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

(Music)

Jennifer Stock: Hi there, everyone. Good afternoon. You're listening to Ocean Currents, a show where we talk about the blue part of our planet, the mighty ocean. My name is Jennifer Stock and I bring this show to KWMR from the Cordell Bank National Marine Sanctuary, which is one of the most unique, vibrant marine ecosystems off the coast here of Point Reyes and part of a national system of special marine protected areas off the coast here. On Ocean Currents, we focus on what's happening out there in what covers three-quarters of the planet.

So, there's a lot of territory to cover on this show. We talk about discoveries, research, ocean policy, and ways for us land-based folks to get involved and learn more. This program runs the first Monday of every month if you'd like to tune in regularly and it's part of the West Marin Matters series where every Monday at 1 on KWMR, you can tune in to listen in about a local environmental or economic topic. This is a special month in June. We celebrate World Oceans Day. It's actually tomorrow and June 11th marks Jacques Cousteau's 100th birthday. Jacques Cousteau brought us underwater by inventing scuba and showing everyone, at the time, what lives beneath the seas with a video series and urging us to protect it for years to come.

So, we'll touch a little bit more on that towards the end of the show, but today we'll focus on our topic for today. My guest is here. This part of the California coast has several superlatives. In spring months our coast receives the highest wind speeds, the coldest sea surface temperatures, an enormous diversity of marine life including the smallest of marine life in plankton and the largest marine animal, the blue whale, and this part of the coast has perhaps the largest concentration of white sharks in the Eastern Pacific and may be the largest in size as well, but we'll have to check in with my guest today to make sure on that.

Long feared and promoted as a gruesome predator by the media, in recent years, attitudes are starting to shift and white sharks, like so many marine animals, they're hard to research and learn about because they live underwater. This specific fish has very big teeth

and they don't do so well outside of their native habitat and environment. However, there are a select group of folks that have figured out some ways to learn about this awesome ocean fish. So, today I'm really pleased to welcome Scot Anderson. He's a local resident here in West Marin and has been able to help uncover many mysterious about this fish over the last few years and has incredible experiences. So, Scot, welcome to KWMR.

Scot Anderson: Thank you, Jenny. It's good to be here.

Jennifer Stock: How are 'ya?

Scot Anderson: I'm good.

Jennifer Stock: So, about two years ago, the sanctuary and the national seashore, we chested a lecture in the red barn classroom and we had Scot and Ron Elliott, another local with lots of white shark experience in the room and the room was packed to the gills, out the doors, every square inch of carpet and I realized at the end, "I gotta get Scot on my show." And so, I take it that since you're on land right now that it's not shark season.

Scot Anderson: That's correct. It's off-season. If it was shark season I probably wouldn't be studying them out there because of the winds and everything this time of year make it almost impossible, really, to be on the water everyday. So...

Jennifer Stock: Excellent. Well, first, before we go into details of sharks, how did you first get involved in shark research?

Scot Anderson: Well, it really kind of came to me, the research aspect of things, just by being in the right place at the right time. I'd always had an interest in white sharks, especially. Growing up as a kid, the fishermen I talked to would see these big sharks and describe them and stuff and they really didn't even know what they were. They just said they were really large and so, the curiosity was there and I kept track over the years in newspaper articles and sightings and stuff like that and anyway, got a college degree and finally went out to the Farallones as a bird-bander.

It was a long process to get to there, but when I got out there, I met Phil Henderson and he stopped on the path as we were walking up to the house and he said he thought he saw a shark fin and I couldn't believe it and I said, "You really thought you saw a shark fin?" And he told me that at some point during my stay there of two weeks that come body would probably see a shark attack on a

seal or something like that, but it may not be me and that was kind of a challenge to me at that point. So, I ended up seeing quite a few in the time I was there and they said, "Well, why don't you do sharks and we'll do the birds?" And that's how it all started.

Jennifer Stock:

It started out with the birds, moving over to the sharks. Well, sharks are obviously, white sharks, are one of the fish that we focus on a lot here because everyone is so scared of them and they're such awesome animals, but there are so many other kinds of sharks in the waters around Point Reyes, in Tomales Bay, and can you give us an overview? I've heard you talk about some sharks before that I didn't realize were around here. Could you tell us some of the other ones that are around?

Scot Anderson:

Yeah. There's actually... Tomales Bay is a little bit of an anomaly on the California coast and there's a lot of different shark species and some of them aren't really found locally along the coast here, but they're found further south. The one shark I'm thinking of that comes to mind is the angel shark. Angel sharks are kind of common in southern California. They're pretty rare in San Francisco Bay and I really don't know any other bay that has them on a regular basis, but there is probably a resident population in Tomales Bay and they lay on the bottom and feed on small fish that swim over them.

So, that would be a shark that would be interesting to find out more about, but the leopard sharks are in the bay and outside the bay. I'm sure almost everybody in the local area has seen them before. There's brown smooth hounds, which often people call sand sharks. There's another larger shark that's called a seven gill. It can reach up to 9 feet. I've caught them off of Chicken Ranch Beach up to nine feet long and a couple hundred pounds. They feed on other sharks and really aren't dangerous to people, but they are quite large and they're in the Bay and as you go getting into sort of the rays and the flatter fish, you have bat rays and there's actually a rare that's pretty rare along the coast, except it's in the bay here, the thorny-backed ray, which usually you find in places like Baja and stuff.

There's a few skates. Sometimes people catch California skates here and then as you go outside the bay, you start seeing a lot of other species, things like blue sharks come into the coastal waters here in the summer. There's mako sharks that when you get out into the warmer water just offshore. I mentioned seven gills already. There's a few six gills around. So, there's a lot of different shark species and they all have a different sort of place in the

environment. They're not all out there trying to eat seals and big things. They feed on crabs and fish and things like that and they really...if people are worried about sharks, they're really not something to worry about.

Jennifer Stock: What about thrasher sharks?

Scot Anderson: Thresher sharks are found, actually, in Tomales Bay. I've seen them jumping in there and along the coast, particularly in the summer months, and they feed on small fish like anchovies and herring and things like that and what they do is they have a long tail, that's why they call it a thresher shark, and they swim in a circle around the school of fish and they slap their tail through the fish, stunning them, and then come around and feed on the fish that are immobilized by that.

Jennifer Stock: So, I guess you've got to spend all of that time out there to see these things. I've never seen a thresher shark.

Scot Anderson: Yeah. You do have to spend a lot of time out there and I guess that's one of the things that you just have to be out there. A lot of people that study sharks, though, actually work in labs and they study tissues and things like that and they don't really get the field experience, but for me, I've always just wanted to go outside and so, it works pretty well for me.

Jennifer Stock: Nice. So, we have six gill sharks out at Cordell. We see them a lot. They seem to be a bit deeper and they're always curious. They come up to the ROV or the submersible and then they take off. I think they're curious by the light, but then they're gone.

Scot Anderson: Beautiful shark.

Jennifer Stock: They are. So, one of the things that I hear about a lot as an educator is white versus great white. What's the difference? What do biologists prefer?

Scot Anderson: Great question. I'm glad you asked that. Well, biologists would prefer white shark and the genus of the species is *Carcharodon carcharias* and that's a scientific name. When you get into common names of things, you run into it with birds, the British have all these different names for birds that we see and they call a common loon a great northern diver and so common names can be a little bit frustrating, but what's happened with white shark, it's become great white shark and it's sticking now to the point where you can't shake it and, in fact, it's so bad when you keep these little baby white

sharks down in the area around...well, down in the aquarium in Monterey, they have them on display and people come up and say, "Where's the great white shark," and the person who's the docent or whatever says, "Well, that is a white shark," and I'll even heard that they'll say, "When it gets big, does it become a great white shark?"

So, people just sort of can't shake the name, but there is no lesser white shark. There is nothing else other than the white shark in the literature. That's what they're called. That's what I call them. Once in a while, I slip, but...try not to.

Jennifer Stock: It depends on what the media likes, right?

Scot Anderson: Yeah.

Jennifer Stock: Most importantly, we have these sharks...

Scot Anderson: And they are great!

Jennifer Stock: ...and people are starting to learn more about them,. That's one thing that's really changed a lot over the years from Jaws. I just read that one of the models of Bruce from the movie Jaws was just found at a dump in LA and it was like big news.

Scot Anderson: Really? Wow. It's probably worth a lot.

Jennifer Stock: He's been resurrected. So, about the research, because you've been involved with research out at the Farallones and more recently you've been spending time near shore and have found some interesting findings, but I read recently that your team....who do you work with right now in terms of shark research?

Scot Anderson: Ok. So, we're working with the TOPP Project, which is T-O-P-P, Tagging of Pacific Pelagics. So, you can go online and look that up if you want to just Google it, but it's part of a larger project that basically, they're tagging a lot of large animals in the Pacific: albatross, blue whales, elephant seals, sharks, salmon sharks, white sharks, all these different things and the idea was to look at to see if there's any kind of common thread that these large animals have to either have in common or movements that are similar or something that, sort of, makes us feel like the environment is more connected and it's a very interesting sort of quest and what we've found, the main thing that's come out of this to date is that that almost all these animals use the California bite at some point. They travel through it or they spend some time there.

So, it's turning out that the California bite, which is the area south of Point Conception down into around the Channel Islands and stuff, is a really important area and nobody really kind of knew that about these large animals. So, that's the first thing that's coming out. It's, of course, an ongoing project. With the white shark aspect, I'm working specifically with Sal Jogerenson, Taylor Chapel, and Paul Konivey, and Barbara Block and that's sort of the team.

Jennifer Stock: What are the main questions that the team is looking at right now for sharks?

Scot Anderson: Well, we've been doing a lot of different kinds of research over the years: tagging animals, photo ID work, and I'm sure we'll talk more about this as the program progresses here, but really, the kinds of questions that are left right now have to do with long-term monitoring to see how the population either changes or doesn't change as well as looking at the females and the, well, the big question is, where do they mate and what are the movements of these females because they have, apparently, an every other year cycle or even more than that and the satellite tags that we've been using in the past only last up to a year and so, we don't have that two years record yet. Although, we have a lot of information that indicates that they probably go to southern California in the off-year and pup down there. That's what we think, anyway.

Jennifer Stock: So, there was some work with the tags recently where you put in some acoustic stations to listen for these tags where they would somewhat ping any time they swam by and it was quite surprising to learn that there is perhaps some movement in San Francisco Bay.

Scot Anderson: Yeah. It's kind of funny to think about because that's exactly probably what everybody didn't want to hear is that the sharks sometimes wander into San Francisco Bay, but it's not surprising. The mouth of San Francisco Bay is a wide piece of water. It's very deep there. It's huge. It's not a small body of water. So, it's not surprising to think about them because they've been seen off Point Bonita and Diablo and there was a person attacked right in Baker's Beach, which is just outside the Golden Gate and so, really, the other thing is that where do you draw the line to the opening of San Francisco Bay?

Do you go from Seal Rocks across to Point Bonita, which, if that were the case, they'd have been seen in San Francisco Bay a lot of

times, but if you draw the line more where the Golden Gate Bridge is, then it becomes less likely to have seen them in there. However, some acoustic arrays were put down there to listen for salmon. They put these acoustic tags on salmon and each tag has a signature code to it and so, each individual can be tracked and you put these monitors in the water and they listen for these fish to swim by and when the fish swims by it records them and then later on, you can go download that data and you know where they are and where they've been and so, the people that put this array down there, they called us and said, "Well, we've seen some of your animals on our array."

The thing that was interesting about it is that they weren't all there at the same time and there was at least four different individuals that had gone through this area. So, they did travel underneath the Golden Gate and were recorded there. So, it's better than just somebody saying they thought they saw a shark. It's actually proof.

Jennifer Stock: And the mystery of where they went will remain to be seen.

Scot Anderson: Yeah and so, you know, those pictures....you probably remember the picture of the shark jumping out of the water where there's a helicopter and a guy on a ladder next to the Golden Gate Bridge. Well, that was..all those pictures are kind of coming back now.

Jennifer Stock: Photoshop.

Scot Anderson: Yeah.

Jennifer Stock: For those tuning in, this is Ocean Currents. My name is Jennifer Stock and today I have Scot Anderson in the studio here and we're talking about white sharks and the white shark research that Scot's been a part of here for many years and learning a little bit more about the shark population out here. Well, speaking of bays, I have to ask for the locals here about Tomales Bay. When I first came here about 10 years ago, I heard a lot about Tomales Bay and, you know, you swim there and people are like, "No! There's sharks." And, well, of course there's sharks, but white sharks in Tomales Bay? What's the myth? What's the fact?

Scot Anderson: Well, ok. So, it's kind of a...it's been a long road to hearing about the breeding ground of the great white shark, they always throw great white in there as well, being in Tomales Bay and I heard about it from when I first started getting interested in white sharks and I still hear it and I still hear it from people who are overseas, you know, English people and stuff like that and so, it's a rumor

and I believe that the rumor has been created out of several facts being put together that don't add up, kind of like the way that Jaws was written.

There was different little scenarios and then they put it all together into one story. So, here's the story: There were more people attacked off of Tomales Point back in the sixties and seventies and eighties than anywhere else in the world, attacked by white sharks, than anywhere else in the world. So, the world famous shark attack spot. Then, inside Tomales Bay, there's lots of small sharks, these different ones that I mentioned earlier, the leopard sharks and things like that. Some small white sharks were caught in Tomales Bay years ago when they used to use these tremble nets to catch white sea bass and things like that.

So, there is evidence that they've come in the Bay, but there is no evidence of any kind of breeding ground or any large population coming in and staying in the bay. They are right outside the bay on an almost daily basis in the fall into the winter and they use that area and that's where those people were attacked. In the Bay, it's a whole 'nother scenario and I believe that basically, there could be another shark that's called a salmon shark...looks like a white shark, it's reported as a white shark every time one washes up, and they tend to strand here and wash up in morbid condition, dying, or dead on a pretty regular basis and we get as many as six or seven in one year.

So, you've got these little sharks that look like white sharks, they wash up dead, you've got big ones biting people off the point, and I think it's just kind of all came together into this story. Well, it's a breeding ground and once a story gets printed or told, it just keeps going.

Jennifer Stock:

What about inside near Clam Island and Dylan Beach area? Is it possible in the Channel there?

Scot Anderson:

Yeah, actually, it is possible and not only is it possible, but there's been a recorded attack on a seal there where the people on the clam clipper saw blood in the water and it was actually somebody up on the bluff that was watching to see a seal disturbance by the clam clipper and kind of watching everything and they saw it as well.

So, it was confirmed by more than one group. So, apparently, a white shark kind of just, you know, decided to come into the Bay there and saw a seal right there off of where they haul out. So, it can happen, but the further up the Bay you go, the less likely to see

one, and like I said, around the corner just off bird rock and Tomales Point and Bodega Head and into Point Reyes, almost every day during the fall and winter and that's where they really spend their time.

Jennifer Stock: So, fall and winter are the months. Is this because of elephant seals here on the coast or what's the seasonality?

Scot Anderson: Well, we don't really know exactly why it's the fall and winter, fall into winter. There's a bunch of different ideas. One idea that I think is important is water quality. The water in the fall into winter is relatively clean, clear water. White sharks are a visual predator. So, they're better able to see their prey in that kind of condition. They also, at the end of the breeding season for all these seals, the elephant seals, California sea lions, and harbor seals, they're at their peak number and the pups, instead of being little scrawny things with no fatty layer, are full grown, you know, not full grown, but they're at their full size in their fat and there's something to eat there.

So, you put together the total number of pinnipeds or seals and sea lions that are in the area along with good water quality and then the other half of the sharks life, which we don't really totally understand, but they do go offshore and there's got to be a component to that, a timing of that. So, there might be a reason why they do that then to go offshore, but it definitely is the most productive time to be feeding here, would be into the fall and early winter.

Jennifer Stock: It kind of overlaps with... I guess it depends on what time of fall, but usually the fall months, we also get some of the warmer waters from the Davidson Current along the coast.

Scot Anderson: Yup.

Jennifer Stock: Maybe more people swimming, but those die-hard surfers, they're year-round. So...

Scot Anderson: Yeah and there is a phenomena where more are seen in the fall than in the winter even though there are probably just as many here in the winter because there's more people out and you just can't help but realize that where people are and the sharks are, they're going to see them more likely than in other places.

Jennifer Stock: Speaking of people and what not, one of the studies that you did starting at the Farallones, I think, was doing a couple of different

types of decoys and determining how sharks react different to different decoys. Could you tell us a little bit about that and caller on the line, we're not accepting calls, unfortunately, but please do keep listening.

Scot Anderson:

Yeah. Well, the way it developed is, again, was just got on the island there and I was sitting...there's a window that faces to the south and this beautiful view looking out the window and, you know, everyone sits at that desk and looks out there, and I happened to be sitting there in the evening just before dark and I saw a log just bobbing along and this shark came right up from underneath it, rolled on it, and swam away and, of course, I ran all the way down there thinking I would see it again, and I didn't because it was just checking it out, but it sort of, it just made me think, "Why did it check out the log, you know?" Why would it do that? And then I started realizing that, well, maybe they're a visual predator and looking at things.

So, I made this decoy that looked kind of like a seal. It wasn't really that well-made and I just put it on a fishing line and the wind blew it out away from the island and put it out for two hours and nothing happened and I put it away and the next day I did the same thing and out of the corner of my eye, I saw the shark jump out of the water and attack the thing. And so, I was like, "Wow. That was pretty interesting." Unfortunately, the thing I made was made out of like, a pool toy, that popped it right away and ruined it. So, yeah, I had to make another one.

So, finally, I got to the point where I was getting tired of rebuilding things and trying to make new things and new designs and all that stuff. So, I just tried a surfboard and it worked as good as anything and was the easiest thing to put out and bring back in. So, I used those for a while and the results were pretty impressive. The sharks really thought it was a seal and would come all the way out of the water to attack this thing and usually the board would just bounce out of the way because they hit it so hard and they rarely would come back and bite it a second time.

They usually just figured it out and then, as the season progressed, the more they would see it, the less they were likely to bite it as well, but because their nature is that they have to capitalize of every sighting of a seal, they can't just say, "Oh, it is a seal, it isn't a seal." They are thinking, "It's a seal." They sort of are committed at a certain stage. So, that's when they just keep going and bite the thing.

Jennifer Stock: Now, is this...these are the adults right, that eat mammals?

Scot Anderson: Yes.

Jennifer Stock: ..and the juveniles eat fish too?

Scot Anderson: Pretty much.

Jennifer Stock: ...or do juveniles eat mammals too?

Scot Anderson: Well, I think that if there was a dead whale on the bottom of the ocean and a juvenile was there it would probably feed on it, but no one's ever documented that. The main thing about the juveniles is that they really are in the areas close to shore where there's fish. They have smaller teeth. The teeth are more narrow and designed, actually, more like what you would see in a mako's mouth, which is a fish eater, and then as the animal grows larger, the teeth get wider and are what we sort of think of as white shark's teeth with those big, broad triangle, really good for taking big pieces of flesh out of marine mammals, basically.

So, there really is a difference between the little ones and the big ones. The little ones don't bite people, in general, and they're not feeding on seals and sea lions. They're feeding on fish and then at around, I was going to say ten years...that's not right...ten feet or so, they start to switch over to marine mammals and the one group that we really don't know very much about these days is that intermediate group between the real adults, the big ones, let's say, anything over twelve feet and then anything under eight feed.

There's this sort of gap there in what those younger animals are doing. The small ones that they've been keeping in the Monterey Bay Aquarium these days, those, they're starting to understand their movements and stuff like that because they've been able to put quite a few satellite tags on them and they can see how fast they grow in the aquarium. You can really do a lot of interesting things. So...

Jennifer Stock: Yeah, it's been amazing, what they've been able to accomplish there. Did you go to see any of them down there?

Scot Anderson: I haven't been to see any of them yet, but I went to see Sandy, the one that they kept at Steinheart for...I think it was only in there for a week or whatever, but that was...yeah, I stood in line for two hours to get in there to see that.

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- Jennifer Stock:* That's great. I think it's been fantastic for the public awareness about sharks and...
- Scot Anderson:* Yeah, it's been a really good program, what Monterey is doing. They're very aware of what the public is sensitive to and they really are open about what they're doing and how they're doing it and why they're doing it and the public has responded very positively from that. So, it's good.
- Jennifer Stock:* That's cool. So, with the sharks at the Farallones, there's this red triangle that people talk about, The Farallones, Ano Nuevo, and Point Reyes Region, because those are the three main areas with these elephant seals, but how many sharks have you seen between the Farallones and Tomales Point? Is that about like a regular area back and forth or are they distinct, stay at the Farallones, stay at Tomales Point?
- Scot Anderson:* You mean, like a shark from the Farallones, how often would it swim over to Tomales Point?
- Jennifer Stock:* Yeah, do they go back and forth?
- Scot Anderson:* Not really. There is some movement and there could be a shark that, let's say, shows up at Tomales Point for a couple of weeks and then moves to the Farallones and then stays there for the rest of the season, or you could see one actually be at the Farallones, bounce over to Point Reyes, and then bounce back to the Farallones, but in general, the ones that we see at the Farallones, they kind of are part of a group that is distinctive for the Farallones and that we're seeing the same sharks show up to the same site year after year and we have a record now of one that was 22 years.
- So, yeah, 22 different years... well, not different years, but up to a 22 year span and, you know, in some years we didn't see this individuals, but it's pretty impressive to see the site fidelity. They really do like certain spots and the Farallones has really got to be the hub of the mature population and the reason why I say that is that you can see an average of an attack a day through the fall there in October into November. One per day on the average, might not see one for a couple of days, but then you might see three in one day on a regular basis, almost every fall. So, they're feeding there on a regular basis and you can see it and it's the same group of sharks year after year.
- So, it's a pretty, I think that the mature, big population of animals use that as, like, the hub is the best way to describe it. They do go

to these other places and there are large sharks that are regular along these coastal places like Tomales Point or Duxbury reef or Bodega, but anyway, yeah. We don't know everything.

Jennifer Stock: So, I'm assuming you know a lot of these animals and you have...you can determine, "Oh, so and so's back this year," and, "So and so..." Is this by photo IDing and video in terms of, like, looking for visual cues on them, scars and what not?

Scot Anderson: Yeah. Certain individuals actually have certain behaviors where they'll circle the boat left to right rather than right to left. Some of them will go under the boat. Some won't come near the boat. So, there's behaviors, but the main thing is that the dorsal fin is what we use as a standard to identify an individual and the one that I talked about earlier that was 22 years, that dorsal fin has really not changed at all.

Of course, the shark has gotten a little bit bigger, first was thought to be 12-13 feet. Now, we see that we think it's about 15 feet, but there's still some that are bigger than that. So, yeah, the dorsal fin is the main thing, but there are some that have huge massive scars on the side of the body or a cut tail and those are really easy to identify. So, you know, when we see one in the field and we identify it in the field, it's like seeing an old friend. It's a pretty amazing experience.

Jennifer Stock: That's cool. Do some not come back one year, but then they come back another year, like, they might have gone somewhere else?

Scot Anderson: Yeah. There's ones that skip a year. The females, like I said, they usually have a pattern of every other year and so, yeah. It could be, on a season that we don't see, that we just didn't see them and they were there, but we don't see them and so, we've started to learn that also from the acoustic tags, the acoustic tags you can put on them and then the next year it's still on there when they return, it's picked up by the receiver.

So, you don't even have to see it to know it was there and that's really filled in a lot of the gaps because the photo ID work, you only get a photograph when there's a shark there and you're there and we're not there every day just because of the weather alone. So, we've kind of filled in the picture with the satellite tags and the acoustic tags and the photo ID.

Jennifer Stock: Cool. Well, we have to take a really quick break, I promise it will be really quick. This is so fascinating. I can't believe it's 1:30

already, but we do have to do a quick station ID and announcement and we'll be right back. We'll talk a little bit more about this satellite study. So, those of you tuning in, this is Ocean Currents and my name is Jennifer Stock. I have Scot Anderson in the studio with me today, who is a shark researcher and has been working off the coast here for many years and is filling in lots of details about this mysterious animal for us. So, stay with us. We'll be right back.

(Music)

Jennifer Stock: This is Jennifer Stock and I have Scot Anderson in the studio with us today. You're listening to Ocean Currents and we're talking about white sharks, mainly around the Point Reyes, Farallon Island region, but Scot's been studying white sharks off the coast here for how many years?

Scot Anderson: You know, I lost track, but I'm guessing since that shark that we've had for 22 years. It's probably be about 23 years now.

Jennifer Stock: Wow. 23 years. So, there's lots of long-term information in Scot's mind, but one of the technologies that's really changed in the last few years is satellite tagging and that's something that you've been a big part of and what has some of the satellite tagging information produced in terms of new information for the sharks around this region?

Scot Anderson: Yeah. Okay, well, the sharks disappear every year, they did, in a way, sort of mystify us. Where did they go? And I used to have this theory that they moved around California, you know, I'd take sightings and say, "Oh, well, look. They're down there now and now they're up here," and try to make a map of some kind of movements and it never really worked out and then one day I saw a small remora on one of the sharks that had just returned and I thought, "Wow. We don't have remoras around here."

A remora is a small sucker fish that will attach to whales and dolphins and sharks and then they don't hurt the animal. They feed when the animal feeds and then they re-attach. Anyway, it was surprising to see that and so, it made me think maybe they go offshore and so, anyway, when we put these satellite tags on them, we found that they do go offshore and we found out they go to a place that's... we call it the cafe, and it's a place that's between the tip of Baja and Hawaii and people always say it's the size of Texas, but let's just say it's the size of Alaska or California.

It's really big...big place and the sharks all, well, most of them go there. The other place that some of them go is through the Hawaiian chain, right? The main islands about 500 west of that or south, actually, southwest and then they hang out in that spot and when they're at these places, we know that they go deep and they do a lot of bounce diving instead of going horizontally, they go vertical up and down, up and down, up and down and at first, when you look at the data, you think there's something wrong with it or it can't be a fish, but it turns out that a lot of these pelagic fish do this.

The ocean is more dynamic going up and down than it is sideways because you have changing temperature and you're going through the, well, there's a place called the deep scattering layer. So, there's food there. Most animals, it turns out, in the big open ocean there in the water are going up and down rather than sideways.

Jennifer Stock: So, that's totally interesting to me. I know Humboldt squid do something similar, but go even further to the oxygen-limited zone, something like that.

Scot Anderson: The sharks do that, too, sometimes. They get down into there, which is hard to believe.

Jennifer Stock: Now, that's actually something I heard about recently. Another shark research out of southern California was talking about this region where they go into and there's also squid there. Any link there? Squid doesn't seem like the food source for sharks?

Scot Anderson: Well, there's two theories out there right now. There just was, in Hawaii, in...what was it...January, there was a symposium on white sharks and the last one was 15 years before that. So, it was long overdue, but all the people from all over the world that study white sharks got together and told their stories and it was a really good symposium, really well-produced, and a lot of really interesting things came out of it. Almost all of the populations now are identified and people know where they're going, north, south, all that kind of stuff. So, it's really good. All this technology with these tags has really advanced what we know, but now I forgot what I was talking about. I got off the subject.

Jennifer Stock: What were we just talking about. We were talking about...

Scot Anderson: Oh, the different research groups. Ok. So, the people that are studying the sharks at Guadalupe Island believe that the sharks are breeding along the coast at these sites where we know them like

the Farallones and Guadalupe Island, and Ano Nuevo and Tomales Point, that they actually use those sites as breeding areas and that's where the mating takes place and then, they go offshore and they call this "offshore zone" and we call it the cafe and I'll just explain, the reason we named it that is because it left the two options open. One is they could be going there to get something to eat or they could be going there to socialize and so, that's why we called it the cafe, but they called their place the sofa.

Jennifer Stock: Sometimes there's sofas in cafes.

Scot Anderson: There is and there was a few jokes about that at the symposium, I'm sure, you know? It was very funny, but basically sofa stands for shared offshore foraging area. So, in that name, it already implies that there's some foraging going on and the shared part is that our sharks and their sharks all go to the same area together and meet out there. So, our group thinks that they probably breed out there and that there's...the reason they're going out there is probably socializing or breeding behavior and that they're here along the coast to really feed and there's an abundant, rich food source and stuff like that. So, we'll see, but the paper has been written. The hypothesis is out there that they're breeding at these seal colonies and we don't see any evidence of it, but that's what they've put out there. So, you know, there's still things to figure out.

Jennifer Stock: Well, it's interesting because white sharks, you know, they're underwater most of the time unlike humpback whales that come to the surface. We can see them and we know these distinct populations and where they overlap, and where they breed, and where they feed, and it's kind of interesting to think about the same type of thing with white sharks that there's these distinct populations maybe all going to that same region, but one of the things I recently read, it's one of the top program outcomes from one of the studies was the genetic distinction between the white shark population here, that it's actually distinct from the other ones.

Scot Anderson: Yes. Yes it is and at the symposium, a woman who is a geneticist broke down the genetics from all over the world of white sharks. She got samples from all the different populations and working with Taylor Chapel here on photo ID population estimates, he came up with a number that's between 250 to 300 animals, these are adult white sharks, along the central coast here and the genetics came out to around that same number and if you look at the genetics, I don't know anything about how it really all breaks

down, but when you look at it, they almost look like brothers and sisters. So, we have a small population here and most of the populations in the world are small, with the exception of the South African population...seems to be the most robust.

Jennifer Stock: So, is this probably one of the larger concentrations here in the Pacific is this part of the coast? I mentioned that earlier, but I was kind of taking a guess, but I wasn't really sure.

Scot Anderson: In the Pacific I would say probably. Fishermen sometimes catch large white sharks in Japan, but there's no real concentration like what we see here. Yeah, really, the two main places these days are the central coast of California and then this Guadalupe Island. They've identified over 100 sharks that keep returning down there as well.

Jennifer Stock: Has there been any changes in population that we know about here for this population here? Obviously, we probably didn't have any baseline numbers, but in the 20-something years you've been here, have you seen an increase or a decrease or a stable population?

Scot Anderson: Such a good question and it's so hard to answer because there isn't any past record and really, you're guessing at that point. You really are guessing and the thing that's changed in perspective of people that are on the water, people surfing, you know, Salmon Creek has become this hot spot for shark attacks on people. Well, it used to be a surf spot that only had a surfer once in a while. Well, now there's people surfing Salmon Creek every single day and that's probably why there's so many incidences with the sharks there.

The sharks have probably always been there, but you just put the people into the mix. So, things have changed. There's more people fishing these days. There's more intelligent people out there as well. People that are looking at animals and identifying them. It used to just be you saw a shark, it was a story, and it just faded away. So, it's so hard to tell, but from my experience. I would have to say that the population is pretty much staying the same. I see the same sharks year after year, I haven't seen any big increase. I haven't seen any big decrease either. I think if the fishing that used to take place here, they caught anywhere from 1 to 5 sharks, white sharks in a year, and so, it did have an impact, but probably...we've probably come back from that impact.

Jennifer Stock: That's a question I wanted to ask, actually is when did we, or was it the state, I guess, that passed a law: no white shark, or is that

international? Is that national, white shark fishing...ban on fishing them?

Scot Anderson: It's...okay. So, the key thing is that white sharks are now considered a CITES species.

Jennifer Stock: What's a CITES species?

Scot Anderson: CITES, Conference for International Species, something, something. I really don't know what it breaks down to, but what it is, is the control of movement of parts of those animals. So, if you buy a white shark jaw in Cabo San Lucas and you try to go across the border, they're going to take it away from you and you could get fined. It'd be like coming back with a whale skull or something.

So, it puts them in a protected status internationally, but they became protected here in California in 1993. There was a threat at the Farallones. There were some fishermen trying to catch some and the place had a history of fishermen catching white sharks and, in fact, four were killed there in one day and that was back in 1984 and after that, the number of sightings of sharks had gone down and we do know that in any one given day, there might be ten sharks there. So, if you take away four, you're going to impact the number.

So, there was one more that was caught, again, just before this law went into effect and then there was other people trying to catch them there. So, no user group, no surfers, no fishermen complained about this law. Everyone was for it. So, it went through without anybody....nobody was against it.

Jennifer Stock: Yeah, I remember growing up, I grew up on the east coast on Long Island. I remember going out to Montauk and there'd be shark fishing tournaments. It's interesting. I don't think that happens anymore.

Scot Anderson: Yeah. It happened here. There used to be the Tomales Bay shark and Ray derby over in Marshall and when I was about fifteen my dad took me over there and the idea was, back then, was to remove these sharks and rays from the bay so they wouldn't eat the oysters and I don't know if you've seen the old oyster fences they used to have where they put a bunch of sticks in a row and that was to keep the sharks and rays out.

So, they would have this shark and ray derby and people would go out and catch bat rays and I gotta thank my dad for taking me there because it wasn't his kind of event and it was a pretty weird scene. There was fishermen coming in constantly with bat rays and there was one seven gilled shark there, but the rest were all leopard sharks, bat rays, and they filled up two rendering trucks full of these animals and, like I said, my dad took me there to see the sharks and I saw...it was interesting to me in one way, but it was also pretty amazing in the other. So, that's not happening anymore, but it just goes to show you that we're living in a different time. So, it's good.

Jennifer Stock:

Well, that's good to hear. I terms of tagging, it seems like there's been a lot of ethics. I get a lot of questions about this because I do a lot of education regarding seabird tagging and people always ask questions about the ethics of putting these things on animals. What is...there have been some issues about that recently and what are your thoughts on that in terms of getting more information?

Scot Anderson:

Well, it...okay. So, yeah, the tags, when they go in the animal, it's a small harpoon dart. There's different types of tags and different ways of applying them. The ones we put on are put on with a harpoon dart and what we've noticed is most of these work themselves out within two years. Occasionally one is in some cartilage in a dorsal fin or something like that and stays long, but actually, it's been one of the problems in tag shedding is that you put out all these tags and you think you're going to get a good record for the next three years and if half of the tags fall off or come out, whatever you want to call it, it makes it harder to see what's going on.

Then, the satellite tags, we're not using satellite tags anymore because we already...they're so redundant. We know where they're going and where they're doing that and stuff and it's just really, it would be no reason to continue to do it. There's a new kind of tag called a spot tag that some scientists from Guadalupe are putting on and other scientists in other parts of the world and what they do is they have to capture the shark.

So, they hook and line the animal and they tire it out and then they confine it in some way. Some people use a big tube that the shark is sort of fed into or led into and that immobilizes the shark long enough to drill some holes in the dorsal fin and bolt this tag on to the fin. The advantage to this tag is that it can last anywhere...well, they really don't know how long they're going to last because it's a new generation of tags, but they say they can last up to six years. I

still think, even if they get three years out of it, that it's going to be interesting.

So, this could help solve some of the mysteries about the movements of the females and stuff like that. The problem is it's very controversial. There's a great effort put into not hurting the shark, but when you hook an animal there's always a chance of injury. The people from Guadalupe are actually lifting the animals out of the water on a huge lift and once they're out of the water, if they're tired, they just don't even move. They just lay there and then the guys take their samples and do the thing they're doing, put the tag on, and let it go. And they say they're had 100 percent success. None of the animals have died.

So, anyway, at the symposium it was controversial, lots of people against it, a lot of people for it and I think it's just going to work itself out in the long run to see what the data is really like, if it really tells us anything that we don't already know. So, that's kind of where it's at right now.

Jennifer Stock:

So, this would help determine where the females are going and that's the big question in terms of breeding and offshore.

Scot Anderson:

Yeah, and like I said, we do have some records that are pretty good. We put a tag on a female shark that had some maybe 2-3 month old mating wounds on her head at the Farallones one year and that next season, the tag came off right at two harbors at Catalina Island and Sal actually went down there and found the tag, which is not easy to do. He got the tag back. So, we got all of the data points from that and that's the pattern we expected, actually, was one year they come back to the Farallones to feed or along the coast here. They go back out to this cafe and then when they come back the next year, two-year cycle, they're ready to pop and they go to this California bite to give birth and that's what we think they do. So, that was a good record because it showed that, which is what we wanted to see.

Jennifer Stock:

And this is all really recent information in terms of what we knew about sharks. This is within the last 15 years, really, that we're starting to get a picture. This technology is really helping us advance a whole lot more understanding in terms of animals and what not. In terms of the future for research and what's happening now, is there, are there any new focuses that you see coming in in terms of questions about the sharks?

Scot Anderson: You know, there's always going to be something new to find out and there's always some questions that haven't been answered appropriately and one is where do they breed? That's a big one and it's kind interesting that there's two groups that thing two different things and you would think it would be a little more obvious, but it's not. So, I think the thing that's going to come soon is just going to be long-term monitoring at these, they call them hotspots, these different places where they're known to be and looking at how stable the population is and how long these sharks actually live.

That's kind of where we're going. There's a few other things that you could look into energetics, how much food would it take to keep a shark going, things like that. So, there's still stuff out there and we'll just have to see. Like I said, with these new generation of tags, what they're finding out and where that leads people. The one thing that I think people should put more energy into is to look at a tag that does the same thing that these guys are doing, but isn't requiring catching the animal and there is a possibility. There's people that have actually studied whale sharks and they go down with this tag, it's the same kind, it's a spot rage just like what these guys are putting on, but instead of bolting it on to the shark, it's on, like, a little clamp, like a little bear trap type clamp.

When it springs it stays closed and it stays on the fin. Of course, you have to place it properly and all that, but it snaps on to the fin and just stays there as long as there's tension and then it should have some kind of timer or two-metal metal link where it dissolves eventually and falls off. That's the idea. So, I believe that...or, the other thing is these satellite tags, the ones we've been using only last one year. Well, they could make one that's twice as big with twice as long of a life with a bigger battery and stuff and then we would get that two-year record. So, I think that's kind of where we're going to start looking into developing some kind of tag that's less detrimental to the shark, period, and give us more information. Otherwise, we're probably just going to continue to monitor the population like we are.

Jennifer Stock: That's good. What are some of the bigger concerns for white sharks in the future here with some of the big doom and gloom questions we have with climate change and plastics in the ocean?

Scot Anderson: 50 million years they've been around. So...

Jennifer Stock: Hopefully they can adjust something?

Scot Anderson: ...I think that the climate's changed a few times. Yeah, they'll be around. You know, there's going to be, if the climate changes radically, there's going to be shifts in pinniped populations and salmon populations. Everything is going to move around, but I just don't see this scenario where the water warms up and everything that was there dies and everything north of there is fine. It's more like everything is going to shift. Things are going to move more north. We may have less salmon in the future and more tuna, that kind of thing if the water is warmer, but things are going to shift and move around because a lot of these animals have been around through these changes before and they may not be as extreme and as fast, but things have survived. So...

Jennifer Stock: Last question because I have a couple of other announcements to finish this show off with, but what would you want people to know? It seems like, yes, we've changed our attitudes, for the most part, and again, I'm probably pretty naive saying that in terms of sharks. We still have Discovery Channel Shark Week and what not promoting this hype in media, but what do you think is the most important thing we can do to help sharks maintain their populations and to come back. We've got some global problems with shark finning and fishing in other countries, but what do you think we can do here in the United States to help promote conservation for them?

Scot Anderson: Yeah. That's a really good question, Jenny, and I would have to say that if you look at the history of the white shark and the way it's gone, if we could deal with every shark species the way we've dealt with white sharks, then we would have success because white sharks were demonized, you know, Jaws was about white sharks and there's all this really bad press and people get attacked. It's just terrible. People die, it's just a sad thing. It's a tragedy, but people in California admire their white sharks and they love them, basically is the way I perceive it.

So, you have an educated population that's gone from demonizing white sharks to actually, you know, they take their little kids to the aquarium and everybody loves white sharks. So, it's changed and if you could do that with blue sharks, mako sharks, tiger sharks, and all these other animals that are the ones that are being targeted or actually depleted and people might have more of an appreciation for them because each species has its unique interests.

So, you know, if you see a blue shark, right away most people are in awe. They're just beautiful. I think that's what people need to do is just hear more about what they're really all about and not just be

afraid of them. The word shark...I like your introduction to this whole thing. You kept calling it a fish and it really is a fish and it's a great fish.

Jennifer Stock: Well, thank you, Scot, so much. This is amazing. I feel like I actually got all these questions in. I'm really impressed because I'm like, "There's no way I'm going to get through this." So, thank you so much for coming in. I'm glad I caught you during non-shark season and I really appreciate it.

Scot Anderson: Thank you, Jenny. It's been great being here.

Jennifer Stock: Thanks so much and good luck on the water this year.

Scot Anderson: Okay. Thank you.

Jennifer Stock: Just stand by a little bit. I do have a couple of other announcements here to share before we close up the show here and make room for Mr. Rick Clark. As I mentioned, June being a big month, we've got World Oceans Day happening tomorrow and what is this? It's kind of like Earth Day, but in 2008 it was officially recognized by the UN General Assembly by a resolution that was passed and it's an opportunity to promote the need for more awareness about the ocean, the dominant habitat on our planet.

So, if you get online, there's a series of events happening all over the world to help promote some basic awareness and I'm considering this my World Oceans Day celebration. It's a good topic. So, we'll get this up on our podcast as soon as possible and a couple other things: Jacques Cousteau, I don't know...I...the 100th anniversary really kind of set me back in terms of thinking about the impact of this person and what he brought to us in terms of getting us underwater and showing us things that we never knew about through the technology of the aqualung and scuba and if you have a chance to Google up a little bit about Jacques Costeau, it's amazing, this internet stuff, learning about his life and what he did. His kids today are still promoting ocean conservation, but I would like to get to some of these old films and check these out. Did you ever see these films, Scot, when you were growing up.

Scot Anderson: Yeah, in fact, I couldn't wait to hear the music and he's a real hero of mine. I went and saw Filipe give a talk. My dad took me again. My dad's my hero, as well, but yeah, just what an inspiration. The guy was amazing. He came up with some incredible stuff and you know, scuba is just something we take for granted and he pretty

much invented it. So...loved the ocean and he predicted a lot of the stuff that's actually happening in the ocean today. So, great guy.

Jennifer Stock:

Yeah. So, if you have a red beanie and you can promote Jacques Cousteau tomorrow or the 11th, find a little red beanie, you can walk around, and talk about Jacques Cousteau and help celebrate him on his 100th birthday. Last thing I want to bring up because we gotta get out of here, but the Gulf of the Farallones and the Cordell Bank sanctuaries just released a report that Scot actually touched on earlier. What's going to happen with climate change?

And there was a working group set up with a lot of scientists in the area here, our sanctuary advisory councils, and staff that compiled information of what they think will happen in this region here in the marine ecosystem with climate change in the future and has a series of outcomes that are very interesting to read. It's all online at farallones.noaa.gov. So, I hope you'll take a look at that. It's really incredible, the group of scientists that contributed to this and it will really help create new programs for us for how to deal with these things and best prepare for the changes that could come.

We're already seeing some of the changes with Humboldt squid and grey whales and bottle nose dolphins, the northward shift of the volcano barnacle...it's a rather large barnacle. It looks like a volcano and it's moving up the coast and I never, you know, the inter-tidal zone is showing impact to. So, it's very, very interesting. Check that out at farallones.noaa.gov, but I'm going to wrap it up here today on Ocean Currents.

If you want to tune in for past shows of this program, you can come to the Cordell Bank National Marine Sanctuary website at cordellbank.noaa.gov. You can listen to the shows live there or download a podcast and subscribe to that for all the shows and we'll definitely get this one up there as soon as we can and we'll be back next month with another program. Thanks so much for tuning and thanks again to Scot Anderson.

(Music)