

Jennifer Stock:

Welcome to another edition of Ocean Currents. I'm your host, Jennifer Stock. On this show we talk with scientists, educators, fisherman, explorers, policymakers, ocean enthusiasts, authors, and more, all uncovering and learning about the mysterious and vital part of our planet, the blue ocean. I bring this show to you monthly from NOAA's Cordell Bank National Marine Sanctuary, one of four national marine sanctuaries in California all working to protect unique and biologically diverse ecosystems. Just offshore of the KWMR listening area, on the West Marin Coast, are the Greater Farallones and Cordell Bank national marine sanctuaries which together protect 4,581 square miles.

I've got a two-part show for you today. On the first half of the show, we are diving into gelatinous creatures, gelatinous zooplankton, jellies, sometimes called jellyfish. Guest Dr. Steven Haddock of the Monterey Bay Aquarium Research Institute will be calling in and we'll be talking all about the jellies, and most recently, specifically, the blue *Verella velellas* that washed ashore. This is an annual thing that happens pretty much almost every spring although some springs we don't see it so much. I'm really looking forward to learning more about these jellies, why they come ashore. I know a lot of our beachgoers notice them and have lots of questions so it should be a lot of fun. Then later, on the second half, we have Dr. Geoff Shester of Oceana calling in to discuss the latest with the sardine fishery in California and the recent decision to keep the commercial fishery closed due to the low numbers.

There's lots going on in the ocean. It's a cool, foggy day out here in West Marin. Hopefully, you're bundled up at home and can stay with us for a great show here on Ocean Currents. Stay with us. We'll be back in just a minute talking about jellies.

(Music)

Jennifer Stock:

Welcome back. You're tuned to Ocean Currents here on KWMR. About a month ago the shores of Point Reyes and the beaches up and down California were covered with blue squishy jelly-like creatures that have evoked a lot of interest from just about every single beachgoer. *Verella velella*, as they're called, really fun to say, washed up in mass along some of our beaches in Point Reyes. In fact, some areas really quite thick, and in other areas a little bit thinner. The springtime phenomenon seems to happen almost annually. I'm excited to talk today with Dr. Steve Haddock of the

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Monterey Bay Aquarium Research Institute or MBARI. Steve studies deep sea gelatinous zooplankton and he is doing research on bioluminescence, biodiversity, and ecology of deep sea and open ocean ctenophores, siphonophores, radiolarians, and medusae. If all those words are new to you well then stay tuned, we're going to dive into all these cool creatures that we're having here. Steve actually has been on our show before. Steve was a guest talking about krill many, many years ago when I first started Ocean Currents. Steve, I'm really excited to welcome you back. You are live on KWMR.

Steven Haddock: Thanks. Thanks for having me back. Can you hear me alright?

Jennifer Stock: Yeah, thanks for calling in.

Steven Haddock: Sure.

Jennifer Stock: So I really wanted to talk about velellas, but I want to talk about other pieces of jellies, too, and other parts. You know so much about them. Velellas are a current rage cause they're all over the beaches. They're kind of fading out a bit here, but I understand they're washing up a little bit maybe in Oregon. Can you just give us a little bit of an overview? Why do they wash up in the spring and why in such mass? Then let's talk a little bit about what these animals actually are.

Steven Haddock: OK. Velella are called the "by-the-wind sailors" by some people because they sail by the wind. They have a fairly firm, stiff sail that sticks out above the surface of the water and they float on the water. They're often offshore where we don't really run into them very much. We just got a report last week of rafts of them off Southern California that a boat captain saw about 50 miles out. They're often out there in the middle of the ocean, even as far as the central gyre, doing their thing, going through their life cycle. When we run into them is when the prevailing winds start to blow them towards the shores. We are seeing the subset of the time that they are abundant and that the winds have pushed them onto the shore.

Jennifer Stock: Is this usually the winds that kind of indicate the beginning of upwelling season?

Steven Haddock: Yeah, it's a similar thing. The winds that are out of the northwest or along the shore or coming a little bit off the shore or on to shore. Those kinds of winds are going to push them from their open

ocean habitat and also move the surface water so that the deeper water can come up to the surface.

Jennifer Stock: I guess they are always in mass when they're on the open ocean, so they come ashore in mass. Tell us a little bit about what each of these organisms are. They have this lovely little sail that sticks up. There's this vibrant blue color and these tentacles underneath. I understand that this animal is called a hydrozoan. Trying to understand a hydrozoan for most of us is pretty difficult, so hoping you can break it down a little bit about what a hydrozoan organism is.

Steven Haddock: OK, so I actually have a video about this too if somebody wants to look it up and see some animations. It's called "The Secret Life of Velella" and it's on YouTube and linked from our jellywatch.org page. The brief version is that hydrozoans are a subgroup of cnidarians which are the stinging animals that include corals and sea anemones and also the big sea nettle type jellyfish that people see a lot in moon jellies. But hydrozoa is a little lineage within that its members tend to be smaller and more transparent. So they may be like a clear bell, like a crystal jelly, and may just have four little canals that look like little white threads forming across inside the bell. One of the characteristics of many hydrozoan life cycles is that they have a hydroid stage. Some of them are always a hydroid. They look like a little feather growing on the rock. They don't make medusae. But other ones grow on the rock, they pop off baby jellies that are like what we would expect a jellyfish to look like. That swims around and reproduces and then settles back down to the bottom and attaches and forms the hydroid again. So it has this kind of alternating phase. The reason I'm telling you that is because velella is a really interesting example where, instead of attaching to the rock, the hydroid actually floats on the surface. So its attachment point is that air-water interface on the surface of the ocean...

Jennifer Stock: Woah, that's crazy.

Steven Haddock: ... It's easier to conceive of them upside-down. Flipping them over they would be more familiar to us like a hydroid's little polyp sticking up off the bottom, but in their case they're dangling down from the surface. One of the reasons for this is that there's tons of substrate in the open ocean if you consider the air substrate, but there's not really any substrate if you have to attach to a rock or some fixed surface and you're trying to live in these vast expanses of open ocean. So if you take one of those that washes up on the

beach in fairly good condition and put it in a bucket of water, maybe like a white bowl or a clear bowl or bucket, and if it's in good enough shape, if you leave it for a couple hours and look in that bucket again, you'll see these tiny little dots sort of like the size of a pinhead, and those are actually the jellies. It'll start producing jellyfish. It does produce medusae off of that hydroid and they can produce thousands and thousands from each one of those little settled groups of polyps.

Jennifer Stock: The medusae that are released are basically baby jellies, baby velellas that are going to grow up to be bigger velellas.

Steven Haddock: Because of this alternating life cycle, they'll make baby gametes, they'll make experiment eggs that will get fertilized and then turn into the hydroid part. The medusae themselves, they live as a medusa their whole lives. They don't go down and settle or turn into the hydroid. It's not quite like a butterfly and a caterpillar, but similar in that they don't really look like each other. But in that case the caterpillar turns into a butterfly. I guess that's a bad analogy, but they have these two very different phases of their life cycle that they alternate between. So the medusae even though they're tiny, those are actually the sexually mature part of the organism as they grow up. They start out really tiny. Again, in that video, there's some clips of them. The deep, deep blue color is a sun protection. They're living in this really extreme environment with tons of UV bombarding them so there's screening pigments to help keep them relatively protected. That's a characteristic of a lot of these organisms that live on the surface, they're called a neuston. Lots of them have a blue or purple color like the Portuguese man-of-war and there's some snails that live on the surface as well that have a bright blue color.

Jennifer Stock: Wow, I didn't actually know that. That is really interesting to help protect the rest of the organism from the UV light. Cool. Now I also read that the sail on these velellas, some of them are oriented to the right and some of them are oriented to the left. Why do they have that difference?

Steven Haddock: If you pick one so that the long axis of the oval, it looks like a zero or a capital "O" and the sail will go across it either like a slash or backslash – like in computer parlance. Everyone always mistakes backslashes for slashes. But anyway, it goes from upper left to lower right, that's a backslash, and we call that a left-handed velella. And there's a notion that ones in the Southern Hemisphere has sails going one way, in the Northern Hemisphere has sails

going the other way to help them sail downwind in the prevailing wind. In my “the right direction,” most of them are left-handed, basically, that we see and even in Japan. In New Zealand, I think, the majority of them are left-handed but some of them are right-handed. Because that sail is tilted it’s like a sailboat in a way with a very ineffective keel, but it will go downwind at a certain angle from the wind. There’s a series of papers about this. If you have a left sail or right sail, it’s going to affect how you move when the wind is blowing. The thought was that it would help keep them from blowing onshore by having a sail oriented it would keep them in that open ocean environment.

Jennifer Stock: Interesting. Is there any thought about potential of this lefty or righty based on distribution of them to distribute themselves in a wider area? If they were all the same side, they might all go the same way. But if they are oriented, is that anything in terms of distribution of the species?

Steven Haddock: I mean it could be, but it doesn’t seem to play out if you look at the numbers. There’s been a few studies where people have done the statistics in trying to figure out how many righties there are out of out of lefties. Actually, if people do end up reporting these guys to Jelly Watch, it would be interesting for them to poke through and look for righties. Again, they’ll look like a slash if you orient the sail the long way. It’s kind of like finding a four-leaf clover, I think, in this case where you’re looking for the right-handed velella. In general, if you think about debris lines and the so-called Great Pacific Garbage Patch and just plastic trash, often if you’re out in the boat you’ll see a line where there’s like a windrow and all this trash is accumulated there. All the things that float on the surface, they tend to pool in these little eddies with the wind. Velella do the same thing, and you get really, really dense rafts of them. It’s not to say they’re always like that. We find them where there’s maybe 20 or 50 or 100 feet between them and they’re just spread out uniformly, but they do tend to congregate. It doesn’t seem like they have a special adaptation of like “you guys go this way and will go that way, improve our chances.”

Jennifer Stock: Interesting. A couple years ago our at sea monitoring program, the ACCESS program that does at sea monitoring for seabirds and mammals and oceanographic monitoring, they were offshore and seeing velellas as far as the eye could see. At first, they thought there was an oil slick when they looked, and they were like “Oh my Gosh, these are actually velellas.” It was so interesting the photos, it almost looked like snow-capped peaks in the sense of

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that light sail and it was really, really cool that they saw that, and they also observed ocean sunfish, or mola molas, totally taking snacks. That was really neat to see all these amazing ocean things. I love the velella phenomena because it's such a great way for all people who enjoy the beach to become interested in the ocean and ocean sciences, and it draws so much curiosity because they're so beautiful. I know that you have started this Citizen Science project to kind of capture that with people that might be enjoying the beach and observing things along the beach. You started jellywatch.org. Can you tell us a little bit about Jelly Watch and what this Citizen Science project is all about and how it contributes?

Steven Haddock:

Yeah. Absolutely. I can start with what you just alluded to which is this idea of inspiring people when they see something weird on the beach and it piques their curiosity. I like to think that we have three goals for Jelly Watch. One is to inspire people to enjoy the ocean, observe it closely, and also not be put off by velella coming ashore. It could get stinky or it could look like it's an invasion, but really they're a natural part of the ecosystem out there and, as you mentioned, they're feeding lots of sea turtles even seabirds and fish. They're feeding the mola molas and the other organisms. For this site, one of the goals is just to try to get people to look at jellies and look at the ocean in a little different way. One of the main ones is for research because we go out maybe once a month, collect in great detail by scuba diving or with one of our submersibles we can sample the jellies all the way down to 4,000 meters. But that's once a month and in one specific location so we don't get a good idea of these big trends of when the jellies are showing up, how intense is the jelly bloom this year, how far does it extend. We started this Citizen Science site because people are on the ocean. Thousands and thousands of people are on the ocean every single day, probably every single minute, and if we can tap into all those eyeballs out there, we can assemble a really, really unique data set. Part of that is making those data available openly so that any setting that goes on Jelly Watch, people can do bulk downloads of all the reports from a certain organism or their area or certain time period. We have a lot of school projects that are able to do the jellies of Indonesia when they might not be able to actually get to Indonesia and see them. Those are two of the main goals are to inspire and to do research, and then also just to educate people. "I see some weird orange blob floating up on the beach," and usually with a snapshot or sometimes even with just a verbal description, we can identify what that was, and then they can look up a picture of what it looks like when it's happily swimming

around. It started as a side project and we didn't have any funding really, but it's just been so rewarding all the interactions with people and the cool pictures that people post. We had researchers fly to a place far away because their study organism was reported, and they met with this mom and the kid who had reported it, met with this researcher and went out to the beach and everything and collected the animals. It's been really fun to make a lot of connections like that.

Jennifer Stock: That's really cool. Have there been any totally new observations of species that you are not familiar with?

Steven Haddock: I wouldn't say species that we're not familiar with, but definitely species in an area where they weren't known before. There's been several examples of that. We actually, from Alaska, we got a report of a guy who saw this giant jellyfish and it turned out to be a deep sea species that was described by George Matsumoto and everybody here a while ago. But it's like a really deep living species, and it turned out this guy had seen it on a scuba dive in Alaska. There's been some fun connections like that.

Jennifer Stock: That's so cool. I want to talk a little bit about jellies and all. I've noticed this on the website jellywatch.org, there is this discussion, there are these claims, that as the ocean warms that there may be more jellies on the rise and the environment is better for jellies than for other species. Is it too early to say that? Have we seen increases of jellies in certain areas of the global ocean yet? Jelly Watch might be a good way to get a little bit of information on that.

Steven Haddock: That's part of the reason that we started it is to try to develop a timeline for claims like that. We actually have done some studies based on the observations that are available, and it's pretty clear that jellies follow about a decadal time scale – so they'll be lots of jellies that people report for 12 years, say, and then another 12 years not. I think that timing lends itself to having people say “well, I've never seen ‘em like this before” because it's a 20-year period until you're gonna maybe see them again or 15 years until you see them again. If you're a lifeguard or even a fisherman or something you might say “wow, I've never seen this before.” I have some newspaper clippings that go all the way back to like 1906 and they're saying, “we've never seen him like this before.” People are always surprised that there are jellyfish in the ocean in high abundance, and their lifecycles do lend themselves to forming these blooms. There's a couple arguments related to that. One

thing is if we do take out fish through fishing, then the relative importance of the jellies could increase even though the numbers are not actually changing because they are a larger proportion of the ecosystem. Then related to climatic change, the distribution of certain species will definitely change as the water gets warmer, for example, in Monterey we may see more of southern species that we don't usually see, but we're gonna see much less of our sea nettle. Our normal local jellies were actually much lower the last couple years because we had warmer waters, and they were displaced to the north. Changing ocean conditions will definitely shuffle the communities that any one point will see. But their overall numbers, they're gonna be adversely affected if the ocean becomes less healthy and less productive because they need to eat as well. They can't subsist on microbes. So they want a good healthy plankton, and they're more competing with whales and some of the sardines and things like that than they are living on their own in their own little part of the food web.

Jennifer Stock: Do jellies discern on the type of plankton that they eat or is there certain species that they don't eat? I'm just being curious about that. All jellies eat plankton, right?

Steven Haddock: Pretty much. We actually have a proposal, we have a project right now to look at prey selectivity in siphonophores, which are another group of hydrozoans, but basically some jellies are very specialized and some jellies are very generalist. We did a food web paper recently. We took all the ROV video observations and looked at who was eating whom in there. We found one kind of jelly that ate 22 different kinds of prey and then we found another jelly ctenophore that only eats one species of polychaete worm. You have the whole range of extremes there where things are specialized for capturing and feeding on certain organisms or they're very generalist and trying to catch anything that they can bump into with their tentacles. We see a lot of relationships in that both the jellies as predators and then also with the jellies as prey. We recently found that there's a deep-sea octopus that seems to feed only on jellies. So it's not just sea turtles but even something like a giant octopus.

Jennifer Stock: That is amazing. That's so cool. That's some of the great stuff that the Monterey Bay Aquarium Research Institute does, and I hope people will take a look at their website. They've got great information on their website sharing these findings of their deep-sea research. It's really, really cool. Now we just have a couple minutes left and I think this might get back to your discussion

about the decadal cycle of jellies, but here locally in Tomales Bay, which is our rather shallow body of water, a lot of us like to swim in, and there do seem to be years where we have really, really thick moon jellies, and then years where we have hardly any. Then one summer we had so many of those nettles in the bay. Thinking about that decadal cycle, I had never experienced that and I've been out for 20 years. It's just kind of curious. Does that kind of play into those decade cycles in terms of how jellies when they appear and when they don't appear? Is there anything that can help predict that?

Steven Haddock: It could. Both of those have polyps. Especially moon jellies have polyps that they like to grow on like the roof of a cave or the underside of a dock. So if there's substrate there that wasn't there before, something for them to have their polyps grow on, then it could happen. Also if you think about it, you have to have a polyp, it grows and grows, makes baby jellyfish, those guys pop off, they go out, they grow, that whole cohort grows up to be a much larger jelly. It takes some time for that to happen and it has to be the right conditions for them to be happy and produce all those babies. I think that the periodicity feeds into that part of the life cycle and the local conditions there in the bay that are going to trigger them to grow quickly and pop off their baby jellies.

Jennifer Stock: Interesting. How 'bout the nettles? Because they were just so abundant you couldn't even go in the water and they were all over the beaches. The *Chrysaora* jellies.

Steven Haddock: How long ago was that?

Jennifer Stock: Was that last year. I think it was last year. Last summer.

Steven Haddock: We typically have those and there's actually a paper from 1925 that talks about the hordes of *Chrysaora* that appear annually along our shores. That's what the leatherback sea turtles swim 6,000 miles to feed on. They've been here for a long time, but for us locally here, that was actually like I mentioned a low year for them a couple of years ago. Like the last two or three years it was a really low year. But now I think they're returning to their more typical numbers. But in Tomales Bay itself, I don't know if maybe a population took hold there and some polyps grew so that they are locally sourced.

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- Jennifer Stock:* We'll see what happens this year. Hopefully, some people will join Jelly Watch now and start sharing this information. I know I'm going to get on.
- Steven Haddock:* We have stickers too. If anybody wants to email, contact us through the website. If you're teacher or something, we can send a pack of stickers out.
- Jennifer Stock:* A pack of stickers. Stickers for jelly watchers. That's great. Well, Steve, thank you for calling in today, and definitely could talk more and more about all these different groups of jellies, but these are the ones that are pretty common around our shores. I love the variability that we see year to year, some things that keeps us curious about the ocean, and what makes these things abundant or less abundant. Thanks for sharing some of the stories too about some of the deep-sea jelly findings and some of the studies going on with that. Really, really interesting. Are there any last things you'd like to share with our listeners?
- Steven Haddock:* Just go to Jelly Watch. I think the idea of the neuston, the velella drifting around in the open ocean, it ties back into the ocean cleanup project so that's a whole another can of worms. I would suggest that people look up an article in The Atlantic by Rebecca Helm about ocean cleanup and its effect on velella and other neuston.
- Jennifer Stock:* Oh, thanks for sharing that. We actually had a show about this, about the ocean cleanup with some marine debris people a couple of months ago talking about some of the impacts that are not widely shared or widely discussed on the open ocean ecology. I'll check that out. Article by Rebecca Helm from The Atlantic.
- Steven Haddock:* In The Atlantic. If you look up "ocean cleanup in The Atlantic" it's one of the first results that comes up.
- Jennifer Stock:* Sounds great. Awesome. Thank you, Steve. Have a great day and thanks for sharing everything about jellies.
- Steven Haddock:* OK, thanks a lot.
- Jennifer Stock:* Take care.
- Steven Haddock:* Take care. Bye.

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Jennifer Stock:

We've been talking with Dr. Steve Haddock from MBARI, the Monterey Bay Aquarium Research Institute, and learning all about velella velellas and other aspects of jellies on our shores. A couple things I just want to repeat that he shared. Their Citizen Science project, jellywatch.org, is a place for us to all contribute our findings. If you're a beachgoer, enjoy the beach once or twice a year or once or twice a week, you can help contribute by sharing your findings at jellywatch.org. I believe there's an app with that that you can download if you have a phone. So check that out. The video that he was referring to "The Secret Life of Velella" is something you can look up to learn a little bit more about these amazing creatures that wash up on our shores. Lastly, he just shared The Atlantic, an article in The Atlantic by Rebecca Helm, an article that looks at some of the ecological issues with the great ocean cleanup that's been in the news quite a bit. Very fun and interesting. I love having the natural history interviews on Ocean Currents. I always learn something new. Today I learned about the color, the blue and the purple, of these offshore neuston. The neuston is the things that free float out in the open ocean on the surface, and they host that blue and purple to help protect the rest of the organism from the UV light they face all day long from the ocean. Fascinating.

So here we are, Ocean Currents. This is KWMR, Point Reyes Station. We are going to take a quick break. When we come back, we will be talking with Geoff Shester of Oceana. Stay with us.

(Music)

Jennifer Stock:

Welcome back. You're tuned here to Ocean Currents here on KWMR. I'm going to transition this next half to talking a bit about the sardine fishery here on the West Coast. My guest calling in is Dr. Geoff Shester from Oceana and he's been on KWMR a couple of times talking about this issue on Robin Carpenter's show, the Farm & Food Shed report. So some of you may have heard some of these stories before about the state of some of these forage fish in California. Geoff currently works on Oceana's U.S. West Coast campaigns to implement ecosystem-based management of forage fish which is the fish that's eaten by lots of other animals, protect seafloor habitats from bottom trawling, and reduce fisheries bycatch. He's had a very lengthy career in marine conservation and has been very up to date on this issue with sardines. I'm thrilled to welcome Geoff Shester to Ocean Currents. Geoff, you're live on KWMR.

Geoff Shester: It's great to be here. Thank you.

Jennifer Stock: Thanks for calling in. So tell us what's going on. I understand that our regulators here on the West Coast voted unanimously to ban commercial sardine fishing for the fifth straight year, or is it the fourth straight year?

Geoff Shester: Yeah, this would actually be the fifth season since they did close the fishery by emergency action back in April of 2015. This vote would actually close it through June of 2020.

Jennifer Stock: For folks that aren't so familiar, sardines are rather small fish. They are up to twelve inches long and they can live up to thirteen years, but usually not past five. They usually reproduce at age one or two depending on the conditions in the ocean, and they can spawn multiple times in the season. These fish are considered one of the healthier fish for people to eat because they're rather low on the food chain eating plankton versus consuming lots of other fish. I know they are a concern for people to be aware about, but they're also such an important fish for seabirds and whales and other fishes in the ocean. How about talking a little bit about what are some of the suspected ideas about their declines in the last few years.

Geoff Shester: Yeah, so sardines and other types of these small fishes like the forage fish you mentioned, they tend to be kind of boom and bust species in terms of their population. They're typically very dependent on what's happening with ocean conditions. Just like we have seasons – summer, winter, spring in terms of on an annual basis – the ocean actually goes through some of these cycles as well both annually and over several years at a time. Over the last decade or so, the water has actually been kind of more on one end of that season that's thought to be, they call it, the Pacific Decadal Oscillation, for all those fancy oceanographers that like big words. Basically, you can have anywhere from 10 to 30 years where sardines are really productive and they do really well; there's a lot of what scientists call recruitment where they basically they make lots of babies, and the babies survive to become adults, and so the population can come back fairly quickly. The problem is that it can also decline very rapidly, too, if that recruitment starts happening very poorly and they don't make as many babies, and the babies aren't as able to survive because there's just not enough things to eat in the water or they're outcompeted by other things, then the populations can crash very quickly. Sardines historically supported one of the largest fisheries in the world back in the 1940s and it

created the whole Monterey Sardine Cannery era that John Steinbeck famously wrote about. But back then the stock in the 1950s and 60s basically went through this incredible crash. And at the same time, it was thought that this industry that had blossomed and gotten so used to this high production, kept fishing at these high industrial levels when the stock was actually collapsing. It was really a combination of a change in ocean conditions that basically moved the population towards the collapse but made worse by continued fishing pressure on a stock that was very sensitive. That's basically the same sort of story that we believe happened recently where in the 1990s and 2000s the sardine population kind of came back after several decades of being gone. It was very productive. It reached its peak in about 2006, but since then it's gone down and dropped by 98% according to the most recent stock assessment that's done by the federal National Marine Fisheries Service. That's definitely bad news, and again the problem was that during that collapse, over that collapse period, despite warnings that the stock was collapsing, much of the fishery management was kind of business as usual, and now in retrospect we know that a lot more fish were taken out of the ocean by fishing than was really sustainable for the population. The collapse really, I think, hit a lot of things hard, a lot of those animals that you were mentioning everything from whales to seabirds to salmon that all eat sardines. Obviously now that the fishery is closed, it's really been literally a disaster as the fishermen have actually been seeking federal disaster relief from the government due to the fact that the fishery is closed.

Jennifer Stock: What are the main areas along the West Coast for sardine fisheries? I'm just thinking of communities. I know Monterey is one, but what are some other key ports along the West Coast where sardine is usually hauled in?

Geoff Shester: Monterey is definitely one of the more famous ones. Then Moss Landing of course that's also in Monterey Bay. There are some landings up in the San Francisco Bay Area, but a lot of the fisheries is down in Southern California. Everywhere from San Diego to the port of San Pedro, Ventura. Sardines are fished all the way up into British Columbia when they're up there. They haven't been seen up there for a few years now. There are fisheries up in Oregon and Washington as well for this same stock of sardines. This same stock is fished down into Mexico as well.

Jennifer Stock: Can you tell us a little bit about some of the discussion over their pushback from any of the fishing communities?

Geoff Shester:

Yeah, so the Pacific Fishery Management Council is a 14member body, and they meet up and down the coast of the West Coast. They're responsible for all these federal fisheries including sardines. They meet everywhere from Seattle to San Diego to talk about these issues. They met recently up in Rohnert Park near Santa Rosa, kind of North Bay area, and this was a few weeks ago. They basically got this new stock assessment. I think there is a lot of concern that the fishermen have been raising every year that the federal assessments are missing fish and they're not seeing all the fish that are out there. We've heard a lot of concerns that maybe they're too far offshore for the survey to see or they're too far inshore, and fishermen will bring out their big plotters and show that they can see a gigantic school of sardines that maybe wasn't counted. There are aerial spotter airplanes that go over and can see schools of fish. I mean it's really been the same story that we've seen for the last 10 or so years where the fishermen are really complaining that the scientists are not seeing enough fish. Unfortunately, the acoustic trawl surveys that are used actually can see into the water in three dimensions and actually use sonar to measure the fish, then they drag nets behind the boats to actually determine which species they are. That's how the federal government counts anchovies and sardines and mackerel and some of these other small forage fish. They've been doing that every year and really have one of the world's best setups to do this type of survey. It's really used around the world and accepted as I think the global standard for how you count fish like this. But anytime that the numbers show up low, you certainly see repeatedly the concerns that, well maybe the sampling method isn't good enough, and maybe it's missing too many fish. The industry I think ultimately wants to see different types of surveys done and make sure they're not missing the fish, but ultimately, I think they saw the writing on the wall that the population really is so low that there's not enough to support a commercial fishery right now. So it was a unanimous decision to keep the fishery closed. Now that the stock is even lower than it's been the last few years, it's continued to decline even with the fishery closed. The council and National Marine Fishery Service are going to have to declare the stock actually overfished which is a legal term and definition that's used when the stock drops below a certain threshold value. In this case anytime the stock is below 50,000 tons, it's considered overfished, and the stock assessment shows it's around 27,000 tons right now.

- Jennifer Stock:* Wow. Do they keep monitoring year-round for these sardine populations or is there a specific time of year for the stock assessments?
- Geoff Shester:* The surveys that they do for sardines, they usually do a spring or summer survey. A survey takes about 80 days and it goes all the way from British Columbia down to the Mexican border. We have to kind of guess what's down in Mexico based on how many sardines they're catching cause we don't have an international agreement on the science to count the fish with Mexico. That adds another level of complication. That's something that we've been trying to push is better international cooperation, at least in terms of the science, much less, it would be a nice thing to actually make sure that there's some sort of international cooperation in terms of how much is being caught as well. That does exist for some species like some of the tunas that are managed internationally, but unfortunately sardines and anchovies and some of these small forage fish are not managed through an international agreement like that. It happens in the summertime and it's basically kind of a snapshot where a boat basically goes all the way down and does these long transects from the shoreline all the way out to many miles to sea and it goes back and forth and "mows the lawn." Based on what they see, they are able to develop these estimates. They've been doing that method for about the last 15 years now.
- Jennifer Stock:* Are sardines only in the Pacific on the eastern Pacific or are they in other areas of other ocean basins?
- Geoff Shester:* Sardines, it's kind of a larger genus of fish, *Sardinops*. They fish sardines in the Philippines, they're off Brazil, you'll see massive sardines in the famous BBC videos and stuff. Down in South Africa there's real famous sardine migration. It's oftentimes different species of sardines or different stocks or populations of them, but they are pretty common forage fish throughout the world. In some places, like the Philippines, it's one of the major staples in food. Unfortunately, as you mentioned, while they are extremely healthy I think for people to eat, we really encourage people to try to eat more of these small forage fish because not only the contaminants are low but it also has a very low carbon footprint and it has a lower impact on the food chain we believe if we're eating these directly. People don't really eat them in large amounts here. At certain times historically, like if you were hanging out in Monterey as a little kid in the 1940s, you'd probably eat sardines every day, but you know unless you live in Norway or something, in this part of the world people aren't really

as used to eating them and I think our preferences are different. We tend to like the big filets of something. People don't like to see actual bones on them. It is interesting that well over 95% of the sardines that are caught here are really just frozen and exported mostly to become either bait for large longline tuna fisheries or probably the majority of them now are being used to fatten up fish on fish farms like bluefin tunas out in Australia where they basically just shovel in several pounds of sardines, and for every 10 to 20 pounds or so of sardines shoveled in you get an extra pound of growth of these farmed tunas, and so it makes economic sense for them to do it, but it's kind of a questionable use of this valuable resource. Why are we fishing these valuable forage fish and rather than eating them ourselves, just feeding them to fatten up something else?

Jennifer Stock: Many years ago, the Pacific Fisheries Management Council passed a ban on krill harvesting on the West Coast. Krill being as substantial harvest or forage for so many species including fisheries, are you ultimately hoping to see something like that for sardines in the future?

Geoff Shester: Well, that's interesting cause what was interesting about krill, which we were actually involved in and made a big push for back when the council adopted that back in 2006 if you can believe it, but it was because their value as forage was thought to be greater than the value of krill if you actually caught them and sold them. There are some interesting arguments about that. One thing that the council has done is basically, cause the thing with krill was that people weren't fishing it yet, and the idea was to prevent a new fishery from starting on it before it started. Right. The idea being that once you start and actually have a big fishery, there's a lot more economic consequences to shutting something like that down and oftentimes you might not see the impact until it's too late. So the council did actually say "you know what, let's not just do this for krill, we should have that policy for any new forage fish fishery that we would look at" So everything from these pelagic squids, like the neon flying squid, one of my favorites, to glow-in-the-dark lantern fish. There are fisheries out there for forage fish that could be caught in large numbers, the council did say "let's put a prohibition on fishing those until we really understand the impacts and essentially reverse the burden of proof." It's a lot harder though when you're dealing with fisheries that there's already an industry set up around. So sardines, anchovies, these are fisheries that have been around for a long time. Our position is really not to see those fisheries go away. It's really that we need to be smarter

and more precautionary about how we manage them. What Oceana's position basically is for these fish that do have these booms and busts, we should be able to go out and harvest those fish when they're in the boom, when they're very productive and when they're in high abundance. The real damage and the impact of fishing happens when we fish too hard when these stocks are low. So what we need to do is basically be able to leave them alone for extended periods at a time. Now that's kind of a difficult thing to do though if you can imagine if you're a fisherman and you want to keep filling your net up. It's a hard idea to say, "well I guess I just have to sit around and wait for another few years for the fish to come back." That's I think one of the big challenges. One of the ways that the marine life does that, since obviously the marine life have to deal with these same booms and busts, is they fish for different things depending on what's more abundant. They tend to actually leave the low abundant things alone more because they are able to harvest something else. Oftentimes, for example market squid, it's another fish or fishery, invertebrate actually, but they're caught with the same types of nets by the same boats that catch sardines off of the coast here. So there may be ways to substitute what we're actually catching and switch just like the predators have learned to do over millions of years of evolution.

Jennifer Stock: So Geoff, we're just about at the end of the show, so just one last question. What is the most important thing for listeners and consumers to know about sardines and the sardine fishery overall? Or maybe it's all fish that they might be thinking about purchasing.

Geoff Shester: I think certainly people need to realize that we're not out of the woods yet with respect to having an overfishing problem here on the West Coast. I think we've seen now this was another example of a healthy fish stock and overfishing did make the problem worse. I do think that we can hopefully learn the lessons there and also realize that these fish do have an immense value for our wildlife and that ought to be taken into account as well. It shouldn't just be about maximizing how much we take out but also thinking about how we get the most value because it might actually make more sense to leave some of these sardines in the ocean to feed the valuable whales that support our coastal communities and seabirds and even other fish that we like to eat as well like larger salmon, halibut, and tunas. Even though they are some of the littlest fish out there, they are some of the most important.

Jennifer Stock: Thank you so much. I really appreciate you calling in to share this information and we really want to be aware to be responsive to

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these fisheries and the changing ocean conditions, in my mind, because we need to protect these for the future for not only the wildlife but also for humans that want fish to have in their lives. We really need to be flexible on how we consider harvesting and staying up on these populations under changing ocean conditions, too. Hopefully, the science will continue to keep going forward to best predict how populations will respond.

Geoff Shester: Thank you for having me and thank you for raising awareness and with everything you're doing.

Jennifer Stock: Thank you so much have a great afternoon.

Geoff Shester: Take care.

Jennifer Stock: We've just been talking with Dr. Geoff Shester of Oceana and learning about the sardine fishery that's just been declared overfished for the fifth year in a row. As we talked about earlier, this is a fishery that really is known as a boom or bust fishery. It really depends on the ocean cycles that we have happening – meaning if it's warm or if it's cold what type of food is available for them to be successful and to reproduce. There's a lot of different factors when it comes to fisheries management and it's great for people to be keeping an eye out. It's great for the science to keep going forward. Thanks, Geoff, for bringing this to our attention today.

Ocean Currents, time to wrap it up, is the first Monday of every month, 11 to 12. I love hearing from listeners, so if you have any ideas for topics, questions, comments, you can email me at cordellbank@noaa.gov. I wanted to just let you know too just in terms of one little stewardship thing I could leave you with... Number one check out jellywatch.org if you're a beachgoer so you can contribute to that. Out in Point Reyes recently we just had an unfortunate situation with an off-leash dog in an off-leash area in a part of the Point Reyes National Seashore. Now this is snowy plover breeding season and so there's areas of the beaches where we have "no dogs" marked off. Sadly, a dog was off-leash and actually ended up killing a threatened pinniped species, a Guadalupe fur seal. It's kind of a really sad situation that that happened. I know a lot of us love the ocean and sometimes forget about the impact of those things, so I just really want to encourage people to keep an eye on the rules and where they're posted about dogs. I have a dog. I love my dog. But I also really love the parks that we have and the beautiful places we have and wildlife. I

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encourage people to really keep an eye on those signs and make sure they know where they're walking so that we can help protect everybody. That's out here at Point Reyes and I know it happens elsewhere around the coast of California and anywhere if you're listening from afar. That's my last little piece of stewardship information for you. Thanks so much for listening to KWMR.

(Music)

Jennifer Stock:

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