decreased the diet, the caloric intake of that mola and it's only getting around .5 percent of its body weight and it's getting quite a lean diet despite its rather bulky appearance and it has lost some weight. I think it was perhaps eating a little too high on the hog in its first months in captivity. So, it has lost a little weight, but it's still got that curious roll around its dorsal fin and so, we're going to be looking into that and seeing if that's all fat or if there's something else going on up there.

*Jennifer Stock:* Wow, that's fascinating.

*Tierney Thys:* Yeah.

*Jennifer Stock:* So, when they're younger they school together. Is that an advantage for...just because they're not very fast? They're kind of slow. Is this an advantage for maybe safety in numbers?

*Tierney Thys:* Well, schooling has been really a survival tactic for so many fishes and the schooling activity provides a disruptive front for a predator. So, there is that, of course, the safety in numbers and molas when they're little are quite speedy. They're certainly nothing that you could keep up with swimming. So, they school until they're about pizza pie size and a little bigger than that they start to become loners and they stop schooling. So, in truth, in today's sort of assaulted seas when it comes to fisheries and (??) and drift nets and all these thing, schooling as actually...doesn't work to a fish's advantage now because it make large numbers of them an easy target. So, by being non-schooling, I think its one of its features for being a fish of the future.

*Jennifer Stock:* Interesting. So, it's...they're not a commercial species in the United States, but they are internationally...in Japan they are?

*Tierney Thys:* Well, in Japan they're caught opportunistically in set nets that line the coastline of Japan as well as in Taiwan and certainly, if they're caught in nets in other Asian countries like the Philippians and China they are eaten, but it's a difficult species to target because of its schooling behavior.

*Jennifer Stock:* Interesting. So, back to their behavior a little bit. We call them the ocean sunfish and, of course, when we're on the surface of the water we have the most likely chance to see them. Do they spend most of their time at the surface or do we know how much time they spend at the surface and what are they doing up there versus spending some time at depth?

*Tierney Thys:* Yeah, well it's interesting because they are one of these unique fishes that just present themselves to the public. You know, this enticing little way of showing their whole body and then...for extended periods of time and then disappearing and that behavior has led to their common name of sunfish, but it's also led people to believe that they're often sick and this is a distressful behavior, a behavior showing that they're somehow afflicted with some disease, but we've found, we've been satellite tagging the mola, and we found that this is a totally normal part of their behavioral repertoire. When we see them on the surface they're actually...that is the surface bouts punctuated by multiple dives to depths that occur during the entire...all daylight hours. So, as soon as the sun comes up, the mola starts bounce diving up and down and up and down to depths over 300 meters and we even have them going down to 600 meters and in some regions, a group in ?? has been tagging and they've got them down to 800 meters.

So, they're able to bounce dive to quite deep and then come up and we feel...we think that what they're doing is warming up. You know, that basking area is...they expose their large side to the sun and that acts as a solar panel and it also helps warm their tummies so that they can digest their food faster. You know, with every ten degrees increase, you speed up your enzymes twice and so they...it's both...it's probably...we think that has something to do with it, that they're warming up from diving multiple dives to feeding areas.

*Jennifer Stock:* That's amazing. I had no idea they went that deep. Are they feeding at that depth?

*Tierney Thys:* Well, we think that that's what would merit that energetic expenditure. We think that they're targeting what we call the deep scattering layer and the animals that live in the deep scattering layer are...it's a multitude of sundry critters from squid to fish to crustaceans to mollusk. It's a whole diversity of animals that live there. So, we think that that could be one region that they're targeting for, you know, high-protein, high-calorie payback.

*Jennifer Stock:* Oh, I see. Interesting. More calories down below. So, worth the energy to get down there.

*Tierney Thys:* Presumably. Yeah.

*Jennifer Stock:* Interesting. Well, those just tuning in, you're listening to Ocean Currents and I'm talking with Tierney Thys, a marine biologist who studies ocean sunfish, also known as the mola mola. So, another thing that's interesting is many people I've heard say...and I never knew this for a fact and I haven't seen it for a fact, that when they're up at the surface that it's also a symbiotic relationship for gulls or birds at the surface that might pick off parasites off them. Is there truth to that?

*Tierney Thys:* Well, there is...I mean, it's a mixed blessing what the birds do with the mola.

*Jennifer Stock:* Oh. I don't know if I want to know.

*Tierney Thys:* Well, certainly anyone who has spent time on the ocean, they know that lots of stuff floating on the surface of the ocean tends to attract other little fish and little critters underneath it and with the mola floating on the surface of the water, it can attract little cleaner fish underneath it. Often you'll...if you swim up to a mola and peak under it, you'll find little cleaner fish and molas are really a

smorgasbord for parasites. Even their parasites have parasites. So, they can...little fish can take advantage of that and from the air, birds can see parasites on the mola and often when you find molas, you'll find them in association with California gulls or western gulls and yes, we have seen them picking shaggy copepod parasites off the skin of the mola and the mola tolerating that, but, you know, if given a chance a seagull will just poke the eye out of the mola as well.

*Jennifer Stock:* Oh.

*Tierney Thys:* So, you know, you have to be careful when you're dealing with seagulls. They'll go for what they can get.

*Jennifer Stock:* That's right. I've seen a couple molas that had some parts of their fins bitten off. What are some other animals that might be attracted to molas for food?

*Tierney Thys:* Yeah. Well, they certainly get beat up around Monterey in certain times of the year because the sea lions, the California sea lions, find that the small molas make really great Frisbees, especially if they can rip their fins off and fashion them into that ultimate fishy disc and they will slap them along the surface of the water and...yeah it's...so, you can also see this during the pelagic period here in Monterey, you know, about October, November...September-October, the little ones come in and the sea lions play with them and then that pretty much renders all their locomotive force useless.

*Jennifer Stock:* Wow.

*Tierney Thys:* So, sea lions are certainly a big predator. Orcas are a predator as well. They...we've seen orcas going after them in the Galapagos and using them sort of as a play toy to possibly train their youngsters and we also have....molas take up an enormous portion of the bycatch in the Broadville swordnet drift fishery...drift-net fishery here in California. They're a large portion of the bycatch of the horse mackerel fishery off South Africa and also driftnet fisheries in the Mediterranean. So, those are some big factors in their mortality.

*Jennifer Stock:* So, is there declines in mola populations? Do we have an assessment of that? Do we know...at some fisheries are suffering in their large populations, but since molas aren't necessarily targeted here in the U.S., but their suffering is bycatch. Do you think that they're potentially at threat for declining?

*Tierney Thys:* That's a really good question and its a difficult one to get because we don't have global baseline population numbers on molas. It's something that we're working towards. So, we can get some insight into that by looking into genetics and into, specifically, we're looking at nuclear DNA. I'm working with Steve Carl who is at the University of Hawaii, Minoa. We've had a partnership going since 2000 exploring the genetics of molas and before I go into the microsatellite data, we think we might have two new species as well.

*Jennifer Stock:* Wow.

*Tierney Thys:* So...which would be exciting. You know, you get new species of beetle on a regular basis, but how often do you get two new species of fish that weigh over 5,000 pounds?

*Jennifer Stock:* That is so cool.

*Tierney Thys:* Or can weigh over 5,000 pounds. That's the world record, but getting back to the way that the genetics work is...there is portions of DNA that are highly variable with all these microsatellites and depending on how much...and those portions are specific to individuals. So, you can essentially get a genetic profile of an individual using these sections of variable DNA and looking at the variability within a population, you can get an assessment of how active is their breeding. So, if the population has decreased in size, hence, you know, the decreased breeding activity, then that would lead you to believe...then you'd be decreased variation in these variable areas of DNA and then you could, you know, that would lead you to the hypothesis that fisheries or bycatch is definitely impacting the population and so we've looked at microsatellites and there are hints that the population has decreased in recent years.

*Jennifer Stock:* Do you think that they're more affected here in the U.S. driftnet fisheries or is it more so overseas?

*Tierney Thys:* Oh, all really good questions and we just don't have enough data to say yay or nay and, you know, everything right now in our mola work is in the realm of small numbers and we need, especially with the genetics, we need lots of samples to have any sort of statistical power.

*Jennifer Stock:* Interesting.

*Tierney Thys:* So, we're still in the preliminary data stages.

*Jennifer Stock:* Wow. So, there's a lot more to learn about molas. How about the shape? Going back to the shape of them, is there a unique niche for them in the ocean? They obviously are eating jellies, which are very abundant sort of predator in the ocean of plankton. So, could...is it fair to say that, you know, it seems that jellies respond to excessive nutrients in the water and there's excessive jellies and would molas respond that quickly in the food web if there's this excessive amount of jellies for molas to reproduce really well?

*Tierney Thys:* Well, those are all really, really good questions. We're certainly looking at molas as a potential harbinger for global sea change and as you say, we've increased fishing and we've increased pollutants and increased warming. We're making the seas more hospitable for low-energy, highly...fast reproducing organisms like jellyfish. So, as we get these...more and more replete with jellies, then one would think that the animals that eat jellies would thrive in that type of environment, but we don't have enough, you know, data right now to get a sense that's actually occurring, but with bycatch and other factors effecting the mola population, they might not have the opportunity to rise to that banquet of jellies that are being presented.

*Jennifer Stock:* How often do they reproduce? Do we know that?

*Tierney Thys:* Well, we know that they broadcast spawn. So, the males and the females must come together and they're actually in the Guinness World Book of Records again for having the most number of eggs in a single vertebrate. Females have 300 million...

*Jennifer Stock:* Wow. 300 million.

*Tierney Thys:* ...were estimated in a four foot, single ovary female. So, that's orders of magnitude more than any other fish. So, we think there must be high infant mortality otherwise you'd be able to walk from here to Hawaii on molas.

*Jennifer Stock:* Seriously! Are there more eggs with older females like rockfish? They successfully reproduce better as they get older or..?

*Tierney Thys:* Well, that seems to be certainly a pattern that we see in fishes. We don't have enough...we haven't actually....um....haven't actually had enough (??) females to say yay or nay, but that's certainly, you know, that would certainly be the hypothesis. The larger you get, the more resources you can put into egg production and if you're looking at a four foot female who can make 300 million and these

molas get to be over ten feet, then that's a sizable number of eggs in those ovaries.

*Jennifer Stock:* Yeah. Someone's eating them. So, when broadcast spotting happens there's males and the females and they come together and they spawn and then some of these get together and become larvae and some of the pictures I've seen on your website, specifically, ocean sunfish dot org, show their larval stage to be really spiky, almost like a crab larvae. What is some of the origins of that and it's so interesting that they're so spiky and they almost look like an urchin in the middle of the water. What are some of the evolutionary background on the larvae?

*Tierney Thys:* Yeah, well the larvae actually give them a lot of insight into why the mola is shaped the way it is. Where does this funny shape come from? The mola gives away....that larvae gives away that the mola comes ancestrally, evolutionarily, comes from and is related to porcupine fish and puffer fish. So, back when molas appear in the fossil record around 55 million years ago, back when whales still had legs and those....they come from coral reef fish that really, their body-form selected for armor and maneuverability and stiff bodies, a stiff-body design, tank design, as opposed to like a streamlined tuna design.

So, from that body shape and that porcupine fish, you know, with the spikes all over it, armored, from that they then evolved into more...as streamlined as they can be given that bloodline.

*Jennifer Stock:* Interesting. Have you ever seen a mola...one fun thing that's always fascinating to me is I've always seen the picture of the larval form, I've seen juvenile molas about the size of the pizza pie, and I've seen a couple big ones, but not quite as big as you describe. Have you ever seen any in-between the smallest larval stage and maybe dinner-sized plate? I'm wondering what they look like in their smaller stages. Just smaller molas?

*Tierney Thys:* Well, they actually seem to have a little bit of a tail after they go...after they start to resorb those spines. It seems...it sort of appears like they have a little tail, but then as they metamorphose through that larval phase, the fin range of their dorsal and anal fins migrate back. So, they don't really, as an adult, have any true tail. They fuse their backbones, they migrate their side fins, you know, the dorsal and anal fins, back to form this sort of rudder-like thing called the clavis and that's their tail. They don't have any other tail.

*Jennifer Stock:* So cool.

*Tierney Thys:* Yeah.

*Jennifer Stock:* So, this is a pretty common fish on the west coast. How do we...do you know how they use the California current? Are there certain areas on the west coast here that molas are more abundant than others so they concentrate in any specific areas?

*Tierney Thys:* Well, we kind of see them in certain periods of time in certain... I mean, we have sightings of molas year-round in Monterey, but you'll certainly see larger numbers of them in the late summer and the fall and when we tag down in San Diego, we always tag in the summer because that's when we see the greatest numbers. From our results, satellite tagging, and we don't have that many, we only have about 14 animals that we've tagged, we see that they make a southerly migration from San Diego down towards Baja off of, you know, getting no farther south than about Cedros Island and then start coming back. So, they're using that whole area, but how...the details of that we're still working out.

*Jennifer Stock:* Have you ever done any tagging from up north or does it seem to happen from the Monterey and San Diego area?

*Tierney Thys:* Monterey tagging is on the docket for this year. So, we'll be putting out at least four tags this year in Monterey.

*Jennifer Stock:* Very cool. Well, you know, we're just getting about to halfway through the show. So, let's talk a little bit more about the tagging and some of the research you've been doing recently in the next half hour.

*Tierney Thys:* Okay.

*Jennifer Stock:* We're going to take quick break. So, please stay on the line, Tierney.

*Tierney Thys:* Okay.

(Music)

*Jennifer Stock:* And you're listening to Ocean Currents. My name is Jennifer Stock and tonight we're talking with Tierney Thys, an ocean sunfish specialist, marine biologist based out of Monterey and we've been hearing a little bit about some of the fascinating natural history about this very oddly-shaped, but adorable, fish that gets quite heavy and Tierney, welcome back. Thanks for joining us again.

*Tierney Thys:* Hi. Happy to be here.

*Jennifer Stock:* So, let's talk a little bit about the research you're starting out of Monterey. You've been tagging for a while. Can you just give us a little bit of background on what you're trying to learn from tagging ocean sunfish?

*Tierney Thys:* Yeah. First I'll preface it. It's totally a collaborative effort. I work...we have a great team together. I work with an....depending on where I'm tagging I work with lots of different people in California with the Monterey Bay Aquarium, John O'Sullivan, Chuck Farwell, and also with Heidi Dewar, have been instrumental in the tagging of these animals and then in different parts I've tagged over in South Africa with the Two Oceans Aquarium in Bali with Bali Hai Divers and in Taiwan with the Taiwanese Fisheries Research Institute and in Japan with Kamogawa Sea World. So, I've worked with a lot of different people and that's been one really fun aspect.

Pretty much, in terms of the questions we're asking....well, it was just a blank slate when we started. We had no...the molas, they just present themselves on the surface. We had no idea what a day in the life of a mola was really like and where they, you know, where are they migrating to? How are they...what's their temperature tolerance? Are they following plankton blooms? Are they...do you find them in association with fronts? Do you, you know, what are the environmental parameters that inspire or negate mola movements and we're just now started to put the pieces of that puzzle together, but some of the really, really interesting things that I mentioned earlier in the show is that bounce diving to depth and in those...when they're foraging, they can be foraging in temperatures to 1.8 degrees C.

So, it is really, I mean, 0 degrees C is freezing. They can, you know, bounce dive to very cold temperatures and then come right back up to 20 degrees C. So, that's an amazing thermal tolerance in one dive and to do that repeatedly is really pretty remarkable. So, that's another thing that we've discovered from them.

*Jennifer Stock:* With these dives that they do, is there...that's an incredible buoyancy management adaptation to deal with. Do they have an air bladder or how do they get themselves down there and then get themselves back up?

*Tierney Thys:* Yeah, they don't have a swim bladder. So, that makes things a little easier and they are negatively buoyant. So, they can pretty much...they swim down and then they swim up, but swimming down is certainly a lot easier.

*Jennifer Stock:* Ok.

*Tierney Thys:* Yeah.

*Jennifer Stock:* So, we're talking about the bounce dives and the tags are starting to help put those pictures together of understanding this incredible tolerance down to 1.8 degrees Celsius and then how about some spatially, geographically stories that they might tell with the tags?

*Tierney Thys:* Well, we're starting to see that they're, you know, they have a home territory and that's important. You know, if you were to compare them to the Olympian migrators, the Bluefin tuna or leatherback sea turtles or something like that, the molas are not transoceanic migrators. They'll stick to a discrete region of a coastline and migrate north and south and I just have to preface all this with, you know, this is based on very few numbers, so, individuals. So, this is all very preliminary, but it does look like they have not a very extensive migratory range, but certainly, a north-south pattern and that's very important because if there is a lot of fishing pressure in these regions where the populations are located, there's some...they run the risk of that whole population being extricated.

So, because it's not...you know, you're not having a lot of influx from other regions. So, what we're finding with the genetics as well is that there are discrete mola populations. They could be, you know, even on the order of being new species, but just, even within the umbrella of mola mola you have discrete genetic populations and that lends, you know, that lends resilience to the species as a whole. So, if you have heavy fishing pressure in one area, you could just wipe out that entire population.

*Jennifer Stock:* That's amazing to think about that and it's, you know, their strong adaptation for reproducing a lot, they have a lot of eggs so they're very successful there, but then they could be completely wiped out as a population regionally around the world. That's interesting...that's amazing and to think about how the genetics have shared over time it makes me think about some of the humpback whale studies being done in the eastern Pacific here of sharing the genetic studies between which whales are over in

Hawaii and which whales are going to Alaska versus which ones go to the California-Mexico Route....

*Tierney Thys:* Yeah.

*Jennifer Stock:* ...and sharing of that in-between. It's interesting to think about the molas sharing their genetics as well.

*Tierney Thys:* Yeah, I mean this is just such a treasure trove to have this evolutionary history retained within every cell. It's a scientist's dream to have that available for exploration.

*Jennifer Stock:* And it sounds like there's a lot of collaborators internationally that have that similar question.

*Tierney Thys:* Yeah, yeah.

*Jennifer Stock:* What have been some of the different methods for tagging molas. You mentioned that you're tagging in a couple different areas of the world and what's it like to...some of the challenges you might face in these different areas.

*Tierney Thys:* Yeah. Every different country presents different challenges. Here in California, we use a spotter pilot because you can see molas from the surface and they're these glinting white discs on the surface. A spotter pilot helps vector us to the molas and we sneak up on it and get a large salmon net and put it over its head and then stabilize it and put the tag in. The tag, it's about the size...from about four inches long like a small little tube-shaped implement and we put...it has a dart on it. We push that into the animal and that's how we do it in California.

In Africa, we don't have a spotter pilot. We just drive around the surface of the ocean and look for the fish and it worked. You know, the times that we've tagged over there we happened to find these big animals. We don't even use a net. We just have a host of divers that we jump off the Zodiac, circle the fish, and hold on....being....well, being respectful and as gentle as we can be and getting the tag in as quickly and painlessly as possible.

*Jennifer Stock:* How hard is it to stabilize a mola in the water?

*Tierney Thys:* Oh, it depends on the mola. Molas are very, you know, they have individual personalities. Some just quiet right down. Others won't have anything to do with you. So, it all depends, but yeah, you have to sort of position them a little bit against the side of the boat

and hold their fin to get the tag in, but we put it in an area where we don't think there's a tremendous amount of nerves. So...and we did tests on mola...captive molas as to the best tag area, which would be the least invasive. So, we try to really minimize the impact on them.

In Japan we really have to work...we get to work very closely with the fishermen and we go out to the set nets with them and they hoist up the fish out of the set net, we put them on a pallet, we tag them, we put them in a live well, and then we have to motor them as far from those nets as we can so they're not recaptured. Every one of these tags costs \$3500. So...and then another \$500 for satellite time. So, this is a \$4000 investment when you tag one of these fish. So, you don't want it just coming right back into the net. You want it to have a little bit of a travel log.

*Jennifer Stock:* So, that's interesting because it seems like the nets are probably set where they're targeting fish which are probably attracting prey of some sort in that area and hopefully....it must be hard to go find out another area where there might be....that might be attractive to a mola to stick around for a while and not drift back to that area where they were.

*Tierney Thys:* Yeah, well so far we've had good luck in getting them, you know, like in Japan where we've done a lot of, most of the working with the fishermen, we motored them out into the Kuroshio Current and then they sort of put their mind elsewhere.

*Jennifer Stock:* Wow, it's like a second chance for them.

*Tierney Thys:* Oh yeah. I think that's a big sigh of relief on the mola.

*Jennifer Stock:* The lucky mola.

*Tierney Thys:* Yeah. In Indonesia, the molas don't really bask to the same degree as we see them here. So, we've tagged them at depth with a modified spear gun.

*Jennifer Stock:* Wow. Why do you think they don't spend as much time on the surface over there?

*Tierney Thys:* Well, it might have to do with the water temperatures. It's a lot warmer over there and we find them in upwelling, cold-water upwelling regions, but by and large the thermoclines moving deeper over there. So, they can...they don't have to come right up to the surface to get as warm as possible.

- Jennifer Stock:* Now, these tags that you're using, these are the type that pop off after a certain amount of time and so you have to retrieve them?
- Tierney Thys:* Well, if we retrieve them we get more data, but the beauty of this methodology, which has really revolutionized tagging open-ocean animals is that you don't have to get the tag back. It pops off the animal at a pre-recorded time. So, we typically tag about six to nine months. We use that window because anything more than that, the tag might have little encrusting organisms on it and if it gets too many of those then when it pops off it will have trouble transmitting properly. So, it's, you know, it's a mixture of factors that we're playing with. So, we typically program the tag to pop off after six or nine months and then it uploads its data, as much as it can, before its battery dies and typically we get...well, that data is...when it's transmitted up to satellite its compressed into histograms and so, we don't get all of the data and we get a compressed data set, but if we get the tag back, we can get all of the data.
- Jennifer Stock:* So, is there, like, some type of GPS thing that goes off that says, "I'm here! I'm on the surface?"
- Tierney Thys:* Yeah. It actually works off of light levels. So, you have an accurate clock and you have a light meter on the tag and from those two you can determine time of day and length of midday and then you can get your position that way. So...and then....but then when it's transmitting, it transmits its position up to satellite and we get its position when its transmitting, we'll get that very accurately from the Argos Satellite System and then where the animal has actually been, that is calculated from light levels in the tag.
- Jennifer Stock:* That's interesting. It's kind of reverse of the way you think about it. So, you've learned a little bit in regards to their potential north-south movement on the California coast with the limited amount of animals you've been able to work with and learned a little bit about their bounce diving technique through the tags. How much do you think....how much longer are you going to be tagging for as you are trying to unravel some of these answers and do you think your questions will evolve a little bit?
- Tierney Thys:* Well, we'd love to see what inter-species, you know, multi-species interactions that are happening, you know, how do the dive profiles of leatherback sea turtles compare to molas since they're both big jellyfish eaters? We don't really have enough animals to know how the molas, you know, what is their big overall pattern for the whole California coast because we've only got data from molas from, sort

of, the Channel Islands down. So, we don't know anything about what's going on with molas from the Channel Islands up north although we do have sightings of them up as far north as Alaska. So, it's, you know, getting that global picture of what's their seasonality, how are they using the oceans, how will a changing ocean effect their migration route and where are their spawning areas?

We have just glimpses of larvae that's been collected in plankton tows, but we...

*Jennifer Stock:* Oh, wow.

*Tierney Thys:* ...really...no one's ever seen them spawning in the wild. So, that's a big mystery. We don't know where they're spawning and that's a huge, you know, if we're to protect the species, it's be great to know when they're spawning and where they're spawning. We just have glimpses of that right now.

*Jennifer Stock:* So, would more visual observations from other folks on the ocean up north where maybe that you're not able to get because there's only so many people that can be watching, but is there a role for the public or those spending time out on the ocean?

*Tierney Thys:* Oh, absolutely and I'm so glad you brought that up because the mola presents this really unique opportunity for the public to participate in the research to unravel the mystery of this magnificent fish. I have a sighting form on my website that I'm the midst of updating that's going to be much more interactive and easier and filtered and provide a more rigorous database for people to put their sighting and when they see an animal, it'll allow an easy template for people to fill out and upload either pictures or stories or their lat and long so that...and, you know, I've had this site, sort of a nominal site, going for several years and I've gotten sightings from all over the world and every religious denomination, every, you know, from Norway to Tanzania, from rabbis to nuns to, you know, school kids to senior citizens all writing into the website, you know, with their shared love of the sunfish and when the world seems to be in a somewhat sad state of affairs when it comes to global cooperation, it's really been a real ray of hope in my life to be able to log in and see, you know, from all different nations people interested in the ocean, loving the sunfish, and wanting to help the scientific process.

*Jennifer Stock:* That's great. Do you think you'll be...I'm just thinking of how to get the word out about that because I just happened to trip upon it

when I was on your website and I'm wondering if, are you planning to get the word out at marinas up and down the coast as far as....I mean, that would just be California. It seems that we could probably help you with that up here at the sanctuary, getting fishermen and folks spending time on the ocean to be aware of that because I think a lot of folks that are out there are completely intrigued by that animal and would be like, "Wow, I remember I saw a sunfish today. I'm going to call up Tierney Thys and let them know there's a mola out here."

*Tierney Thys:* Yeah. No, it would be great and so we're redesigning the site right now and we'll probably be ready to launch the new one, I think in a month and a half, but I'm working with the Monterey Bay Aquarium to see if this is something we can partner on because I think it could be not only a tremendous community resource, but a global resource, not only for individuals and sport fishermen and recreational fishing and ocean-going, but also for, you know, the sanctuary that does ariel surveys, for whale watching boats that keep records...it really could be a repository for a lot of data.

*Jennifer Stock:* I could see it as a great resource for educators as well having students be able to track them around the world.

*Tierney Thys:* Yeah, absolutely and we're starting a little adopt-a-mola foundation too. So, you know, stay tuned, you know, keep looking at the website so they'll have some updates.

*Jennifer Stock:* That's great. So, I'll mention that we haven't said Tierney's website. It's oceansunfish.org and for those of you that want to learn more about the mola, Tierney has a great site with references of other papers and other collaborators, a little bit more background on the project here and it sounds like it's getting upgraded. So, maybe check it out now and come back in another month or so.

*Tierney Thys:* Yeah, we're going to overhaul the site, but another good thing about the site is that it pays homage to my funders, you know, National Geographic and Microsoft and Monterey Bay Aquarium and I've been very fortunate to have some great funders.

*Jennifer Stock:* Well, I think it's rather strategic to have a very cool animal that seems like it would generate a lot of interest that way. So...

*Tierney Thys:* Yeah.

*Jennifer Stock:* ...that's pretty neat. Are there any other things you'd like to share about ocean sunfish and your research?

*Tierney Thys:* Well, just that I appreciate all the people who have shared their thoughts on the sunfish and I think it's so important for people to spend time at the ocean and to have their kids spend time at the ocean and to keep the ocean in the front of their consciousness. I think it's...we're at a challenging point with protecting the world ocean right now and we need to keep...we need to not back-burner it. We need to keep it in our consciousness.

*Jennifer Stock:* Is there one thing that you'd like to let the listeners know about their personal role in taking care of the ocean.

*Tierney Thys:* Well, I think there's actually kind of three things.

*Jennifer Stock:* I'll take three. That sounds good.

*Tierney Thys:* You know, we as individuals and American citizens collectively and as a whole have tremendous power. Our vote has a lot of power. So, making sure we do our research for which candidates have ocean conservation on their ticket is vital. Our spending power....you know, Americans spend 50 billion dollars a year on seafood and so the consumer choices we make at the market have huge impact, 50 billion a year. So, making sure we know what are the right fishes to buy through the marine stewardship council program or [seafoodchoice.org](http://seafoodchoice.org). We should demand from our vendors to have sustainable seafood to buy and Americans, the one thing I'm really so proud of is that American generosity far outweighs other nations. We as individuals give away 200 billion dollars a year and less than 4 percent of that is for the environment and for animals.

So, I think our generosity is something really to champion and to bolster and I think we can bolster in this arena. You know, Thomas Friedman said that green is the new red, white, and blue and I think that we should make that ring true.

*Jennifer Stock:* That's wonderful. I think I agree. It's a new trend and people are starting to pay attention as they're being affected by interesting weather patterns that may not have been quite as normal in the past few years and there's a lot of hype right now about what's going on on our planet. So, I hope more attention does go to that.

*Tierney Thys:* Yes, yes and I think there is a movement afoot and it's certainly exciting and it's a viable time to be interesting in the ocean. So, yeah...

- Jennifer Stock:* Tierney, thank you so much for sharing some of your information. I know we just kind of tipped the surface of molas and ocean sunfish. I really, really appreciate your time in sharing this wonderful information with us.
- Tierney Thys:* Well, my pleasure, Jennifer. It was great talking to you.
- Jennifer Stock:* I wanted to mention also to listeners that if you look up on the National Geographic website, Tierney has been an emerging explorer in the past and has many activities for students and teachers up there and some neat videos about her work with the sunfish and as a marine biologist. So, NationalGeographic.com and research Tierney. Thanks again, Tierney and we'll be talking to you soon.
- Tierney Thys:* Thank you, Jennifer.
- Jennifer Stock:* Take care.
- Tierney Thys:* Buh-bye.
- Jennifer Stock:* So, earlier we were talking with Tierney Thys studying ocean sunfish, a fascinating animal, and I think that we sometimes talk about some heavier research or larger oceanographic processes, but sometimes it's just neat to be fascinated and have curiosity and it drives us to learn more and be more curious about the world and for me, the sunfish has been one of those animals and for someone else it could be something completely different, but whatever it is, find out what it is and learn a little bit more about it because I think it helps to inspire us to become better stewards of where we live.
- So, thank you very much for tuning in again and thanks for supporting KWMR and Ocean Currents. Goodnight.
- (Music)
- Jennifer Stock:* Thanks for tuning in to Ocean Currents. This show is produced in collaboration with KWMR, community radio for West Marin in California and Cordell Bank National Marine Sanctuary, a division of the National Oceanic and Atmospheric Administration. Opinions expressed on the show by the guests may or might not be the same as the sanctuaries. This show is meant to be educational in nature. For more information about the sanctuary program visit [sanctuaries.noaa.gov](http://sanctuaries.noaa.gov).