Jennifer Stock: You're listening to Ocean Currents, a podcast brought to you by NOAA's Cordell Bank National Marine Sanctuary. This show was originally broadcast on KWMR in Point Reyes Station, California. Thanks for listening!

(Music)

Jennifer Stock: Welcome to another edition of Ocean Currents. I'm your host Jennifer Stock. On this show we talk with scientists, educators, fishermen, explorers, policymakers, ocean enthusiasts, kids, 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 of rocky shorelines, sandy seafloors, rocky banks, deep sea canyons and maritime landscapes and artifacts.

We have a two-part show today with two different topics, lots of science. And on the first half of the show I'll talk with Dr. Jarrod Santora, a research scientist at the NOAA Fisheries Southwest Fisheries Science Center in Santa Cruz, CA. We'll discuss an article that Jarrod was the lead author on with several collaborators that looks at what is called "habitat compression" and the ecosystem shifts between a warm ocean event and record high whale entanglements. If you have seen humpback whales very close to shore along the coast of California in the last few years, this interview will be of great interest to you.

On the second half of the show, around 11:30, I'll be talking with Dr. Melinda Conners, a postdoctoral conservation biologist currently at State University of Stony Brook. Her research interests are conservation focused and include understanding the effectiveness of Marine Protected Areas for protecting mobile marine vertebrates such as seabirds and whales, and understanding relative risk and resilience of these species to climate change. We'll be talking with her about a recent study that is making some headlines about albatrosses that were outfitted with GPS trackers

that were able to detect illegal fishing activities on the high seas. Super, super interesting. I'm really excited to dive into some science, all of it very interesting and relevant to our areas here on the coast of California, but also out at sea, and share some of this with you today. Stay with us. In just a few moments will be bringing Jarrod on the air.

(Music)

Jennifer Stock: You're tuned into Ocean Currents here on KWMR. On this half of the show we're talking a bit about the last few years and some different conditions that set up on the ocean and some of the ecosystem effects that took place with this warm water event that we've called The Blob. Starting in 2014 the North Pacific started experiencing a warm water phenomenon that came to be known as The Blob which dominated the waters off the West Coast. A cascade of effects took place with various research and data being collected. Around that time as well humpback whales started showing up really close to shore and were feeding actively and causing quite a show for whale watchers. Jarrod and his colleagues documented the conditions and events that took place and developed a new measure for ocean conditions called the Habitat Compression Index, which we'll find out what that is. With me on the phone is Dr. Jarrod Santora. He's the lead author of this study.

Jarrod Santora: Hi Jennifer. Thanks for having me.

Jennifer Stock: Thanks for calling in today. We're just giving a little bit of a background about what was happening in 2014. Can you first just go over a little bit about what was this warm water event, The Blob, and what were the drivers that really set it up starting, I guess, in 2014?

Jarrod Santora: Well, it's actually a marine heat wave. It was nicknamed The Blob, I guess, for communicating out this really anomalous warming event that happened in the North Pacific. Essentially, this long story short, it was a failure for the ocean conditions to cool down in the winter and so the warming event persisted for a number of years after that. As you as you alluded to, it caused a whole number of severe impacts on the California Current Large Marine Ecosystem when it landed off our coast.

Jennifer Stock: When you say the California Current Large Marine Ecosystem, what would be the northern range and southern range of that area?

Jarrod Santora: Sure. It would be up to about-- the transition zone is around Vancouver Island off Canada down to the beginning of the Baja Peninsula off of Mexico. A very large stretch of water out to about 100 miles offshore, a bit more than that in some case depending on the strength and intensity of the current.

Jennifer Stock: Ok. What were some of the effects that were documented as that warming event set up?

Jarrod Santora: We've been monitoring the biodiversity and catches of mid-water organisms like juvenile rockfish, squids and krill since 1983 with this one particular survey. We started seeing some really early warning indicators of increased sub-tropical species that were sort of moving in with the warmer oceanic water further offshore, which is not typical of our cooler upwelling ecosystem. But also, which was quite a surprise to us as well during this period, was some of the highest juvenile rockfish recruitment estimates that we've experienced since the early '80s. So there was a lot of strange creatures like argonauts and other sub-tropical species that were being found off of the coast like also the red crabs. It was a good time for some of our coastal species as well, like I said, with the rockfish species doing quite well. But most importantly, which really impacted the socioeconomics and aspects of the marine ecosystem, was this persistent harmful algal bloom which was caused by naturally occurring organisms, dinoflagellates, that produce domoic acid. That impacted the food web. It got into the food web and it impacts the seals and seabirds, marine mammals, other fishes, and essentially it also impacted the Dungeness crab fishery as well by causing a delay in the fishery due to crab quality.

Jennifer Stock: That fishery had a very large delay. Typically, it opens in November and they didn't open till March. I know they took a big economic hit from that. They were able to set up, eventually, when the domoic acid levels were considered safe for consumption of crab. What took place at that point with setting up crab traps and where they set them up and following up with whale presence?

Jarrod Santora: Sure, yeah, that was a really serious and unprecedented delay that the fishery has never really experienced before due to that domoic acid contamination. That happened from November 2015 to about late March 2016. Essentially that 5-month period, there was no vertical lines with no traps being deployed and the fishery wasn't open. In that particular case, when it was opened in April, it was

unfortunate because there was a lot of the humpback whale populations and other whale populations on our West Coast that have been growing substantially for the last few decades due to successful conservation acts that were put in the '60s and '70s. Essentially, we were still in this stressed ecosystem state of this persistent warming water and altered food web that impacted the forage species that whales typically feed on. When all the gear was going out in April, when the fishery was open, it was during peak timing when most of the humpback whale population is coming North and taking up their spring, summer feeding grounds off the coast of California. That kind of put them in the crosshairs with this sort of very limited productive habitat specifically for the amount of krill that's typically available. They had no other option, the whales, to go and switch to feed on anchovies. For humpbacks, that typically prey switch, they're quite capable and happy to do so, from feeding on krill to anchovy. In that particular case, it was further amplified with the distribution of crab gear and whales all being sort of peak timing going out in a particular few locations along our coast. That helped fuel the number of entanglements that started. That really showed a strong peak in that year. But the entanglement numbers also peaked two years before that due to the change in the ecosystem itself due to climate change and climate variability associated with the marine heat wave.

Jennifer Stock: Those anchovies really set up in abundance near shore. Do anchovy typically go offshore too or is that more sardine that's typically more offshore? It seems like it is very narrow, near shore.

Jarrod Santora: Sure. Well sardines, they're typically further offshore. Anchovies will actually extend offshore as well. There's a classic hypothesis that describes this called the Ocean Basin Model; when the population increases, it expands along our coast. The primary anchovy spawning grounds are within the California Current and there are some places along the coast, too, that come out of San Francisco Bay. But in general, this wasn't a strong anchovy population year; not anything like we've been seeing the last two years. The anchovy populations now are really surged orders of magnitude, higher than we've seen. The last previous strong anchovy year was in 2004-5. There's a distribution shift that goes North and it also increases offshore as we get more and more anchovy. But during these years, The Blob years, the only anchovy that was available, again there was a major decline in krill available for whales to feed on, was this little pocket of anchovies that we detected in our mid-water trawl surveys that was occurring

within Monterey Bay and off Half Moon Bay, North of Point Reyes areas and coastal waters.

Jennifer Stock: From my memory there was just a lot of reports about crazy whale behavior feeding right off of the piers near Moss Landing and Monterey and Half Moon Bay. People were paddling out to be near these whales, which is illegal and dangerous. So there were a lot of concerns for that approach as well. But, like you were talking about, so all their prey just happened to be co-located with Dungeness crab gear which is typically considered a very good fishery for low bycatch and a well-managed fishery in terms of sustainable harvest, and ongoing. That year we had just unprecedented amount of entanglements, right? With whales and the whale response team was called quite a bit.

Jarrod Santora: Yes, that's right. Yeah, as you're noting. The behavior of whales is a really critical aspect of this. It reflects what they're feeding on. When they're feeding on krill, they're a bit more dispersed. They're not in a higher aggregations, flailing around and sort of leaping and splashing about. While they're actually feeding on krill, they tend to take longer and deeper dives and they just kind of open their mouths and swim through the large krill swarms that are out usually along the outer shelf break or within submarine canyons. When they're feeding on forage fish like anchovies that are schooling and they're trying to evade being eaten, humpback whales work in groups. They do their bubble-netting feeding behavior and they are a bit more active and they're splashing around. We also think that their actual foraging behavior, when they're feeding on fish, might increase their susceptibility to getting entangled.

Jennifer Stock: For those tuning in, this is Ocean Currents. I'm talking with Dr. Jarrod Santora, and we're talking about the cascading effects of a marine heat wave here in the North Pacific and what took place with whales' food moving near shore and setting up with crab gear and entanglements that resulted.

So a lot of data being gathered through all this from very many different scientists and institutions, and it sounds like your paper kind of put it all together in terms of describing this cascading effect as well as considering potentially some new tools that could be developed to help prescribe future management. Can you talk a little bit about that?

Jarrod Santora: Sure. I'd be happy to. Yeah, this was a major synthesis that we've worked on for three years to put all the pieces together. It's really about communicating ecosystem science and the value of ecosystem science. You can't just look at what the whale population is doing independently of the crab fishery. What's also happening with climate change, climate variability and how it's impacting our California current ecosystem that we share with these species? We spent a lot of time carefully going through a variety of indicators on ocean and forage conditions and working closely with the Dungeness Crab Fishing Gear and Whale Entanglement Working Groups. That was hosted by the Ocean Protection Council and NOAA, and a contribution of state and federal resources. We spent a lot of time working with this diverse stakeholder group composed of commercial, recreational fishers, state and federal resource manages, and other scientists and conservationists all working together to figure out how we can utilize ecosystem science to develop a new program to mitigate entanglement risk so we can have thriving whale populations and thriving sustainable fishing communities.

Because it can't be one or the other, we have to work together. This paper really is-- there's two parts of it. One is about documenting the scientific facts that happened through here and the steps that we took to quantify them. But it's also about communicating and working as a group to solve this issue so we can reduce entanglements in all these fisheries. The paper goes through all that; describes that communication strategy; describes this new management challenge of having this nexus of events of increased climate variability which equals increased variability in our ecosystem which ultimately results in increased uncertainty. This is really the new management challenge of this century as we have these successful conservation acts that went in place in the '60s and '70s to support driving whale populations. We're now faced with trying to account for how climate change and variability is going to impact these highly capitalized fisheries and the whale populations and our fishing community. We're trying to put it all together to be better communicators in how the ecosystem science can really benefit these really difficult decisions. To that end, we developed the toolbox that tracks a variety of these factors including fishing activity, number of entanglements and forage fish aspects. Specifically, we developed a really new exciting index called the Habitat Compression Index. It's a really neat index that describes the spatial area of upwelling habitat through time. We use a combination of oceanographic models and remote sensing

like satellites to track the amount of habitat in any given time period now, to provide that information to mitigate risk of entanglement and ultimately risk to this really important valuable fishery.

Jennifer Stock: That's amazing that we have a tool like that now considering such a variability in this ecosystem. It sounds like a really important tool. Who has access to this? Is this something that is online and how is it used, I guess, throughout the year? Or is this new? Is this kind of being phased in now as a new tool to work on? And I understand it will probably continually evolve as well over time.

Jarrod Santora: Yeah, science is about evolution. We're always going back and looking and checking on this. It's a great question. Yeah. The tool is out there. We're working on further evaluating and bringing it online to benefit the working group that I mentioned earlier that are working hard. They do a number of risk assessments throughout the season to determine risk to the fisheries and risk to whales, and so we're hoping this new set of indicators can be used indefinitely into the future. A lot of this information is already found on the California Current Integrated Ecosystem Assessment webpage. It's a page that's produced by NOAA National Marine Fisheries Service. A lot of these indicators are already on there. The neat thing about this paper is it kind of pulls it all together into a one-stop shop. We're also building a new website that will have this information. It'll be transparent and we'll have all the data available for anyone that wants to look at it. Scientists and fishers alike love to look at data from my experience being involved with this working group. We like to provide as much data as possible.

Jennifer Stock: That's great. Well, we really appreciate the translation of the data, for the rest of us that are not in the numbers every day because it helps to understand what's going on with these complex situations. For me, I see this as a really good example of how we're preparing for being resilient in a very dynamically changing ocean ecosystem that is so valuable to so many animals, but also these communities and economies along the coast of California, the state of California and beyond. It's really important to keep up this important science that brings it all together to make good decisions. Are there other tools or other aspects of this paper that you're hoping to see built on in future years?

Jarrod Santora: There's a lot of exciting possibilities for helping mitigate this new challenge. I think we need to develop new tools so that we can be

ahead of these "ecological surprises," if you will. I think we can see these things happening. It's really unfortunate what happened with the entanglement and the hardships that the community went through, but we can now see these "perfect storm" scenarios where we have persistent heat waves or an El Niño event that the scientific community is well aware of due to our really rich, long time series either from the California Cooperative Fisheries Investigations survey which has been going on for over 70 years now. Then the survey that I work with out of the Santa Cruz Fisheries Ecology Division Lab, the Rockfish Recruitment and Ecosystem survey, which is going since 1983. We have really long time series. These are monitoring series that we can use to describe to the public the natural variability but also what happens during these extreme events that we could be better prepared to see this happening. I want to be part of a solution that prevents these sort of "perfect storm" scenarios where we're going to have a really stressed ecosystem due to a heat wave. We need to be ahead of it. Hopefully, these tools that we put together will allow us to potentially forecast a few months before these really extreme events land on our shore.

Jennifer Stock: Last question as we get to the half hour here; what are our ocean conditions looking like right now as we are in late January in terms of temperature and the food web as we see it right now? As compared to what might be a bit more normal even though we don't really have a normal.

Jarrod Santora: Sure, yeah. That's a great question. 2019 was largely dominated--we had another marine heat wave during that year, but conditions really turned around come September and October last year where upwelling really kicked in. We had a strong, late fall. Good upwelling winds blow along our coast, instead of that really strengthening, cooled down and kept the marine heat wave off our coast. As we've moved into December and January, the outlook for spring at this time is an El Niño neutral period. We're not going to see much impacts of an El Niño developing. We had a minor one last year. But right now the ocean surface conditions for temperature look really good. They're cool. They look to be about average. Another important indicator that we track at this time of the year is called the North Pacific High. It's the atmospheric pressure cell that's off our coast. That really sets the timing of the spring transition and the upwelling conditions from late winter into spring and summer. We're looking at that now through this past January. The area intensity of the North Pacific High looks really

good. It looks really high and the highest it's been since 2013. So at this time we're anticipating near average or slightly better than average cool upwelling conditions coming into spring. We monitor this on a weekly basis and a monthly basis, so things can change. As of now, that's where we stand and things are looking to be a bit better.

Jennifer Stock: Super interesting. Thank you so much for sharing all this. Is there a website that you'd recommend for people that might want to learn more or read up on this study?

Jarrod Santora: Oh there is a lot of stuff out there. I'd encourage folks that are interested to read the paper. There's been a lot of great media coverage and weblinks associated with that. I would go to the California Current Integrated Ecosystem Assessment webpage, also known as the CCIEA. There's a lot of amazing resources on there. You can also check out our IOOS website www.ioos.noaa.gov
as well as CENCOOS www.cencoos.org/
which is a great website hosted by NOAA Fisheries. There you can find a lot of information that is going on in the environment at this time, real time monitoring and things that are being forecasted.

Jennifer Stock: Fantastic. Also, the NOAA Fisheries webpage has a great summary of this work with some links to that. That's fisheries.noaa.gov. Look at the feature stories. That is where this has been described as well.

Jarrod, thank you so much for coming on and talking about this work, and also for the integrated science that you are applying with so many collaborators to bring some real tools moving forward with being able to keep as many ecosystems and people happy as we move through this very different time in ocean conditions with climate change. So thank you so much.

Jarrod Santora: My pleasure. Thank you for the opportunity.

Jennifer Stock: All right. Take care. Have a great afternoon.

Jarrod Santora: Bye bye.

Jennifer Stock: We've been talking with Jarrod Santora who is with NOAA Fisheries, and hearing a bit about the cascading effects of the warm water event that we had starting in 2014 and how it changed the

prey moving near shore and humpback whales coming in to feed on that, and having it co-located with Dungeness crab gear and very high entanglements. A lot of response came out of that which is so promising in terms of communication across all these different sectors with helping to find solutions to adapt to these changing conditions. Very exciting work to learn about from NOAA. As you see humpback whales on the coast outside their normal season in the summer, you can think a little bit more about what's going on there with this happening along the coast here.

We are going to take a short break. You are listening to KWMR in Point Reyes Station. This is Ocean Currents. We're going to take a quick break and when we come back, we're going to transition to more of a seabird topic and seabird science with albatrosses and some really cool work that's happening down in the Southern Ocean. We'll learn more in just a little bit. Stay with us.

(Music)

Jennifer Stock: You are tuned here to KWMR in Point Reyes Station, and you're listening to Ocean Currents. My name is Jennifer Stock. On this second half of the show we're going to change gears a little bit, and still talk about some really cool science happening out on the ocean through albatrosses. Here in the waters offshore of Point Reyes throughout the Cordell and Greater Farallones National Marine Sanctuaries, we have two typical common species of albatrosses that regularly visit these waters, a couple others come occasionally: Laysan and black-footed albatrosses, which are, amazingly, considered small in size compared to other albatrosses in the Southern Ocean. Like half the size practically, which is unbelievable cause they're just huge. With GPS tracking we've learned where birds spend their time when they're breeding and when they're not breeding. A new study led by Henri Weimerskirch from France along with others has been making headlines as it utilizes what we know about these far ranging seabirds and considers how these birds could be natural law enforcement monitors out on the high seas. I'm thrilled to welcome Melinda Conners. She is a postdoctoral conservation biologist currently located at State University of Stony Brook, did some work here, too, in California and Santa Cruz, and studies albatrosses. I'm really looking forward to bringing Melinda on.

Melinda, you are alive on KWMR.

Melinda Conners: Hi! Hi, Jennifer. Thanks for having me.

Jennifer Stock: Thanks for calling in. Your name was mentioned in an article that I read and I'm really glad we were able to connect because I love talking with people that are studying albatrosses and all the many aspects of them. Can you just give us a little history, a little bit of background on what your research goals are and what you're working on right now?

Melinda Conners: My work broadly researches mobile marine predators such as albatross but also sea turtles and whales and marine species that move really vast distances in the ocean. What I'm really interested in is finding these sort of habitat-animal connections and using that to understand how to best protect them. In terms of designing Marine Protected Areas or Marine Reserves and things like that.

Jennifer Stock: Is that based on locations of these birds or based on what? Or I guess other animals as well.

Melinda Conners: Yeah so most of my work is focused on seabirds. We use tracking data so you put a little tracking device on the seabird and it goes about on its daily business and we use those locations to see not only where the birds are going but what are the environmental characteristics like in terms of where they are going. We try to link what's important to the birds in terms of the habitat. Once we understand the habitat characteristics that are important to these animals, then then we can design marine reserves around that. I've done a lot of work with individual species, but currently my work, more and more, is interested in synthesizing datasets from different taxa. So combining datasets from seabirds and turtles and whales.

Jennifer Stock: Excellent. In terms of this recent study that we were communicating about; this is kind of turning it a little bit and also using these birds with trackers to tell us also what humans are doing out on the open ocean. Can you tell us a little bit about this study that we were discussing by Henri Weimerskirch, and what new information it has brought us to learn about albatrosses out at sea?

Melinda Conners: Yeah sure. So this is a pretty fantastically clever study. Typically, tracking studies use GPS or satellite tags. You put a tag on an animal and the tag pings a location or records this information from satellites and you can see where they went. With logging technology in general keeps developing. Every year there's a new

development in the technology. This technological development of this new tag type, that the study's about, addresses a very important question in conservation on the high seas. That is: How do we measure illegal fishing activities on the high seas? This is important for the management and conservation of many species including albatross because they have a risk of being a bycaught species in a lot of longline fisheries. The problem with understanding where the illegal fishing activities are happening, or what even a level of this activity is, is how do you detect these fisheries? Boats have an identification system that can be seen from satellite. That's one way of identifying fishing boats. However, if you are a fishing boat and you are fishing illegally, you often will turn that AIS off so that you can't be identified. That leads us to the problem of not being able to really understand even the extent of illegal fishing especially out in international waters, which we often call the high seas.

What this study does is it developed a tag so Henri Weimerskirch and others at the French National Center for Scientific Research, they worked with developers to develop a tag that has radar detector. How this works is the bird goes about its business flying out into the sea and if it comes into the vicinity of five kilometers of a ship, then it can detect the radar of that ship. Even if the ship's AIS signal, or identification system, is turned off, then the ship is still detected through this radar detection.

Jennifer Stock: And so that sends a live data point to a satellite which then comes to a computer so you can almost watch remotely?

Melinda Conners: Exactly, yeah. There's a GPS tag on the tag as well to get fine scale locational data of the bird and the ship, but also a satellite transmitter so that if the bird comes within five kilometers of a ship or detects the radar, that triggers the tag to send that data to satellite. Actually, what this research group did was really taking this to the next step. They develop this framework called the Ocean Sentinel Framework. Basically, they developed a platform that could provide authorities immediate information on illegal fishing activity. Once the tag is downloaded or uploaded to the software platform, that then notifies whatever sort of enforcement or regulatory organization needs to be notified about the illegal fishing activity. They developed this sort of preliminary framework that could be adopted by other countries and organizations to monitor in real-time illegal fishing activities.

Jennifer Stock: That's amazing. So what birds were tagged? What species of albatrosses and where?

Melinda Conners: In this study it was wandering albatross, which they breed in the Southern Ocean. They are the largest albatross species. Their wingspan, I think, it's approximately 12-foot wingspan. It's huge. The albatross species I worked with predominantly were the Laysan and black-footed albatross that breed in the Hawaiian Islands, which is the species you see out there in California. They have a wingspan about 6-feet. And they're huge. So you can imagine a bird twice that size is a pretty sizable bird. They can be equipped with larger tags than a lot of other species just because of their size. They're a good test case for this type of technology because they can handle larger tags than most other species of birds. They also fly vast distances. These guys circumnavigate the Southern Ocean waters. There's some estimate here going around that, I think, it's in a lifetime of wandering albatross they could fly the distance to the moon and back 10 times or something like that. Their entire design is to cruise wind on the ocean. Their design is to maximize the energy gained from the wind off the ocean, so they have to do very little work to cruise around. You can see this application, they are perfect because they cover these vast distances that no plane or train or automobile could even compare to. They do it pretty energetically, efficiently, and they get to regions that people can't. They're just covering a ton of ground very efficiently and bringing with them this sort of radar detective or detection tag.

Jennifer Stock: That's so cool. Well the other thing about albatrosses is that we know that they do have an incredible sense of smell and they are attracted to fishing vessels because of the smell of fish waste or fish catch and often will be following these fishing ships. It's just amazing. It's a brilliant study that really brings together all these things we know about albatrosses and the technology that is advancing to be able to start detecting what some human activity is out at sea.

Now do we know anything about potential concerns for this in terms of albatrosses, which you know some of these species are threatened and endangered, and sometimes from bycatch by getting hooked on some of these longline hooks that are deployed when fishing. Are there any concerns from this type of new knowledge about these birds that might be following the ships and

word getting back to these fishing ships and maybe hurting the birds?

Melinda Conners: Right. There is some concern about potential retaliatory actions from the fishermen themselves. Certainly, we see that happen with wildlife. You see sea lions getting shot or a lot of Gray Wolves getting shot in retaliation for depredation events. There are certain situations that set up an animosity that we would definitely want to avoid. I think there should be some caution if we were to move this forward at a larger scale. However, I think logistically it would be challenging for that to have a real strong impact. There's a lot of nuances there. Some species, I think wandering albatrosses and short-tailed albatrosses in the North Pacific, they're a bit boat-shy, so they tend to hang farther back from the boats. They really wouldn't, I can't foresee there being a huge risk to getting shot off the boat or something like that. Other species are a little more boat-friendly, you could say. I think moving forward it should be something on people's minds as to how to make sure that it doesn't create this big animosity between fishermen and seabirds, but I don't see it as a huge risk because the birds are staying far away enough from the boat, especially if you think about the Southern Ocean, there's huge waves…

Jennifer Stock: Yeah, big swells.

Melinda Conners: …big swells. I'm just trying to think about this from the fishermen perspective, trying to hang out on the side of the boat and shoot a flying bird while going over these huge swells. It just doesn't seem super practical and maybe even worth your ammunition.

Jennifer Stock: What's the foraging range for wandering albatrosses? It seems like a geographic area potentially that was targeted. Are there other albatross species that they are considering learning more about or trying this out with to see what else they can find?

Melinda Conners: Yeah. So wandering albatross, they kinda cover the entire Southern Ocean region. They breed around the globe and in the Southern Hemisphere, mostly, and in very high latitude, polar and sub-polar regions. And then again, they cover vast distances. Most of the Southern Ocean in high latitudes is covered by wandering albatross. Other species definitely are being considered. I was actually involved in some field work deploying these tags on Hawaiian albatross last year. They also cover really vast distances. If you consider the entire annual cycle of Layson and black-footed

albatross, during their breeding season they kind of stick around the Hawaiian Islands but extending up to the transition zone, which is sort of halfway between Hawaii and Alaska. Other times of the year they travel all the way over to California, as you know, or up to the Aleutians or over to Japan. So they cover the North Pacific region. They have interactions with longline vessels out in those waters as well, so they're certainly good candidates. Also, the Galapagos albatross down in more tropical waters. They are also being considered. There is a lot of fishing that goes on in that region, potentially illegal fishing, so I know there's some interest in targeting them as well. Albatross species in general, there's 22 or 23 species all in all, and most of them would be pretty good candidates, but I am sure the target wouldn't be some of these really highly, critically endangered species. Other than that, I would say the North Atlantic. They cover a good, fair amount of the global ocean. There's a lot in the South Atlantic but none in the North Atlantic. If you see an albatross in the North Atlantic, you're seeing something that really doesn't happen very often; you've got a bird really blown off course.

Jennifer Stock: It does happen occasionally.

Melinda Conners: Yeah.

Jennifer Stock: They can detect a fishing vessel with the radar, but it doesn't identify the vessel. How would the further information get developed to press charges necessarily? I mean it basically identifies where there might be illegal fishing happening, but it doesn't necessarily identify which boat. What are some thoughts about how things could be refined to have more of an enforcement effect?

Melinda Conners: Yeah, that's a really good question. I'm not sure what is in the plan in terms of technological development that way. Certainly, a lot of wildlife albatross species have carried cameras before so that's another option. I could see that not really working out super well because the bird would have to get close to the ship and… But what I can see really happening, I would say over the next 10 years, is this set up could be really good for the short-term. It gives us a much better idea in terms of what is the extent of illegal fishing in the global ocean. Thinking in terms of longer term technology, I could see this sort of heading more in the direction of say autonomous gliders that could be very hard to detect, that have a little bit more technological capability to pick up on things like

that, like identification of the boat. I think currently, for an albatross, I'm not sure what else they could really add to the tag to do that, but I don't see that as being sort of the long-term enforcement solution over the next 50 years or 100 years. I think it's probably going to go a little bit more towards the direction of autonomous gliders or drones, but certainly it's a great first step to understanding the extent of this illegal fishing.

Jennifer Stock: Wow, that's so cool. I'm just amazed because it really-- with the technology to even just track these things, track the birds out at sea, feels so new still and now we're able to really expand upon that with the technology on these tags, and who knows what else will happen. A lot of cool technology being developed for deployment on these large animals that are above the water and below the water, too. Some of the tags on sharks and whales…

Melinda Conners: Absolutely. It's amazing. We're seeing tags now, or a lot of people are using tags to use these animals as sort of ocean sensors themselves. If you have a large enough animal, or a small enough tag, you can put on salinity sensors, temperature sensors, wind devices or wind measurement devices. These birds themselves are serving as an opportunity to collect things that are typically collected on say CTDs or big at-sea vessel operations that drop off oceanographic devices into the waters, and are now basically being miniaturized to put on animals so that they can take ocean or environmental characteristics in real time, which is really cool. The other sort of direction that we're headed is just getting the tags smaller and smaller and smaller so that we can put them out on more and more species. We're starting to get to know quite a bit about large animals such as whales and large seabirds like albatross. But some of these smaller species like a tiny little storm petrel, it's much harder to get a good understanding of where they're going and what habitat is important to them because we don't have the technology that's small enough. It's getting there for sure, but the smaller the tag, the more animals we can learn about.

Jennifer Stock: Awesome. Well, we have time for maybe one more question here, and I really want to kind of shift gears a teeny bit. Albatrosses are really these sentinels of the sea and they really are an incredible opportunity to learn more about the ocean health as a whole because they're such predators and far ranging and where they breed and where they feed. You said you were out of the Hawaiian Islands and we know that we have a Layson albatross out there

who's been named Wisdom who is known to be 69 years old and still breeding. I just think it's an amazing story of hope and resilience that that one bird has been able to tell. Can you just take maybe 2 minutes to talk a little bit about that cause then we need to wrap up our show.

Melinda Conners: Sure, yeah. Many seabird species and especially albatross are really long lived. When I was in Hawaii, I was working with, again the two species of albatross, and I would take their identification band number, look them up, and sometimes they would be older than I was. That just instantly gives you just a huge amount of respect for these animals. They've seen so much change in our ocean over their lifetime that we can't even begin to fathom the kind of changes they've seen. On Tern Island, where I was at, that used to be LORAN Station, halfway point between Midway and the main Hawaiian Islands. It was covered in military equipment and bunkhouses and things of that nature. Midway, same thing, military outposts. You have birds that were on Midway and saw it being converted into a station and now being converted back again to a wildlife refuge. If you think about Wisdom, she's seen all of this in her lifetime. It just goes to show that we can learn so much from them if we just take the time to sit down and get to know them.

Jennifer Stock: And it's almost February, so I'm just thinking in terms of breeding right now, chicks hatch around March time or what's the timeline for chicks hatching?

Melinda Conners: Yeah yeah. February, March.

Jennifer Stock: Pretty soon she'll be out foraging again and bringing back to her chick. It's amazing. People, you need to look her up. If you're listening and you're just learning about Wisdom, you gotta check her out. It's just an awesome story.

Melinda Conners: Absolutely.

Jennifer Stock: Melinda, thank you very much for calling in today and talking about this study and the work with these trackers for all these animals and learning more about how to help protect the ocean based on what the animals are telling us through their movements on the water. Thank you for your work and thanks for sharing it with us today.

Melinda Conners: Oh, my pleasure. Thank you so much for the opportunity, Jennifer. I really appreciate it.

Jennifer Stock: Alright, take care.

Melinda Conners: You too.

Jennifer Stock: I love taking about science and all the incredible things that scientists are doing out on the ocean and applying it towards conservation. I's just really fun to share it with you all today. I hope you enjoyed those interviews.

Ocean Currents is the first Monday of every month and we're 11 to 12:00 o'clock. You can hear past episodes through the podcast which is in iTunes. Ocean Currents podcast is in iTunes. I also have all our past shows up on the Cordell Bank website - cordellbank.noaa.gov if you'd like to catch up on the 10, 11, 12 years of shows hosted here at KWMR. I love hearing from listeners so if you have ideas for topics, questions, comments, please email me at cordellbank@noaa.gov or jennifer.stock@noaa.gov.

Thank you so much for tuning in. Thanks for listening. Enjoy the ocean, bay or whatever body of water you can get into safely. Certainly, out here in Point Reyes we've had some big winds these last few days and I know elephant seals are still on the beaches. A lot of moms are near shore or onshore and pupping, so definitely keep your eyes out and pay attention to posted signs about beach closures or places you can be with a dog perhaps, too. We really want to help minimize any disturbance to those animals. Thanks again for listening to Ocean Currents here on KWMR.

(Music)

Jennifer Stock: Thank you for listening to Ocean Currents. This show is brought to you by NOAA's Cordell Bank National Marine Sanctuary, on West Marin Community Radio, KWMR. Views expressed by guests on this program may or may not be that of the National Oceanic and Atmospheric Administration, and are meant to be educational in nature. To contact the show's host, Jennifer Stock, email me at jennifer.stock@noaa.gov. To learn more about Cordell Bank National Marine Sanctuary, go to cordellbank.noaa.gov.

(Music)