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The Impacts of Desalination on the Coast/Ocean environment/Sanctuary Expansion Update!
Jennifer Stock, Claire Waggoner, Bridget Hoover, John Largier

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

(Musical Intro)

Welcome to another edition of Ocean Currents, I'm your host, Jennifer Stock. On this show we talk with scientists, educators, explorers, policy-makers, ocean enthusiasts, adventurers, and more, all uncovering and learning about the mysterious and vital part of our planet: the blue ocean. I bring this show to you monthly on KWMR from NOAA's Cordell Bank National Marine Sanctuary, one of four national marine sanctuaries in California, all working to protect unique and biologically diverse ecosystems. And Cordell Bank is located just offshore of the KWMR Listening Radius off the Marin-Sonoma Coast, and it's an area that is thriving with life both above and below the surface.

Today we are talking water, and discussing desalination and the coastal impacts it can have. It seems like it's all over the news these days and something that's been on my mind is where we are we going to get more water? So discussions and news reports have been focusing on the California extended drought conditions: more and more work has been going into figuring out how we're going to get more water here in the west. While we can't make it rain or snow, desalination is a technology that can extract salt out of the water for human consumption or irrigation, and is a technology already used in California, but with great expense.

Today we'll explore the potential challenges this brings with California vibrant coastal ecosystems, and the impacts desalination can have on the coast and ocean. Towards the end of today's show we'll have a short update about the Cordell Bank and Gulf of the Farallones Sanctuaries' expansion up to Point Arena, and we'll discuss the oceanographic linkages with John Largier of UC Davis Bodega Marine Lab. So we have a very full show, talking a lot about water--salt and fresh--and how to make that happen.

So my guests today are Claire Waggoner, who is an environmental scientist in the Waste Discharge Unit in the division of water quality with the State Water Resources Control Board, and her work is primarily associated with desalination in California addressing intake and discharge. In addition, with me in the studio is Bridget Hoover, who is the Water Quality Program director at the Monterey

Bay National Marine Sanctuary, and is addressing desalination projects just to the south of us on the coast. Since last week's announcement out of the Governor's office, an order of 25% water cutback use was stated, and more discussions are coming up about desalination. So perfect timing, and thanks to both Bridget and Claire for joining me in the studio today!

Bridget Hoover: It's great to be here, thanks Jenny!

Claire Waggoner: Great, thanks for having me!

Jennifer Stock: Claire, if you don't mind diving right in, let's start. And if you wouldn't mind just giving us a brief overview of what exactly desalination is and how it works?

Claire Waggoner: Okay. Well, desalination is really a general term for a process that can be used to separate salt, minerals, and other components from seawater or brackish water. And the goal is to produce fresh water that can be used for human consumption, municipal use, irrigation purposes, industrial use, or even ground water replenishment. And so that can done by taking water from an ocean or a bay to desalinate, but also in some cases it's being used in inland areas to remove salt from water that's too salty to use for irrigation or drinking water purposes.

But regardless of whether you're using ocean water or bay water, the desalination process is generally the same, and what it typically entails is three general steps. And the first step is the pre-treatment process, and this is to remove larger particles like suspended solids or organic matter, and this is done before you take the salt out of the water-you separate the salt. And so the second step is getting the salt separated from the freshwater that you want, and this can be done a number of different ways, it can be done by evaporation or distillation, but in California it's being done on a commercial level using reverse-osmosis. And so this is where water is being passed through reverse-osmosis membranes, and these just have the ability to separate out the water molecules from the salt, and so that's why that first step is important, because you wanna get the larger stuff out that could potentially clog the membranes. And so this reverse-osmosis process is so effective, that you're stripping out almost 99.9 percent of the salt. So this water then requires this post-treatment where you kinda have to add some salts back in to make the water suitable for drinking or municipal purposes before it goes into the water supply.

Jennifer Stock: Excellent! So I can imagine with reverse-osmosis that this is a very energy-intensive process, and I know that's been covered quite a bit in the media. Do you have an idea in terms of -just to give us a gauge of just how much energy it costs to produce one gallon of water, or maybe there's another measurement for…

Claire Waggoner: Well, it really depends on what your source water is. So if you have low-salinity water, coming from a bay or an estuary, and the salinity is really low, it's not going to take nearly as much energy as if you had saltwater that needs more energy, more pressure to separate out the salt, you essentially need more reverse-osmosis membranes, because you put them in sequence to really pull out the salt. But then there's also energy recovery devices that a lot of these desalination facilities are using, recognizing the fact that this process is energy-intensive. And so this is sort of a way of recycling the energy in this energy-intensive process. So I know it's not a very satisfying answer, it's one of those 'it depends".

Jennifer Stock: Yeah, I understand there's a lot of those (both laugh) when it comes to technology, and the ocean, and the coast.

Claire Waggoner: Yeah.

Jennifer Stock: In terms of the history in California, how many desalination plants do we currently have in California, and where are they?

Claire Waggoner: So there's 11 coastal desalination facilities, and they're really small facilities, so most of them produce less than a million gallons a day of fresh water, and they really operate intermittently. So there's about three in the Monterey Bay area, and probably another five in the central coast area, and two in the Channel Islands, so one's in San Nicolas Island, the other on Catalina Island.

Jennifer Stock: Well I used to live in Catalina and I used to remember the water tasting really different (both laugh), and that explains it.

In terms of the future, and currently, are there a lot of projects in the works to increase the desalination plants in California?

Claire Waggoner: Yeah, so what we've seen is in the past desalination wasn't really the water supplier's first choice, and I would say it still isn't because it is energy-intensive. But entering our fourth year of drought, and water is becoming an increasingly limited resource, and so there's several coastal communities looking at using desalination as a tool to improve their local water supply reliabilities. And so what we've

seen is there's about 16 project proposals, and these are not so much in the north coast because obviously they have a good supply of rainwater. But we've seen these hotspots in Monterey Bay and Southern California, where desalination is being looked at as a tool to add to the water supply in these areas.

Jennifer Stock: Now I know that California's also on track to try to reduce their carbon emissions drastically in the next 10 years, what's the conversation there with energy conservation, reducing carbon emissions, but also potential need for more energy in creating water? Seems like a tough trade-off!

Claire Waggoner: Yeah and it is something that everyone's looking at. One of the things that I know a lot of the people who are proposing desalination facilities is they're recognizing the cost could go up in the future and so it is to their advantage to design the facility to be as energy-efficient as possible. And so there are facilities that are proposing to be carbon-neutral, but typically by doing things like installing solar panels or the energy recovery devices, and then making up the rest with carbon offsets.

Jennifer Stock: I'm curious, can solar panels --and this might be a technical piece that's tough to answer--can solar panels produce enough energy for one day of a desal plant?

Claire Waggoner: You know, I can't really say for sure whether that's possible, it depends on the size of the facility. When you're looking at a really large facility in an area like Southern California where you're space-limited, it could be a logistical challenge. But for a smaller facility in an area where it might have more room for solar panels, it could potentially work.

Jennifer Stock: What an exciting time for energy and development in California! I know solar has been on the rise for a long time, but this could be very neutral in terms of carbon emissions in production of water.

But let's get to some of the impacts. We're talking about desalination, and my guest on the phone is Claire Waggoner with the California--I always get it wrong (both laugh)-- the State Water--which is California--Water Resources Control Board. I also have here in the studio with me Bridget Hoover from the Monterey Bay National Marine Sanctuary, who has been working with a lot of desalination projects in the coastal region.

But we talked about the intake, and the water, and what about the discharge? We have to take all this salt out, and where does it go?

Bridget Hoover: Well so for these facilities, a lot of them choose to discharge it back into the ocean, and for a lot of them people talking about putting salt back into the ocean, they think "Well, what's the problem?" right? It came out of the ocean, it's going back into the ocean, no big deal, right? But the problem is, along with that salt you're extracting, anything in excess can be a potential problem. So there is a point at which salt can be toxic for marine organisms. And so there's better ways for us to discharge this back into the ocean to minimize the impact to marine life. So for example, since the salt you have added mass, the discharge plume is dense, it's negatively buoyant. So it has a tendency to sink to the seafloor, and it can form this layer where you prevent adequate oxygen mixing, and so you can get hypoxic or anoxic effects in the benthic marine environment.

So there are, as I mentioned, better ways to put the brine out, and so one potential method for bringing brine out is by mixing it with wastewater. So a lot of coastal wastewater treatment plants discharge millions of gallons of freshwater plume, and so this water can be mixed with the brine to reduce the brine, and reduce the effects of negative buoyancy and toxicity so that you don't have issues. And then for areas that may not have wastewater available for dilution, you can install what's called "multiport diffusers", and essentially it's a system that would go on the end of a discharge pipe. A lot of wastewater treatment plants already have these. So the objective is to just rapidly dilute the brine. So you push it out of these diffusers at a high velocity, and it forces turbulent mixing so that salt is rapidly dispersed and diluted, and so you don't get the dense, negatively buoyant plume, and they're also reducing the area in which you're having toxic salinity effects.

Jennifer Stock: Are you aware of any research efforts or studies outside of desalination plants to study the changes in marine life around them?

Claire Waggoner: Regarding desalination facilities?

Jennifer Stock: Yeah, and with the discharge of the brine.

Claire Waggoner: You know, we're starting to hear a little bit about it, it's become a hot research topic in a couple of years. So I've heard there are some academics who are proposing, er, requesting grants from

places like Sea Grant to study this, but then as these facilities come online, part of their requirements will be to look at some of these impacts. And so we'll get more data the more these facilities go online.

Jennifer Stock: Fantastic, well this is where I'd love to bring Bridget into the conversation. Bridget is with the Monterey Bay National Marine Sanctuary, and please stay with us too--right there on the phone too, Claire--

Claire Waggoner: Okay.

Jennifer Stock: Bridget's been working in the Monterey Bay National Marine Sanctuary as the Water Quality Director for many years. If folks aren't familiar with the Monterey Bay region, the sanctuary actually starts all the way up here in Marin County and goes all the way down to San Simeon, and has a wealth of incredible ocean habitats, deep-sea canyons near shore, intertidal, and also is located near an area that doesn't have a lot of water! (Bridget laughs)

So Bridget, you've been so involved, and I know you worked on a framework, a sort of best-practices, with several agencies in terms of how to best manage this. And somewhat ahead of the times, which I was really impressed to see, you kind of got onto this before it really became an urgent issue! Can you tell how a little bit about how the sanctuary managed, learning about desalination and the plants in the area itself?

Bridget Hoover: Yeah, it kind of started when we went to our management plan review process in the mid-2000's. We developed with NOAA fisheries, with the coastal commissions, with the state board with other state and local agencies, guidelines for, as you said, best practices for project proponents thinking about a desalination plant. And so it really lays the framework of things that they should really be thinking broadly about where to best site a facility, kind of based on what Claire was just talking about, potentially having a regional facility so we don't have a whole bunch of facilities along the coastline, considerations for discharge of brine, using existing infrastructure, things like that, getting to your point about lowering the carbon footprint and the greenhouse gas emissions. And so it just gives a real general kind of concepts about things the project proponents really need to think about, and if they do move forward, then to apply for a permit they would need to demonstrate that they have considered all of these different actions.

Jennifer Stock: Excellent. Now the plants that are in the Monterey Bay region--the desal plants that are in the Monterey region right now, were those there prior to the sanctuary's establishment or did they come on after the sanctuary?

Bridget Hoover: Oh, probably both, and like Claire was saying the ones there now are very small, those are more individual to provide water for that particular facility, say the Monterey Bay Aquarium. But what's being proposed now is to provide potable water for the community, so it is a much different scale.

Jennifer Stock: (Echoes) Much different scale.

Bridget Hoover: Yeah.

Jennifer Stock: So imagine with the scale, increased concerns. And you know, I'm trying to think "What would I do?", but all the habitats in this region are so, so precious in terms of migratory birds on the coast, and kelp forest habitats. What habitats are the sanctuaries most concerned about?

Bridget Hoover: Well, so when it comes to desalination, we have three main concerns, and one is the intakes: where is the water coming from? And if they're open-ocean intakes, then there's potential for both entrainment and impingement. So entrainment is when organisms get sucked into the process with the water, and impingement is if there's screens involved on the intake, then the organisms get sucked up against the screens and can't escape. So entrainment and impingement through the intake of the water, as Claire was mentioning the discharge of brine is a concern. And then also part of the sanctuary authorization, our regulations, new infrastructure on the seafloor is prohibited. If they had to put new pipes for the intake or for discharge, that would require an authorization from the sanctuary. So it's for the disturbance of the seafloor and the discharge of brine that are prohibited in the sanctuary's act, but then of course the entrainment and impingement is an issue as well.

Jennifer Stock: Where are some of the desal plants--the larger desal plants being proposed right now in the Monterey Bay region?

Bridget Hoover: So we have three that I would kind of categorize as large: one is in the Santa Cruz area, the Santa Cruz-SoCal Proposal, they've kind of put it on the backburner, they've done years and years of

environmental studies looking at the best possible locations for the intakes and the discharge of brine and that sort of thing. They did all of the semi-documentation I think two years ago, I had an EIR that was out for comment. And that was--we've--as you were saying, we've always been kind of short on water on the central coast, because we don't import water from the rest of the state, we have to live with the water that falls from the sky. So they've been thinking about this for a long time but they also kind of thought "Well let's look at our options", so it's kind of been put on the backburner, and that's about a 2.5 million gallon per day project.

In the Moss Landing area there's another one called the Deepwater Desal Project, and that's--they're considering that a regional plant that would potentially provide potable water to the north end of Monterey Bay to the south end of Monterey Bay, and even up into the Salinas Valley, and that's propose to be 25 million gallons per day potable water. So they basically have to pull 50 million gallons per day out of the ocean, to be able to make that water it's about 50 percent effective. So that is proposed to be in open-ocean intake just at the head of the Monterey Bay submarine canyon from deepwater granite, but there still is a lot of organisms and diversity there. And then that discharge is not mixed with any kind of freshwater-affluent, so that would be a straight brine discharge back out into the bay.

And then the third is the Cal Am Project, between 5 and 9 million gallons per day proposed. What they're trying to do--they're trying to pull water through a subsurface intake, what they call a "slant well", so this pipe actually goes under the ocean and pulls from a shallow water aquifer. So we were the federal lead on a test that's actually just installed a test well, and we're very interested to see if that's viable and if that's going to provide enough water to satisfy the needs of the Monterey Peninsula.

Jennifer Stock: I'm imagining this is a hotbed for research! Monterey Bay in general has a--you know you see Santa Cruz, you see the Monterey Bay Aquarium Research Institute, Hopkins Marine Station, there's so many incredible marine science efforts. What do you know in terms of impacts? I mean we briefly discussed this earlier, but in terms of "Do we know anything?" Just thinking about how much plankton is being sucked up by the ocean… and fish! It's interesting--the subsurface one is very interesting because it's a little bit (inaudible): it's in the ground!

Bridget Hoover: Exactly, exactly. There are a lot of studies that have been conducted, both for the Santa Cruz plant and for the deepwater plant. There is a model that they use--Claire might know, it's a ETM model that was designed and approved by the US EPA, and they basically can calculate the area of production foregone. So they go out and they can do these net tows and they basically say "Okay, what is the main population that we're seeing in this area?", then they can extrapolate out "Okay, where do these organisms come from based on their size and age, how much area of the ocean is where they thrive and grow?" And then that's kind of the currency that is used in these projects, mostly by the Coastal Commission just to determine how significant the impact is.

Jennifer Stock: Is the Coastal Commission the primary authorizing agency for the development of these plants? How many different agencies are involved?

Bridget Hoover: Many, many. I would say upwards of 15 to 20 agencies that have to be involved and issue some sort of permit or approval process, I can speak specifically for the sanctuary, and again for us it's disturbance of the seafloor and the discharge of brine where we have to authorize a permit. So it would most likely be the Coastal Commission permit for a Coastal Development permit, and that would be for laying of the pipe, but then the Regional Water Quality Control Board would issue an NPDES permit for the discharge of brine and we would potentially authorize that.

Jennifer Stock: I'm imagining the authorization pieces would be really tricky issue to talk about, even to think about, because basically it makes the sanctuary--gives the authorization and has the ability to give you a permit for another agency. But when it comes to trade-offs, like I guess it depends on how much you would lose versus how much you needed, and I think the prices get higher and higher for the stakes of water for survival. Is it likely that the sanctuary would authorize the permit for the water if it came down to these emergency situations?

Bridget Hoover: You know, it really is so site-specific and so size-specific, and we would really have to feel confident that there is no significant impact to the sanctuary, and that all of the best possible practices have been put into place. And that's again why if Cal Am can demonstrate that a subsurface intake is viable and would produce enough water for the Peninsula, I think that would probably move through potentially quicker than an open ocean intake would.

Jennifer Stock: Interesting. Now, Claire, I'm not sure if you would know this, I know that Marin County had a desalination plant proposed that went, for many years I think, through the Marin Municipal Water District, and I don't know the status of it. Can you talk to that at all?

Claire Waggoner: Hmm, that one--you know part of the problem is because of these projects sort of change hands. Who is--what are you calling that project today? And the other thing is that it might be--no, I think that one is going forward, but I don't have any details on that facility.

Jennifer Stock: Okay, we'll do more research on that one. But I believe the intake for that one was in San Francisco Bay.

Claire Waggoner: Oh that's why. (both laugh)

Jennifer Stock: Not necessarily a Pacific ocean. So we'll have to learn more to talk about that project, I just learned about that one recently because I was curious.

Now, Claire, the other thing you mentioned is that desal seems to typically be in Southern California areas: areas where there isn't a lot of natural water, and yet a lot of the North coast too is facing a lot of drought conditions, not having a lot of rain. Is it more about location in terms of where there's more likely to be rain, or is it more about the habitat, the terrain that this desal plant would be put on, can you talk a little bit about that? I'm just curious because the north coast I know is facing a lot of drought conditions too.

Claire Waggoner: Yeah so really the decision to develop a desal plant facility comes from water suppliers, so people responsible for supplying reliable, safe water. And this is kind of one of the reasons that desal hasn't really been the first option, it's typically more expensive, it's energy-intensive, there's cheaper ways of getting water. So the decision really is a local decision, somebody who's responsible for providing water looks at their water pie and they say "Okay, this much is conservation, this much is coming from pure, this much is coming from there", and so the decision really is (inaudible), we really are in need for an alternative supply option. So for example the city of Santa Barbara, they have their desalination facility, it was built in the 90's, but went offline because it rained. And now we're in our fourth year of drought, we're looking at this again as "Okay, well we've exhausted all of our other options, we need to make sure people have water", so I would say that's the more common theme as to why you'll see a desalination facility pop up. So obviously in someplace like Southern California, there's so many people, and

only so much water, and so that's why I think we're seeing it proposed in recent years.

Jennifer Stock: What are--Are there any other projects being proposed north of the Golden Gate Bridge?

Claire Waggoner: Let's see... (pause) I don't think so, I haven't heard of any of theirs, potentially the Bay Area Regional Desalination Project, which is either going to be--I mean it's going to be somewhere in the bay, but we don't know yet whether it would be in Contra Costa, Oakland, or somewhere in San Francisco. And then the other one (pause) looks like it would also be in the bay, but they haven't picked a place yet, and that one's the California Water Service Company. But other than that, we aren't seeing anything north of San Francisco.

Jennifer Stock: Okay. Well one of the things I just realized is, I wanted to ask you this earlier, but the desalination process removes the salts and then is treated to bring in some of the things that typically are in drinking water.

Now for taking water out of the ocean, there's a lot of pollutants in the ocean too that have ended up there from our land practices, how do those filter through with desalination? I know that there have been people who are very concerned with radioactivity and we know that the levels are very low so far in terms of the testing with the kelp. Can you talk to that at all about pollutants in the ocean and how those are transferred through desalination?

Claire Waggoner: Well what would happen is anything that's been in ocean water would come into the facility and through the treatment steps, and any of the sea organics, pesticides and compounds, those probably would be filtered out in our pretreatment process. So the drinking water portion, or the product water, post-desalination would be pretty clean, the process takes most of that stuff out.

But then you're looking at this waste stream, right? So in addition to brine, you have anything else that was in the seawater, it's just been concentrated now. And so as Bridget mentioned, the regional board's issue, the National Pollutant Discharge Elimination System permit, or the NPDES permit, so a lot of this is regulated, and even though the brine and all the other pollutants are going to be discharged back into the ocean, the facility still has to meet certain standards. And so that's involved in their permit and if that's a

problem where something is high, their standard procedure is for making sure that it doesn't impact beneficial uses of ocean water.

Jennifer Stock: Has there ever been thought about discharge on land, are there discharge locations on land that could take this brine?

Claire Waggoner: So there are things like salt ponds that people have done, there are systems that could put it back into the beach sand and it sort of diffuses back that way. So there are options for that as well, however that's also permitted by the regional board usually, so it's not like you would get out and start requirements that way.

Jennifer Stock: Okay. Well, Claire, are there any other last pieces that you want to make sure we know in terms of desalination and what coastal communities should be thinking about?

Claire Waggoner: I just think that the take-home message is that it's definitely not the solution to California's water problem, but it can be a tool to use if it's done properly. So as Bridget mentioned, they have a really great document for things to look at, how to do this in the most environmentally responsible manner, and I think that would be the take-home message for the development of these facilities should be done in a sustainable, environmentally friendly way if possible, recognizing there are always trade-offs when we do things for human needs.

Jennifer Stock: Now, actually getting back to that, since the Monterey Bay National Marine Sanctuary put together somewhat of a best practices of framework for plants in the Monterey Bay Sanctuary area outside of the sanctuary, we still have an incredible coastline, are some of these areas kind of held to the some of these standards the sanctuary took the lead on within their sanctuary?

Claire Waggoner: Well so the State Water Board is developing a proposed amendment to the Water Quality Control Plan for Ocean Waters, kind of known as "the Ocean Plan", and this is a regulatory document of essentially what you can and can't do in ocean waters. And so the amendment addresses desalination facilities, and so it provides guidance and sort of a rule book for if you're going to develop a desalination facility in California, this is how it should be done, within the regulatory confines of the Water Board.

Jennifer Stock: Is that a document people can review online?

Claire Waggoner: It is, so we are currently in our second round of public comments on

the document, and I know I should have had the webpage ready to go.

Jennifer Stock: Well what would they look up if they were to just type it in, "California Ocean Plan Desalination Amendment," perhaps?

Claire Waggoner: Yeah if you go to the State Water Control Board Maintenance main page, then you would click on "clean beaches and ocean standards", and then from there there's a desalination page.

Jennifer Stock: Excellent, fantastic. And Bridget, how about for you, as things move forward, what's the best case scenario for you and seeing these plants move forward in and out of the sanctuary I guess?

Bridget Hoover: I think everything Claire has said as far as doing everything in the most responsible, kind of environmentally-friendly manner. I think one thing that's kind of missing for us is really understanding that water balance, and how much water is really needed and necessary, both to keep water in our streams for the (inaudible) and the aquatic organisms, what we need as a community, right now we know what the shortfall is, and then kind of work from there, rather than seeing all of these potentially different water districts popping up and just thinking about their community, but really looking at it more holistically, and what does this region need for trying to forecast that out.

Jennifer Stock: It's the hot topic of the day!

Bridget Hoover: It is.

Jennifer Stock: All the time, I mean all of us are thinking about it. I'm sure a lot more people are thinking about "where is their water is coming from from their tap," that they never really thought of that before, it just came. It's such a precious, precious resource, and it's such a fascinating topic to think about that we live next to the greatest water resource on the planet, yet it's salty! So I really appreciate both the perspectives that you're bringing, Claire, and all the information you shared, and Bridget, you as well, to talk about desalination today! Thanks so much for coming on the show!

Claire, thanks again and we'll talk to you soon!

Claire Waggoner: Okay, great. Thank you!

Jennifer Stock: Thank you.

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For folks tuning in this is KWMR Point Reyes Station in Bolinas, and this Ocean Currents. My name is Jennifer Stock, and we've just been talking about desalination in California and some of the thoughts behind taking water out of the ocean and making drinkable water for us, and some of the impacts that could have. California has incredible ocean habitats, so there's a lot of things to think about as we move forward in this California drought, and thinking about getting the needs met across the state.

We're going to take a break and come back in a little bit to talk further about this sanctuary's expansion, both Cordell Bank and Gulf of the Farallones at the coast. Thanks for tuning in!

(Musical Interlude)

And welcome back, you're tuned to Ocean Currents, this is Jennifer Stock, and you're listening to KWMR. And I wanted to just finish off the show talking a little bit about the expansion of the Cordell Bank and the Gulf of the Farallones National Marine Sanctuaries, which was announced just a few weeks ago the final rule published. And on the phone with me we have John Largier, who's a professor of oceanography in the Department of Environmental Science and Policy, and research director at the Coastal and Marine Sciences Institute at the University of California Davis Bodega Marine Lab, and John is also an Ocean Currents veteran, we've had him on the show before. So John, welcome and thank you for calling in!

John Largier: Thanks, Jennifer, pleasure to be here!

Jennifer Stock: So, just a few weeks ago, the final rule published for the expansion all to the way up to Point Arena--or just past Point Arena, and now we wait for 45 days of continuous congress for official changes and regulations to go into effect. And you've been involved in this effort for several years, even before NOAA took it on as a 'NOAA Action', what is the significance of this expansion to you as a oceanography expert?

John Largier: Well you see, Jennifer, it's been a long time that we've looked at this part of the ocean. I think the first study that I did up here was back in the 1980's. And what one comes to recognize is that the ocean has a landscape, just like the land has, it has valleys and plains and things are connected. And the Gulf of Farallones and Cordell Bank has been known for a long time as this bounty of productive systems, full of whales and birds, and down on Cordell Bank the rockfish and deep sea corals and everything. But as I

came to understand the oceanography more, what we understand are these upwelling cells, they're headwaters, they're places that come. Just like on the land we'd want to include the headwaters in Yosemite or something like that, if water comes down the mountain, you would want to make sure they include it in the system, so here the waters that are making Cordell Bank and Gulf of Farallones so productive and so rich are upwelling at the Point Arena, and that's the essence of this expansion, is connecting those two, so that they're including the headwaters in the system that we are protecting and we are trying to be real good students for. As the water upwells from the depths full of nutrients into the light of Point Arena--and all along the coast, but that's really the core, called the upwelling center--so it starts and it develops over the course of the next week or something into this super plankton, with all those mammals and birds and the fish and the salmon are migrating from the central valley of San Francisco Bay, they're all loving it, that's why it's so bounteous there. So the concept of being around for a while and it's wonderful to see science and policy coming together to do something really valuable.

Jennifer Stock: That's exciting. I'm curious, there's a million factors involved with what creates this productivity, what is so specific about Point Arena that makes that such a hot spot? I mean this is the peak upwelling zone for the entire west coast as I understand it, but what is it about Point Arena that makes it "the zone", "the spot"?

John Largier: So there are two things are going on right now, one is sort of large scale, the California current upwelling system starts way north in--actually up to Vancouver Island even in summertime, and it shifts with the seasons. In wintertime it goes down into mainland Mexico, down maybe south Oaxaca but definitely Nayarit and Jalisco and so on. But in this area in north central California, and particularly the close to Bodega Bay area has been the middle of it, the strongest most (inaudible) winds, it upwells all through the wintertime, in between the rains, it upwells most strongly in the spring and the summer. So there's that story, but that's the warm region, you can go up to Montreal and (inaudible) and Mendocino, and it's all a very strong upwelling region.

Then there are these headlands like Point Arena and Cape Mendocino and further south you get Año Nuevo, and further south Point Sur, they're all upwelling centers, and that gives you an idea of the size of these upwelling cells where there's these building blocks of the landscape. So Point Arena will upwell and go south and feed the Gulf of Farallones and Cordell Bank, Año Nuevo will

flow south and feed Monterey Bay, Point Sur will flow south, and so on. The symbol of these, probably the north-most that has a structure like (inaudible) is Cape Blanco, which is in Oregon and feeds the northernmost part of our state. So that's what makes it special is that the upwelling happens almost everywhere along the coast but these are where the water comes from the deepest, and even when the wind stops it continues in these headlands

Jennifer Stock: Just because of the flow of water.

John Largier: Yeah.

Jennifer Stock: How is upwelling affected by El Nino, can you talk a little about that, since I understand we're in a mild El Nino period right now, just as we're about at the beginning of an upwelling season?

John Largier: Yeah. I'll just briefly say I think a lot of your listeners of your program know about the ocean and about upwelling, but I'll point out that the importance of it is that the deep waters in the ocean are like a compost heap. So as things die in the ocean they fall down in the deep water, and it's full of nutrients there, but there's no light, so upwelling brings that nutrient-rich water into the light where you can now have your photosynthesis. And that's the basis of why the west coast is so productive compared to almost any around the world, the west coast's upwelling regions to Chile, Peru etc, and California and South Africa and Libya.

But the El Nino comes and they sort of suppresses this upwelling a little bit in two ways: one the warm water is coming up from the equator, and two you have a weakening of the wind, so there's less nutrients around, like you haven't put as much compost in your car. This year is sort of weird because it's not really an El Nino, but it looks just like one, in other words the water hasn't really--the typical process that happens on the equator between the Philippines and the Americas has started up and sorted faded out. But we've got this big, warm blob of water which has come in different routineness, different mechanisms, but has still been suppressing upwelling since July and June, as well as anybody knows the sea lions and the birds, a lot of the higher trophic level marine life are struggling with this lack of upwelling. Last week it came back, so hopefully it's here to stay, we saw temperatures 10 degrees below centigrade with 49 degrees Fahrenheit or something, we haven't seen this since last June, and with that came the nutrients and hopefully the system is going to be cranked up again. I like to call it

a “warm anomaly”, it’s anomalous because it’s warm like an El Nino, but not exactly El Nino so we’re trying to figure it out.

Jennifer Stock: Fantastic. I had a feeling those were upwelling winds last week, it had that certain intensity and persistence that was definitely upwelling, and I hoped that was what was going on, so thanks for telling us a little bit about that.

We just have another minute or so left, as a community leader and a professor, and adviser to the sanctuary, through the Sanctuary Advisory Council, what do you hope this expansion will mean, not just for the coastal communities, but inland communities in Sonoma County and southern Mendocino?

John Largier: Well the meaning to me mostly is trying to understand the ocean so that we will understand the mechanisms and achieve what we hope to achieve. And what we hope to achieve is that the oceans will continue being a bounteous, wonderful place, and we don’t unwittingly dilute it or reduce it as time goes on.

And so there are so many ecological services from the ocean, I mean some obvious ones is food, like we carry on catching and eating the fish and shellfish in the ocean, but there are many others as well including water quality and air quality. Why is it so wonderful to live near the coast? Because we have the pier coming off the ocean, I mean there are countless benefits and that’s our aim at the sanctuaries is not just to preserve the (inaudible) of the ocean, but to preserve the ocean functioning as a healthy system that in the long term is going to benefit us as humans, and that’s not just for those who live on the coast, but throughout the state and in fact throughout the nation and the world.

Jennifer Stock: Fantastic. Well, John I just want say thank you for all of your contributions in science and advising to the largest ocean community as well as the National Marine Sanctuaries along the coast. Thank you so much for calling in for a few minutes today!

John Largier: Well it’s great to be on the program. All the best, Jennifer.

Jennifer Stock: Thanks again.

We’ve had a very diverse show, talking about desalination, and the potential impacts that desalination can bring to coastal communities and the ocean, and keep your ears posted with what’s going on along the coast here. We’re all thinking about water very carefully,

and just think about it a little bit more when you open up that tap, and think about where it came from. And of course how to best conserve it; it's such a precious resource.

And then also to John, thanks for giving us the update on the expansion, and you'll be hearing about this days, weeks, months to come! I'm really excited to hear about how this is all tying together, the entire ecosystem, the source waters to the area where a lot of the production takes place. And I'm thrilled to hear that we just had a little upwelling last week with some cold water, and hopefully that'll help bring back the food for the local wildlife and the migratory species that come here from so far away.

Thanks for joining us today on *Ocean Currents! Ocean Currents* is the first Monday of every month, part of the West Marin Matters series, you can catch past series by visiting cordellbank.noaa/education, or you can catch the podcast in iTunes, just search for *Ocean Currents* and you'll find all the shows there as well. Thanks so much for tuning in, and get those buckets out for the rain, and have a great afternoon

(Musical outro)

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