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!

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Jennifer Stock: You're listening to Ocean Currents. My name is Jennifer Stock. On Ocean Currents, we delve into the blue, watery part of our planet and highlight ocean-related topics. We talk with scientists, educators, explorers, policy-makers, ocean enthusiasts, ocean adventurers and more trying to uncover and learn about the mysterious and vital part of our planet. I bring this show to you from NOAA's Cordell Bank National Marine Sanctuary. Cordell Bank is one of four special areas in California waters that are part of the national marine sanctuary system. The sanctuary is located just offshore of the KWMR listening radius off the Marin-Sonoma coast in California.

Today we'll be exploring the recent abalone die-off that resulted from a red tide event on the Sonoma Coast just north of Point Reyes. My guest is Laura Rogers-Bennett who works as a senior biologist specialist with the California department of fish and game and the University of California Davis Wildlife Health Center and she has been monitoring this area of the coast prior and after this event and has been very closely involved with learning what's going on and what to do. So, we'll be back in just a moment talking with Laura. Please stay with us.

(Music)

Jennifer Stock: Oh, hello. This is Jennifer Stock and you're listening to Ocean Currents. That song gets on your brain and you want to keep singing it. We're going to be talking about abalone today. Welcome back and if you've been paying attention to the news in the last few months, you've heard of a recent event that has led to a localized abalone die-off on the Sonoma Coast. It started in late August and lots and lots of abalone and other invertebrates were washing up on shore. So, we're going to talk a little bit about this event today. My guest is Laura Rogers-Bennett. She is a senior biologist specialist with the California Department of Fish and Game and the UC Davis Wildlife Health Center. She focuses on addressing processes that impact marine populations and communities then applying these findings to fishery management and marine conservation issues.

Her lab works primarily with benthic, that's animals on the sea floor, marine invertebrates inhabiting nearshore rocky-reef ecosystems. So, Laura, I'd like to welcome you to Ocean Currents. You're live on the air.

Laura Rogers-Bennett: Well, thank you for having me, Jennifer.

Jennifer Stock: Thanks so much for making time. I know you're really busy this week and this is a great opportunity to talk about this event that's so close to Point Reyes. So, first, just before we get too far into it, this position that you have is a joint position with the state of California and University of California Davis Wildlife Health Center. How are these two organizations linked up in terms of the type of work that you do?

Laura Rogers-Bennett: Well, I'm a biologist who works with the California Department of Fish and Game and that is my position and I have an adjunct position with UC Davis and so, I'm able to work with a lot of the staff and resources there as well, but we have a number of different groups that work on the ocean and I think that having those different groups and the resources that they bring to bear really helps us with our work. As you know, trying to work out on the ocean is really not a one-person adventure. You need ship time, you need scuba, surveys, and you need a lot of equipment. So, that's...those are the kinds of things that we've been doing on the Sonoma Coast.

Jennifer Stock: That's great. So, you specialize in the nearshore environment, the rocky-reef habitat area, and you've been also working very closely on the abalone issue, but can we talk a little bit about first, about abalone in general? We have had lots and lots of abalone in our historic past in California and the populations have really changed a lot, but can you talk a little bit about the species that we have and what is the most prominent species that we're working with now as a recreational fishery on the Sonoma Coast?

Laura Rogers-Bennett: Yes. A lot of people don't know, but we have seven different species of abalone on the California coast and some of them are endangered. Some of them are species of concern and some of them are doing quite well and we have fishery, recreational fisheries for them. So, the northern California area, we have the red abalone and that, north of San Francisco, they support a recreational fishery that we've had for many, many years. It's been a sustainable fishery and we have free divers that go out and are able to fish. We have a number of important regulations on that

fishery including bag limits, daily bag limits, yearly bag limits. We have size limits and season-closures.

So, all those different regulations have been in place and they are functioning to help us maintain that fishery. In southern California, we have a number of species that were once fished both recreationally and commercial. We have pink abalone, green, white, threaded abalone is a subspecies of pintos and those are all in the south. Those are not able to be fished right now and some of those are very low densities.

White abalone, for example, is one of our endangered species in California. It was the first species to be put on the endangered species list that was a marine invertebrate. Shortly after that, we listed as endangered, the black abalone and those are a very shallow inter-tidal species and those are also at very low, critically low densities. So, we have a range of species in the state and there is a range of population conditions, some doing well and some in need of help.

Jennifer Stock: Great overview. For listeners that aren't too familiar with what abalone is, it's basically a large snail with a big outer shell and, you know, wider than your hand typically, I guess if you stretch out your hand...and the colors of the shell, is that related to the diet of algae that they eat since they eat algae as their primary diet?

Laura Rogers-Bennett: Yes and it's also related to which species they are. So, for example, the red abalone along the north coast and in the colder waters in central and southern California. That species is actually the biggest species of abalone in the world. So, we can boast the biggest species of abalone and it has a beautiful brick-red color that it gets from its diet, which includes some of the large mackerel algae, like kelp, giant kelp and the bull-rip kelp that we have in northern California as well as some of the short-red algae that it eats and when it eats the short red it develops this beautiful bright, brick-red coloration.

Jennifer Stock: The species in southern California, have they become so low in number and endangered because of over harvesting by humans or what were some other factors that would influence those populations?

Laura Rogers-Bennett: Yes. So, in southern California we had very active commercial and recreational fisheries and in 1997 those fisheries were put together and they were over harvested and once those over harvestings took place, in '97 they closed those fisheries.

Jennifer Stock: Yeah. I've seen pictures of just piles and piles and piles of these shells in the past. We don't see that anymore.

Laura Rogers-Bennett: No.

Jennifer Stock: Obviously. Now, there's also…have you worked on the withering foot syndrome? This is an issue that kind of took place in the nineties and I haven't really heard too much about it recently, but this is a syndrome that affected the size of the snail's foot, the abalone's foot. It really was hurting these populations. Is that something you were working with as well?

Laura Rogers-Bennett: Yes. We have a researcher here in the lab where I work at the Bodega Marine Lab who has done a lot of work with the withering syndrome. Withering syndrome is caused by a bacteria in the water and that bacteria is now endemic, south of San Francisco and that bacteria infected into the abalone in conjunction with warm water can bring on the onset of this withering syndrome, which is a disease of abalone where they…the foot muscle withers up and the animal dies fairly quickly.

So, that withering syndrome needs both the bacterial infection and the warm water to trigger the disease. So, you can have populations that are infected with the bacteria that don't succumb to the disease, if they're living in the cold water. So, some of the laboratories here are tracking this northern spread of bacteria and it has slowly been moving north through central California up and most recently, it's been found just south of Point Reyes.

Jennifer Stock: So, is it endemic only to abalone? Could this spread to other mollusk animals that are snails or limpets?

Laura Rogers-Bennett: No. We haven't seen it in other species. It seems to be fairly specific.

Jennifer Stock: It's so interesting. I just find that fascinating that...

Laura Rogers-Bennett: Yes, it's another threat to abalone populations, which we need to consider in the management of the species.

Jennifer Stock: Yeah. I can imagine with the climate change, temperature changes, and habitat range shifts of other species, this could be just one more thing to add to the list of things that could happen.

Laura Rogers-Bennett: Yes.

Jennifer Stock: For those tuning in, this is Jennifer Stock and the show is Ocean Currents and I'm talking to Laura Rogers-Bennett, senior biologist with the California Department of Fish and Game and the University of California David Wildlife Health Center and we're talking about abalone. So, we've talked a little bit about their natural history. It seems like they thrive in cold-water environments. So, during El Nino events when warm water comes up, do they just not do as well or what happens during El Nino events when we have warm water?

Laura Rogers-Bennett: So, during the warm water events we can have a combination of things that are not good for abalone as I mentioned, if those abalone are infected with the bacteria that causes withering syndrome, they can succumb to the disease. The foot muscle will die. They're not able to consume their food and process and absorb the food and they will starve and die. The other thing that can happen during warm water events is the warm water holds a lot less nitrogen, which is important for kelp growth and so, the kelp supply, the food for the abalone, will decrease during warm water years. So, sometimes we'll have a very poor kelp year during warm water El Nino events and the abalone will have very poor reproduction and gonad mass during those warm water events.

Jennifer Stock: How much algae does an abalone need in terms of their daily intake for survival?

Laura Rogers-Bennett: Well, they need quite a bit and they…what they do is they will eat the amount frequently that drifts past them. So, as you know, the kelp are very productive plants and they can shed off their blades in the water and those blades drift past the abalone and some of the other invertebrates on the bottom and they'll reach up and capture them and consume them.

Jennifer Stock: Wow, I could see that, just visually, a little bit of a reach there.

Laura Rogers-Bennett: Yeah, you can see them. I know that maybe some of your listeners are divers, are abalone divers, and you can actually see them rear up and extend their foot and try and capture the drift that's coming past them.

Jennifer Stock: That's great. So, this past summer was a really interesting event. Starting in late August, there was a really harmful algal bloom or red tide event and we'll talk about the specifics of that in a little bit here, but can you talk a little bit about the situation that we had here in terms of this event and what happened to this near shore environment during and after the event?

Laura Rogers-Bennett: Yes, we had a large red tide event and it was the start of it we were able to notice a lot of bioluminescence in the water which we've seen in the past. This was actually an unusually strong bioluminescent pattern in the water and the waters in the evenings were a bright blue, neon blue color and that happened starting in August, mid-August and we had some red tide in early August. You could see very faint streaks of a reddish-orangish color in the water, almost looked like tomato juice spilled into the waters and we could see some of that in Sonoma county and then coming around the end of August, August 27th, 28th, we got our first reports of dead invertebrates washing up on the shore, dead sea stars, dead abalone, and some of our large kitans, gumboot kitans, which are sort of an orange color as big as abalone and they were washing up dead on shore and that was the first indication that instead of having just a phytoplankton bloom, which we do get frequently in the late summer and early fall, that this was actually a harmful bloom that was killing marine invertebrates.

Jennifer Stock: So, when we talk about harmful algal blooms, it's phytoplankton, but they're harmful because they're toxic because it's so much mass or is it just…how is it harmful?

Laura Rogers-Bennett: Well, some of the blooms can be harmful in two ways. Most of the blooms that we have are not harmful at all. The vast majority are phytoplankton blooms that are actually feeding the trophic level in the ocean and they're not harmful at all, but there are some occasions when we'll have such a huge bloom that the biomass itself of the phytoplankton can start to deplete oxygen in the water and we've had that in northern California in the past in very small areas like the backs of coves, maybe areas less than the size of your living room or maybe two living rooms. You can see that the oxygen has been depleted there and many of the marine life have been killed in those very low water movement areas.

Sometimes we also get a lot of kelp washing into the backs of the coves, the bacteria that are breaking down the phytoplankton bloom or breaking down the kelp will pile up and they'll start to kill organisms. As I say, very localized patches. The other way that algal blooms can be harmful is the blooming species can actually produce biotoxins and there are both dinoflagellates and many of the dinoflagellates that we get, of course, are non-toxic, but there are a few that are toxin-producers and you may….many of the listeners may have heard about some fish kill. They may have heard about paralytic shellfish poisoning and these are toxins that are accumulating in the tissues of marine life and then humans are

eating them and getting sick. So, it's not a new phenomenon, but it's something that very rarely kills marine life on the north coast.

This summer, what we had was something very different. We had a phytoplankton bloom, which turned out to be one of the dominant species in the bloom was a dinoflagellate that was goniallax was the genus name and we'd been working closely with researchers at Sonoma state, Corina Nielsen and Adele Paquin, and they'd been looking at some of the phytoplankton that we have in the nearshore and they were able to identify the species that was dominant during the late August mortality event for abalone and urchin and they found goniallax binifura was the dominant form in the phytoplankton bloom and so, that's what was happening at that time and that is the known toxin producer, but we know very little about the kinds of toxins that those goniallax produce.

Jennifer Stock: Are you thinking that the die off…it seems like these are all really large invertebrates, these sea stars and gumboot kitans and abalone. Those are all really large invertebrates. Is there thought at this point as to was it the hypoxia that created this die off or the biotoxin from the goniallax?

Laura Rogers-Bennett: Well, it's a very important question and it's one that we're still looking into. We have a number of indications that it may have been a toxin involved. It may not have been just hypoxic conditions. First of all, we've seen some mortalities in aquaria that had high oxygen concentrations. We've seen mortalities in transect locations that were out on exposed headlands where we know there was a lot of wave action and a lot of water mixing and a lot of oxygen. So, those are indications to us that there may have been a toxin involved and that it may not have been a localized hypoxia event.

Jennifer Stock: That's so interesting. I mean, I've heard of biotoxins affecting like, sea lions, domoic acid for example is really harmful for their…it really screws up their brain…and I've just never heard about that with invertebrates before. Is this fairly new to see something like this?

Laura Rogers-Bennett: Yes. It's not very common that the biotoxins will have effects on invertebrates, but there are different kinds of toxins. There is…some toxins that only effect fish. There are some toxins that will only effect invertebrates and so, some of these toxins can be very, very specific. With the die off that we've had here, one of the interesting things about it has been that there have been some species that have been more affected than others. So, for example,

the sea urchins, especially in water depth less than 30 feet, have been heavily impacted and the abalone less than 30 feet have been impacted, but out at the deeper depths, the mortality is much less.

Also, the species that are affected have been very different. So, bat stars seem to have been doing fine during this event whereas sea urchins and sea stars, other sea stars, seem to have been affected. We've not found any evidence of any fish mortalities during this event.

Jennifer Stock: So interesting and how are they…are they just ingesting the dinoflagellates because it's everywhere and it's on top of their food resource or how are they ingesting it?

Laura Rogers-Bennett: Yes. This is another very interesting aspect of this particular harmful algal bloom event is that we have a very poor understanding of the mechanism of action and how the transfer of the toxin from a planktonic up in the water column, phytoplankton species, down to the benthos. These are not filter-feeders, abalone and sea urchins. They are eating different types of algae on the bottom and so, those organisms that are in the phytoplankton, we don't understand that transfer into a herbivore very well. Although, dinoflagellates are known to produce cysts. They have a cyst which is part of their life cycle and those cysts can be benthic and they do undergo some parts of their life on the bottom, but this is another part that is very poorly understood.

Jennifer Stock: Wow. These tiny little microscopic organisms are wrecking havoc on our understanding.

Laura Rogers-Bennett: Yes they are.

Jennifer Stock: Well, how about transferring to the food web. We have all of these dead invertebrates on the shoreline and what a perfect scavenging opportunity for near shore mammals that are near the edge of the sea like raccoons or gulls and other sea birds. Did you see any transference or were animals eating this, the dead stuff?

Laura Rogers-Bennett: When we were diving, we did see a lot of bat stars feeding on dead and dying urchin and abalone, but as I say, they seem to be doing just fine and weren't negatively impacted by that. We were concerned about potential transfers up the food web and so, we were able to get very small numbers of sea birds that had washed up on shore, recently died, and we were able to test a couple of common murres and it looked as though from the test results from UC Santa Cruz and the Fish and Game lab there that routinely

screens for dead birds and sea birds that these were very normal mortalities of young of the murre, common murres, that seemed to have very poor fat content and were starving and not doing well and, of course, many of the sea birds in the fall, that's a time when there is some mortalities that are normal for that time of year.

So, we did not see any evidence of transfer up the food web to marine birds.

Jennifer Stock: Well, that's good. At least we didn't have a massive event here. Well, you know, last month..I think it was last month, I had Josh Adams from USGS on and we talked about sooty shearwaters and we were reflecting about how the inspiration for Alfred Hitchcock's The Birds movie came to be and it was from reports of sooty shearwaters that had ingested some plankton bloom, probably a biotoxin, that they just went nuts and they were hitting doors and houses all over the place and dropping in the town of Capatola and it's amazing, the stories and the ideas that come around from these blooms, but we need to take a quick break right now just for another minute or two and I'd like to come back and talk a little bit about what causes these harmful algal blooms or red tide as they're popularly called.

So, if you wouldn't mind, Laura, just staying on the line another minute. We'll come back in just a minute and continue the conversation.

Laura Rogers-Bennett: Sounds good.

Jennifer Stock: Thanks so much. Just stay on line. For those of you just tuning in, this is Ocean Currents and my name is Jennifer Stock and I'm talking today with Laura Rogers-Bennet, who is with the California Department of Fish and Game and the University of California Davis Wildlife Health Center and we've been discussing abalone and this big die off event that happened on the Sonoma Coast due to the red tide and harmful algal bloom. Very interesting stream of events and the biology of all these animals and how they're inter-related. So, we're going to take a short break. We'll be back in just a minute.

(Music)

Jennifer Stock: And you're tuned to KWMR, Point Reyes Station and Bolinas. My name is Jennifer Stock and you're listening to Ocean Currents. Ocean Currents is the first Monday of every month. We're part of the West Marin Matters series and today we're talking about

abalone and the interesting way it's tied with our food web and oceanographic events we've had this year. We recently had a red tide this late summer. So, I'd like to bring back Laura. I have Laura Rogers-Bennett on the phone. You're live back on the air, Laura.

Laura Rogers-Bennett: Good afternoon.

Jennifer Stock: Thanks for waiting on the side there. So, I want to just get back to what causes these events. It seems like every year in the late summer or fall, we do have a bit of a brown water. I notice when going to the shoreline, you do kind of smell it a little bit, but what are the conditions that cause this type of event in the ocean?

Laura Rogers-Bennett: Well, it's usually a combination of factors which we get in the fall and that is a lot of sunshine will promote blooms as well as still ocean conditions without a lot of turbulent water and sometimes there will be organisms that the conditions are just right for them in the populations will bloom or you'll get high densities of them in the water column.

Jennifer Stock: I think I remember back, it was around Labor Day, and we had really calm sea conditions, like super flat. Is that about all when this was taking place?

Laura Rogers-Bennett: Yes, actually. We had the mortality portion of this event happen in the end of August, which was around 27th and 28th. So, we had some sea conditions at that time also that were quite calm and still water. So, we had a bloom event and the red tide and the bloom event continued for many weeks. It was in Sonoma County. We had dark-red-brown waters in the near shore for most of the month of September even a little until October and the species composition of those blooms is very dynamic and they can change very quickly over time. So, we've had a number of different species that have bloomed and been the main contributor to these blooms persisting. Most of the species that have been blooming since the late August event have been not known to produce any toxins.

So, those are just blooming species without the ability to produce toxin.

Jennifer Stock: So, that was a very focused event in a very specific geographic range, it seems, that had that biotoxin.

Laura Rogers-Bennett: It was. As far as we can tell, it was pretty much isolated to

Sonoma County. We had reports from a little bit south of Bodega Bay up past Shelter Cove and it looked like it was pretty much confined to that region, which is quite a large area for a bloom and given the information that we did receive on the abalone dying we did make recommendations to the fish and game commission to close the abalone season a couple of months early. Normally, abalone season would close November 30th and we asked them to close it two months early. So, they did that in the Sonoma County range.

Jennifer Stock: Have you had any pushback from recreational divers about that? It seems like it would be hard for them to take, but it seems like it makes a lot of sense. We want to protect this as a sustainable fishery.

Laura Rogers-Bennett: I think keeping the Mendocino area open, Mendocino County open, still provided for a lot of fishing opportunities in October and November, which are pretty low fishing months anyway, especially in November. We get a lot of the beginning of winter storms. So, I think a lot of people realized why we had made the request for the premature closure just in Sonoma County.

Jennifer Stock: So, you have been monitoring in this area, or your team has been before and after this event. What does a survey consist of and where do you survey?

Laura Rogers-Bennett: Yeah. So, we routinely survey four sites in Sonoma County and four sites in Mendocino County and we use that information to help us gauge how those populations and sites are doing and how the fishery is doing and we feed that information as mandated in the abalone recovery and management plan into some formulas to determine whether we should maintain the fishery as is or if we see big decreases in the densities throughout the fisheries and that would trigger a request for a reduction in the take. So, that's how the abalone are managed in northern California and what we found after this event was we were able to increase the number of surveys that we routinely do and this event came towards the end of our normal sampling season and so, we went back out to some of the Sonoma County sites and we were able to do surveys there to see if we could document how many abalone were dying at some of those sites and what our surveys entail are usually we do around 36 transect surveys. We lay down transect tapes.

They are 2 by 30 meter tapes and we count and measure abalone and urchin and invertebrates along those transects. We also document algal cover and substrate type and we have been doing

that since 2001. So, we have a pretty good sense of what is out there for those particular sites and what we did in response to the harmful algal bloom event was we went back out to the Sonoma County sites and we were able to document that close to 30 percent of the abalone along the transects that we surveyed were dead at Fort Laws. We had comparable numbers at Timber Cove, Ocean Cove, and then up at Salt Point.

We had lower mortalities as we moved north and those were about 12 percent of all the abalone that we documented along our transects were dead at Salt Point and as I mentioned before, the transects in water less than 30 feet had higher mortalities and the transects deeper had lower mortality. So, it was…we did have much higher in the shallower waters.

Jennifer Stock: Really shallow area…it may be a little warmer, more intense bloom or something going on.

Laura Rogers-Bennett: A lot of those blooms will be in the upper layers of the water column and that upper portion then we seem to get a lot more mortality in shallow.

Jennifer Stock: And then, for sampling can you look at online data in terms of chlorophyll data to get a sense of when red tide is happening or do you have to go out and sample it all the time? How do you get an idea of that?

Laura Rogers-Bennett: You can…we don't typically keep track and monitor chlorophyll concentrations as part of our abalone work since they're not filter feeders. They're not eating some of the components of the organisms that make up the chlorophyll A measures, but what you can see is that if you look at a trace of chlorophyll, we typically get the most productivity in the spring when we get the strong upwelling. So, the upwelled waters will bring nutrient-rich water to the surface. It's very cold and that will trigger a lot of organisms to be growing during those conditions.

So, those chlorophyll A concentrations are much higher than what we saw during this mortality event, which is in August. So, typically we will get a higher chlorophyll in the spring than we did in the fall.

Jennifer Stock: Yeah. So, how about…this is kind of switching topic here real quick, I know that you've been doing other abalone surveys in other parts of the coast, right? Or do you just focus on the Sonoma Coast?

Laura Rogers-Bennett: We also do surveys in the Mendocino Coast.

Jennifer Stock: Oh, that's right. Sonoma and Mendocino. I am trying to remember here, I think….was there a survey going out on the Farallon Islands for the black abalone. Were you involved with that at some point? I think Ed Ueber was leading that.

Laura Rogers-Bennett: Ed Ueber led that and that happened quite a long time ago. We are interested in potentially repeating some of those surveys. So, that's something that we might do in the future, but it would be really nice to see what black abalone populations are doing out at the Farallones. Logistically, they're a difficult place to work. So, we haven't been out there yet.

Jennifer Stock: Pretty hard place to visit and survey I take it.

Laura Rogers-Bennett: Yeah.

Jennifer Stock: I was just mentioning it in the office and Dan Howard mentioned that you had been helping Ed with that a couple of years back. So, I was curious to hear if it was still happening.

Laura Rogers-Bennett: No. We haven't gotten out yet to do that work, but we're interested in putting that on our to-do list.

Jennifer Stock: Is there a thought with the closures of abalone up and down the coast, I mean, we have this north coast fishery that seems to be hanging in there, but we have so many species here on an endangered list or a species of concern. How abut those? Have we seen many changes in those populations since those closures have been in effect?

Laura Rogers-Bennett: Yes. That's a really good question. One of the species of abalone in California that's in the most trouble is the white abalone. They were at fairly low numbers to begin with and then they were part of the fishery down in southern California and there was not a concerted effort to keep track of just that portion of the fishery. Now, they would track white abalone landings per se, and in some cases they were lumped in as abalone landings and so, some of these species who were serially depleted, we did see the depletion of some of the pink abalone in southern California commercial records and then some of the fisheries switched to some of these other species like the white abalone. Right now, the white abalone are in very bad condition.

We have a few in captivity and we are trying to develop a captive breeding program for that species, but that's been a big challenge and the other challenge with that is how the juveniles might fair once they're put back out into the wild. Although, we have not gotten to that step yet. So, that's something that is work that needs to be done. Black abalone are also on the endangered species list. They were hit very hard by the withering syndrome and some of the warm water events in southern and central California. So, we've had some areas out on the Channel Islands where there used to be millions of black abalone and now those populations have, about 90 percent of them, have died due to withering syndrome and they are doing very badly.

The two other species that are species of concern in southern California are the greens and pinks and some of our team, Ian Tamaguci down in southern California who's also with Fish and Game, part of our project, he and his colleagues have been tracking greens and pinks and they've been seeing some recovery, natural recovery of pinks in very small pockets. So, we see some juveniles. So, that's been very encouraging and they've been experimenting with different types of aggregation work that they can do to help to facilitate natural spawning. So, they've been very active in working with the federal NOAA partners in the programs there who deal with protected species and protected resources division and working with those pieces.

Jennifer Stock: So, what I was reading about mariculture and abalone, it seems like it's been a really tough mariculture situation to get set up and to be successful in terms of having the spawners meet in the water column and then settle out. Has there been advances in that? It sounds like if we're trying to do a breeding captivity program, we have to try to figure those things out. Have there been some advances in that?

Laura Rogers-Bennett: Yes. Well, one of the things that we're really lucky to have is a small, but active, abalone aquaculture industry in California and they were some of the pioneers in terms of being able to culture and rear abalone in captivity and we have a small number of farms in California that raise abalone for the restaurant trade and for consumption and they have been the ones who figured out the spawning and rearing methods and they're very successful at spawning male and female abalone, getting the gametes to meet, and fertilizing, rearing the larvae. There's a sort-lived larval period where the abalone are in the water column. They're living off of the yolk and then they settle down on to the benthos, metamorphose, and begin their benthic existence.

Jennifer Stock: Well, that's promising in terms of both supporting the potentially the wild population, although the reintroduction back into the ocean sounds like a challenge and how about long-term concerns for abalone? This is a mollusk and they need calcium carbonate in order to produce a shell from what I understand. Has anybody been doing any research on the potential impacts from acidification, ocean acidification, on abalone and their reproduction.

Laura Rogers-Bennett: Yes. We think that abalone, like many of the shellfish, can be very negatively impacted by ocean acidification. So, as you know, the more CO2 in the atmosphere, that can change the water chemistry to make it more acidic and that makes it difficult for organisms to lay down shells to calcify and abalone would be one of the animals that would fall into that category of species that might be susceptible to ocean acidification. At the Bodega Marine lab they're putting together a research program to investigate ocean acidification and that's a project headed up by Dr. Sanford and Brian Gaylord and those people are going to be working on a number of species.

Right now, I think they're mainly working with oysters, but they may be expanding the species that they work with and looking at other species other than oysters and mussels and sea urchins.

Jennifer Stock: Great. Well, thank you Laura. This has been really interesting. Are there other last comments you have in terms of our long-term conservation for this habitat and the species and how we can, as people who potentially eat abalone and enjoy this part of the world, how can we be better stewards of it?

Laura Rogers-Bennett: I think that in the past we have been very good stewards of the red abalone fishery in northern California and I think we could view it really as a Cadillac fishery in the region because it is one of the largest species in the world we have really active wonderful divers who go out free diving and they know the importance of not collecting too many at all the depths as we did in different parts of California and so, they've been good about sticking to the rules. I guess what this event has taught us is that there may be some unforeseen events that can come in and impact abalone and urchin populations that we have to take into account. These weren't really accounted for in the management of the species. These risks that just came out of nowhere and so, I think moving forward, we're going to really need to think about all of the potential impacts on the fishery and on the species if we're going to try and maintain it in a healthy, sustainable way.

Jennifer Stock: Yes. Is there…I know poaching has been an issue from time to time with this fishery. Is there a poaching hotline that people could call if people are witnessing something they're not so sure is legal.

Laura Rogers-Bennett: Yes. Our enforcement with Fish and Game, not only have been vital to our efforts to go out and sample this event that came up so suddenly at the end of August. We were out on all of the enforcement patrol boats, expanding our surveys, and working with patrol boat marlin, and patrol boat steelhead and all of our enforcement staff, but they also have a hotline for turning in poachers called Cal Tips. So, it's 1-800-CAL-TIPS and if someone sees poaching for any species in California, they can contact that hotline and the dispatch will talk with the enforcement officers who are on call and working that area. So, that would be great because having more eyes and ears out there would really help the resources of the state.

Jennifer Stock: Sounds good. Well, I think it's important. I know the diving community is very supportive. They want to see this fishery continue. It's such a special thing that we have here on the coast.

Laura Rogers-Bennett: It really is. Yeah.

Jennifer Stock: I enjoy it from time to time and it's a celebrated delicacy. So, thank you so much for your work in helping to help sustain the fishery and to learn as much about it to help other species as well and thanks again for coming on to Ocean Currents.

Laura Rogers-Bennett: You're welcome.

Jennifer Stock: Have a great afternoon.

Laura Rogers-Bennett: Goodbye.

Jennifer Stock: We've just been talking with Laura Rogers-Bennett who is the senior biologist with the California Department of Fish and Game and the University of California Davis Wildlife Health Center and she's been studying and monitoring the abalone population on the Sonoma-Mendocino coast for some years now and we just were talking about the recent abalone die off event that happened this late summer, this red tide event we had. It's kind of interesting, coincidentally, I was offshore at the Cordell Bank Sanctuary during our annual field seminar and we get offshore to look for marine wildlife and we had a mysterious absence of humpback and blue whales this September and usually at this time of year they're feeding all over the place. I say usually because typically that's the

way it is, but this year was not the case and we noticed there was a lot of red water and I saw those streaks of red and orange that Laura was talking about earlier and I haven't been able to find any links in terms of a biologist or ecologist tying the link together, but I'm curious if there's any coincidence there.

We had the whales move out of the area and a large red tide event, but we don't know. It's hard to say how those whales are spotted. It sounds like they're hanging out in Monterey Bay and out in southern California now and if any of you are traveling there, I'll just remind you that they are protected species and to admire from afar. There's been a lot in the media of some really close encounters and these are very large mammals. So, be careful and stay at least 100 yards from these mammals if you have the great opportunity to see them.

I have one announcement here before we wrap it up today. The Cordell Bank National Marine Sanctuary is seeking to fill several seats on its advisory council. This council represents the public's interest in sanctuary matters and provides advice to the sanctuary superintendent. The council's role is to provide the superintendent with advice on the sanctuary's resource protection, research, education, and outreach activities and recently, they've been focusing on climate change issues, vessel traffic, and protecting leatherback turtles. So, the seats that we have available are for input and for application. We have fishing seat, education seat, and a community at large Marin County seat.

So, hopefully some of you listeners here are interested in this or know of somebody that would be interested in sitting in on this council. They meet four times a year. It's not a huge commitment of time and it's a really nice way to get involved and interact with other constituents that are participating in the guidance of the sanctuary. So, if you're interested in learning more about that, you can go to the sanctuary website,
that's www.cordellbank.noaa.gov and learn a little bit more about that.

Thank you so much for tuning in today. You've been listening to Ocean Currents and my name is Jennifer Stock and this show is the first Monday of every month, part of the West Marin Matters series. You can go tocordellbank.noaa.gov for archived shows and you can subscribe to a free podcast there as well. So, thanks for tuning in. I will be back December 5th and I'm going to be hosting Barb Emily, a fisherman in San Francisco, a fisherwoman, and I'm meeting with her in the next week or so to pre-record a show with

her. She's a very busy lady, but really interesting and I'm looking forward to bringing that to Ocean Currents on December 5th. So, thanks for listening and keep tuning in to 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 of this program may or may not be that of the National Oceanic and Atmospheric Administration, and are meant to be educational in nature. To learn more about Cordell Bank National Marine Sanctuary, go to cordellbank.noaa.gov.