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

(Music)

Jennifer Stock: Welcome to another edition of Ocean Currents. I'm your host, Jennifer Stock. On this show we talk with scientists, educators, fishermen, explorers, policymakers, ocean enthusiasts, authors and more, all uncovering and learning about the mysterious and vital part of our planet, the blue ocean.

I bring this show to you monthly from NOAA's Cordell Bank National Marine Sanctuary, one of four National Marine Sanctuaries in California, all working to protect unique and biologically diverse ecosystems. Just offshore of the KWMR listening area, on the West Marin coast, are the Greater Farallones and Cordell Bank National Marine Sanctuaries, which together protect 4,581 square miles.

It's October here in Northern California and we're taking advantage of the warm fall days to get in as much beach time as possible before the days shorten, and it gets chillier. When we plan trips to the coast, we often are using the sandy beach to plop our stuff on, dig and play, gaze out on the ocean, or use it as an entry point to get into the ocean. Seabirds utilize this habitat in search of sand critters, and the swash zone where organisms wash up, and pinnipeds like elephant seals and harbor seals utilize sandy beaches to give birth and raise their pups. While sea level rise threatens coastlines all around the world making our beaches narrower or drown them altogether, another unseen threat is looming and impacting these sandy environments and it's not being talked about. Sand mining is taking a toll around the world, and on today's show I'll be talking with Dr. Aurora Torres who is a research fellow at the German Center for Integrative Biodiversity Research and Martin Luther University of Halle-Wittenberg.

Her research has a true transdisciplinary character in a sense of problem orientation to real world problems and cross-disciplinary adaptation of methods. Since July 2015 she's leading and coordinates a pioneer working group with

scientists from Michigan State University, Boise State University and Georgia University that aims at providing an integrated perspective on global sand use and the long distance environmental and socioeconomic interactions between sand extraction and consumption. This research bridges gaps between different research fields from social to natural sciences, and the team is open to considering new collaborations as well as engaging with policymakers and practitioners. I'm going to put some music on for just for a few minutes while we wait for Aurora to call in. She is calling us from Germany. Stand by and we will be diving into this topic of sand mining.

(Music)

Welcome back everyone. You're tuned to Ocean Currents here on KWMR. This is Jennifer Stock and earlier I introduced the show and our topic today of sand mining, and this very complex topic. We are very lucky to have Dr. Aurora Torres joining us today from Germany. Aurora, you are live on KWMR. Thanks for joining us today.

Aurora Torres: Hey Jennifer. Thank you for the invitation to join the conversation.

Jennifer Stock: Thank you for joining us with quite a time difference. I know it is rather late in your day in Germany. So thank you again for making the time.

Aurora Torres: You're welcome, it's fine.

Jennifer Stock: I really want to start kind of broad. This is such a complex topic. How did you get into this area of study regarding sand and sand mining?

Aurora Torres: Well, Actually, my background is in road ecology and landscape ecology, so in my thesis I have studied the impacts of intensive human land uses like urban sprawl, road development or agricultural intensification. Before I used to focus on what happens when you build a road or build up area in the immediate environment, but I realized that was only part of the story because what is going on with the resources that are needed for construction. So two years ago the co-authors of this work, we met in a conference in Portland, I think it was, and we started to think of these

challenges and especially focus on the long distance interactions between sand mining areas and the consumption points.

Jennifer Stock: Wow, so we're talking about sand. Construction is one of the uses that it's used for. What are some of the other uses that sand is mined for from coastal and ocean areas?

Aurora Torres: Well sand is actually a resource that like water it's almost on every aspect of our daily lives. As you said, the construction is the most dominant driver of increase in sand demand because sand is a key ingredient for concrete, asphalt, glass, electronics. But we also require massive amount of sand, for example, beach renourishment programs to combat our ocean which will become more and more important with sea level rising in the next year. Sometimes it's not only to combat the ocean but to meet the expectations of the tourist of idyllic sand beaches. At the same time, we are in moments of escalating transformations in the land-sea interface as a result of growing coastal populations, land scarcity and geo-political issues that need massive amounts of sand to create new land. For example, like in Singapore. Sand is also attractive even for energy production. This is a big thing in the US. Sand is required for the process of hydraulic fracturing because it is one of the programs to fracture the rock and to keep the fracture open and being able to extract the shale gas. Sand mining for fracking has rapidly expanded during many areas of US in the last year like in Wisconsin. It has also raised environmental and social concerns for landowners and the small communities in those areas. So these are basically the four main drivers of the increase in sand demand that we described. But there are many more uses. As I've said, it's almost every aspect of our daily lives that requires sand.

Jennifer Stock: Being that it is something that touches our daily lives, why do you think that it just has not hit the radar in terms of global awareness of it being overmined and causing so many problems?

Aurora Torres: Yeah, well, it's an aspect that I find really fascinating. I think one of the problems is that when we think of sand, we think that sand is everywhere and it's available for all of us. But actually not all sand is treatable for construction. Many people when they saw this paper for the first time, they were

pointing to the Sahara Desert and saying 'why is it possible that sand is becoming increasingly scarce if we have massive amounts of desert sand?' But what they don't know is that desert sand is actually not very suitable for construction, in general, because it creates concrete of poor stress because of the erosion by the wind that makes the grains of sand is smoother and thinner than other more irregular grains of sand from rivers or coastal areas. We also have the option to mix this not very suitable sand with other substances but then the production of sand becomes more expensive, it requires more energy and it also increases the greenhouse gases emissions. So it's not really a very good alternative. I think this idea of sand being an infinite resource is one of the key elements that has contributed to sand becoming increasingly scarce, becoming under the radar.

Jennifer Stock: Sand is a production of erosion, of rocks, and is made over long periods of time. I'm assuming we're taking it out much quicker than it's possibly be made. Is that correct?

Aurora Torres: Yeah. Well, the thing is that we are very cautious in our paper. We don't say loudly that sand is a global scarce resource at the global scale. We know that there are many areas that are running out of sand and in which sand is becoming increasingly scarce. The problem of the global scale is that we are missing the numbers, we don't have the numbers to say how much sand is produced and extracted. So, I think this is one of the directions that we really need to develop in the next years. But, yeah, my feeling is that with the current extraction rates of sand, it's impossible that sand can be considered as a renewable resource.

Jennifer Stock: Where is sand mining taking place?

Aurora Torres: In general the best quality of sand is the sand that we found in areas close to rivers and also in coastal areas. There also are some places that are not so close to rivers. Another process that is very common in countries like Spain, the country that I'm originally from, what they do in Spain is crushing stones to produce the sand. It is more expensive than extracting the sand directly, but it can be an alternative for areas that have this treatable type of rocks. Also because of sand mining bans in rivers and coastal areas, sand mining is moving towards offshore areas. This is something that for example is happening in Germany.

Jennifer Stock: I've seen actually some technology developing of deep sea, seabed mining where they send down these really giant robots and the technology is getting greater and greater and they're able to go to areas and can stay under water for long periods of time. Is this part of your study as well in terms of some of this deep-sea mining that's away from the coast and somewhat unseen?

Aurora Torres: Yeah, well it's something that we have considered in this paper. We talk about the environmental effects of sand mining. We also have considered the impacts that it may have in coral reefs or seaweed or seagrass meadows. So yeah, we are counting on that. We are considering this. The problem is that there are not so many studies made until now because sand mining offshore has not been so common before and it's very new. Then there are not many papers reporting about these effects but some people is suggesting that this might be, may have linkages with fishing and with other activities that are affecting human systems. So it can be a big deal. It's something that needs to be look in detail. They're another thing that we need to consider in this type of operation because, depending on the intensity, they may have reversable or irreversible effects in the environmental system. It's quite complex but we need to focus on that.

Jennifer Stock: Excellent. For folks tuning in, this is Ocean Currents and my guest today is Dr. Aurora Torres. She's calling in from Germany and we're talking about sand mining that's happening globally.

So you are talking about a systems integration approach with your team. Can you talk a little bit about this systems integration approach?

Aurora Torres: We are applying this system integration approach because what we found at the beginning, when we started to study this area of research, is that we have very different thesis of the science but they were not connected. So until now the research literature has been largely fragmented and we have papers in sedimentology, remote sensing, social issues, but there was nothing connecting all these thesis. And this is a perfect scenario to apply system integration approaches which is a very basic and interdisciplinary perspective that tries to identify all the systems involved. In the case of sand mining, we can think of course of the sand extraction area, but we have also the consumption areas that sometimes are

not so close to this extraction. In the transportation of sand from the extraction to the consumption point, we might be affecting other systems, for example the spread of sand-based species. This framework helps to identify all of this long distance, environmental and socio-economic interactions between systems. They have been previously applied to other very complex issues like food security or biofood, so we thought this might be a good opportunity to start applying this to get a better understanding of the system, and then to move forward and start quantifying all these effects and interactions and achieve sustainable extraction strategies.

Jennifer Stock: Is this a study that takes place over a year or two years? It sounds very, very complex.

Aurora Torres: Yes, exactly. It has taken two years of reading and synthesizing a lot of information and connecting all these thesis, and also something that we wanted to do because previous to this work has been quite a lot of articles in the media. Actually, it's fascinating to me that the media has actually, the media and the journalists has been the ones raising awareness of this issue. But something that we're working on is the evidence behind many of the statements that we found in this type of articles. We have been examining very carefully all the literature and really assessing the evidence and the support for saying that sand mining extraction, destruction and trade have significant environmental and socioeconomic effects.

Jennifer Stock: Let's talk about a region that has really shown a huge growth in sand mining in terms of production or consumption. Is there a specific area in the world behind this issue in terms of its escalation?

Aurora Torres: Well yeah there is a region, actually. We can think of Asia and Africa also as the areas where the sand mining is now progressing faster and is having more effects in the human and environmental systems. The perfect example of this is India more because of the urban expansion and transport infrastructure expansion in the last decade. This has increased a lot the demand for sand to the point that sand mining has become a very profitable business. It has contributed to the creation of what has been recognized as 'sand mafias' in charge of the extraction of sand, and also with linkages with the government in some areas. Actually,

something that everyone can do is to check for Google update, the alert, you put 'sand mining', and then every day you will receive many news coming from India reporting conflicts related to sand mafias like murders, rapes and all kinds of conflicts to the point that hundreds of people have been killed in the recent years in India because of sand wars and conflicts between the sand mafias and local populations.

Jennifer Stock: Wow. So really the consequences go way beyond environmental as well. There's quite a social impact as well that's happening. How about in Vietnam? I was reading that Vietnam is really at a crisis point. They are losing sand so dramatically so that there is hardly any left.

Aurora Torres: Yes, actually the case of Vietnam is one of the cases that we usually comment to support this fact that sand is becoming increasingly scarce because during this summer the Ministry of Construction in Vietnam declared that by 2020 they may run out of sand for construction because they are depleting their national reserves at a rate that the deposits are not able to replenish. It's also in part because of the consumption of sand inside the country to support this urban development, but it's also for the contribution of sand mining trade because Vietnam is, for example, one of the countries that has been exporting sand to other countries nearby like Singapore which is the main global importer at this point.

Jennifer Stock: So Singapore is developing rapidly I take it.

Aurora Torres: Yeah, exactly. It's not only that it is developing quickly. It's that the surface is increasing because of land reclamation projects so the surface of Singapore has increased by 20% in the last year. To create more land, you need sand to create concrete and new areas for construction. Then you need massive amounts of sand. They have been importing sand from Malaysia, Cambodia, Indonesia, Vietnam and other countries nearby. These have led to geopolitical conflicts in the area because sometime some countries have claimed Singapore of getting sand illegally.

Jennifer Stock: The countries that are most affected by this, are there any regulations on the continent or in the country itself in terms of the extraction or the export of sand? Are there any regulations at all in these countries?

Aurora Torres: Well it depends on the area. There are like several problems. It's not only a matter of regulation. In general, regulation in this area is very poor, but sometimes it's not so poor, but it's not enforced. Something that happen in most of these areas is that illegal sand extraction is very common because sand is what we call an 'open-pool' resource - that's open to all. You can't imagine putting a fence to sand. It's really difficult to regulate and to monitor. In these areas, it's not only a matter of regulation but a lack of enforcement.

Jennifer Stock: Also reporting, they may not be reporting as much as actually is taking place.

Aurora Torres: Yeah, there is also one of the big problems trying to understand this challenge is that sand is one of these resources that is commonly underreported in global statistics. Well global and national statistics. This makes our task more difficult. Another point that is very important to consider for the sustainability of the extraction of sand is to have very good knowledge of what we call the sand budget, which is basically to know how much sand has been naturally replenished and how much sand has been extracted in order to think about sustainable extraction rates. This is missing for most of this area.

Jennifer Stock: I'm really curious. On the east coast of the United States, there's this barrier island ecology where there are these offshore little islands of sand. Of course they are completely submerged, but the idea is over time, geologic time, these sand islands somewhat turn over themselves, and it's a really important part of the ecology of these islands. Are there areas like that too that are affected by sand mining?

Aurora Torres: Yeah, well we have to think of coastal systems as dynamic systems. In some areas sand is removed naturally and then in a few years, sand is recovered naturally. Yeah, this come on very often. But sometimes in many areas we want to have the prefect beaches with the perfect amount of sand all the year for our tourists. Sometimes we increase our need for sand for this replenishment programs instead of waiting for these areas to recover naturally.

Jennifer Stock: Also, after a lot of these big disasters like hurricanes or tsunamis that sand replenishment is creating a huge demand as well.

Aurora Torres: Yeah, it's one of the key elements that has a very clear demand of sand. Somewhere in which we have seen this really clearly is Sri Lanka, which is also a very interesting country, and most of the elements that we have in the paper, they are having in Sri Lanka. For example, a recent report have concluded that the tsunami in the Indian Ocean, the tsunami that happened in 2004, had more intensive effects because of the extensive extraction of sand that was going on in the coast before the tsunami. After that, this has significantly increased the demand for sand, which makes things more difficult in the future. The problem for the next years is that all the activities that are demanding sand are going to increase. Our ocean is going to become a bigger thing and the same with urban development. We really need to start thinking about strategies and improve the research, the quality, and the amount of research that we are doing in this area.

Jennifer Stock: Your work with the systems integration is really critical of this time. And are you one of the only teams looking at this? This is a cross-cutting, international team as it is. Are there other teams working on this issue or are you hoping to build your team?

Aurora Torres: Well, so what I can tell is that we are a pioneer working group; the only working group that is now trying to provide this imperative perspective to the global sand supply and demand. One of the things that we want to do in the next year is to increase the interdisciplinarity of our team because this is an area of research that is so complex that we are going to need people with many different profiles. Until now we are all from ecology, with different backgrounds, but at the end we are all ecologist. So we are starting to contact experts in other areas of research and also even from our disciplines to start thinking about governance strategies, global sand budgets and all the key elements that we think that should be key in the next years. We are we are hoping to take the lead in this. What we wanted with this paper was to present this challenge to the global community. But now was there are several works going on for the next months and years that are going deeper in many of the topics that we highlight in the paper.

Jennifer Stock: Excellent. What are you recommending at this point that could possibly be done to slow down this issue in terms of extraction and this demand for sand?

Aurora Torres: There are several things that can be done. I'm a bit cautious talking about alternatives because this is a resource that is used in massive amounts. If we are going to think about an alternative, we need to guarantee that it's not going to be worse than the current damage that is causing destruction of this resource. But something that can be done, for example, is increasing the efficiency of sand use and trade. We are promoting and encouraging recycling policies and avoiding waste along the supply chain. This is something that, for example, in Europe is getting more and more success. In countries like Europe, the recycling of construction material is becoming a big proportion of the cake. This is not enough. We also need to think about coordination among multiple, multi-national and international policies and establishing controls in extraction, trade and monitoring of the sand mining and trade. So yeah regulations from the global scale to the local scales, international conventions. We really need to start giving the steps to this global sand governance.

Jennifer Stock: For folks tuning in, this is Ocean Currents. We are talking with Aurora Torres and talking about sand mining globally and the rates that it's happening and the destruction that it's causing all around the world. Are there alternatives for building materials in terms of this specific sand grain? Are there other types of alternatives that could be used besides sand?

Aurora Torres: Well apart from crushing stones that I mentioned at the beginning, there are many research teams across the world trying to find innovative alternatives for sand. Some of them might be useful at the local scale. What happens in most of the cases is that the process becomes more expensive, it requires more energy and it increases the pollution. So we need to make more developments in areas to be able to find alternatives that can be implemented at a larger scale, and not only for the countries that have the technology to do that because the main areas where this is having a huge impact now is in Asia and Africa, and we need to guarantee that they are going to have the technology to implement this alternative.

Jennifer Stock: You mentioned recycling policies. How is sand possibly recycled or is it the building materials that you're talking about being recycled?

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- Aurora Torres:* Well it basically comes from the demolition of buildings that are no longer of use and all these structures are crushed. I don't have a deep understanding of these, but I think these materials that come from these demolished buildings are somehow mixed with other components to make good quality concrete and other construction materials.
- Jennifer Stock:* I got it. I see. Woah! Thank you so much for sharing all this. It's kind of another example of justice. We are running out of room on our planet for the resources that we need to exist and competing with the natural world as well that also provides us with so many different services. I've learned about it just two years ago. Actually it was through media. That movie "Sand Wars" came out and it was the first time I read about this issue. It's just not something I've been reading about a lot. I think mainly because I'm here in the United States and we have a lot of regulations to protect against sand mining. It's not in our face here in the United States. This is really a big thing that I think the media is helping to tell the story by sharing the photos and the video and telling the story. I hope that it becomes more prevalent in terms of people understanding this threat out there and looking at our beaches a little bit differently.
- Aurora Torres:* Yeah absolutely, and something very important about the documentary that you mentioned, "Sand Wars," is that it created the basis for the report that was published, I don't know two years later, more or less, by the United Nations Environmental Program. It really had an impact. This is one of the very few reports that was found of the topic, so it really made a difference. I think until now the media has been pushing for this and in the next year, we hope to do the same in the research area. Even though I said before, that most of the impacts are now taking place in Asia and Africa, we have examples of impact of sand mining all across the world. Also, in the US, there is an area in the Monterey Bay that has been affected for many years for extensive extraction of sand in the coast. I think for more than 70 years. Finally, my understanding is that sand mining is going to stop in 2021 because of the concerns that it has risen in the area.
- Jennifer Stock:* Yes. I'm glad you brought that up. I actually wanted to find some local context because along California here we have four National Marine Sanctuaries, and the Monterey Bay National Marine Sanctuary is the largest between the Marin

County region and San Simeon region. This plant, I think it's CEMEX, they operated in Marina, Monterey before the California Coastal Commission was established and never applied for permits and permissions to continue beachfront sand mining, like off the beaches. As time went by, the Coastal Commission was pushing them to apply for permits, and the State Lands Commission. My reading of the articles today is that the California Coastal Commission issued a cease and desist order for them to minimize their operations over the next three years and close the entire operation in the next six years. The community in Monterey and other experts in this region were seeing these beaches in Monterey diminishing. There was a lot of local application and people seeing it happen. This is the last beachfront sand mining company in the United States, so that'll be shutting down in the next 6 years. There is a some local awareness here, but I'm sure the global awareness in terms of impacting people and this sand mafia you're talking about is a really different scale, too, that we don't necessarily see here in our daily lives in the Unites States.

Aurora Torres: Yeah, you're absolutely right. And yeah, we need to bring these examples from areas far away to our daily news.

Jennifer Stock: That is happening elsewhere, and it is equally of concern. When I came here to work here for the National Marine Sanctuaries and learning about the regulations and prohibitions we had, I didn't really think that much about the seabed disturbance regulation. I just didn't know that much about seabed disturbances until, as time went by, I realized we have this protection in place in our National Marine Sanctuary here; there's no disturbance to the seabed including extraction of sand and seabed material. That's a positive and some forward thinking we had here when we were establishing some of these Federal Marine Protected Areas along the coast.

Any last things you'd like to share with us about this issue and your approach? I just want to commend you for your international effort to bring together experts to really look at this in the cross-disciplinary nature that it is and starting to raise the awareness. Any last things you'd like to share with us?

Aurora Torres: Well, thank you very much. No, I think more or less the main, key aspects of these emerging issue are over. I would like to

invite anyone that has questions or that want to get more involved into this research, to get in touch with me. As you said before, we are open to considering new collaboration, and we need people from all fields and all areas of research. Also, from the general public.

Jennifer Stock: Is there a specific way people can contact you?

Aurora Torres: Yeah, there is my email address and they can also follow all the developments in this area in my Twitter account.

Jennifer Stock: That is @Aurora_TorresM. I'm finding Twitter such a useful tool for finding out about information, and I was able to follow you and see some of the links that you've been sharing about the information. It's such a great little aggregator for learning about topics that you're interested in. Thanks for sharing your expertise that way, as well.

Aurora Torres: Well, thank you very much. For me, it's also very useful for my work and to know what is going on in other areas of the planet. Also, to know about news related to sand mining and trade. It's a very powerful tool.

Jennifer Stock: All right. Well, I want to thank you again for joining us so late in the evening from Germany to share with us about sand mining. I look forward to following your research and work as time goes by. Thank you again for joining us on Ocean Currents.

Aurora Torres: Thank you. I would love to talk to you again in the future.

Jennifer Stock: Okay, we'll definitely be in touch. Take care.

This was a very complex topic that we were addressing today here on Ocean Currents; sand mining that is happening all around the world. It's something we just don't see in our daily lives. When we go to the beach, we see sand, but there is a lot of sand being taken away. The US production alone has increased by 24% in the last five years. There is a report online that you can look at produced by the USGS, United States Geological Survey. It basically highlights all the mineral commodities that are produced in the United States. It's called the USGS Mineral Commodity Summaries 2017. It's a report that details all the mineral commodities that are extracted here in the United States.

Very easy to just Google it: "USGS Mineral Commodity Summaries 2017."

We're going to take a short break. In a few minutes, we'll also be sharing our Positively Ocean episode produced by Liz Fox to share something that's working well for the ocean. We've talked about a pretty big, heavy topic here today, but there are some positive things happening too want to share those, too.

(Music)

Jennifer Stock:

This past week our sanctuary research team with the Cordell Bank and Greater Farallones National Marine Sanctuaries, in collaboration with the local nonprofit Point Blue Conservation Science, they celebrated their 50th research cruise in the Cordell Bank and Greater Farallones National Sanctuaries, just last week. This is a program that's been going on for 14 years that's called Access The Applied California Current Ecosystem Studies Program. It's really a critical monitoring program that takes the pulse of the ocean conditions in our local National Marine Sanctuaries, in our local ocean off the coast here, which is just one of the hotspot areas for biodiversity around the world, this whole California current ecosystem. So we really want to say thank you to Point Blue Conservation Science and both Cordell Bank and Greater Farallones National Marine sanctuaries for continuing to do this work. It's so, so important to keep monitoring these areas, especially through the changes that we're talking about a lot here on Ocean Currents. You can learn more about that program at AccessOceans.org and if you're on Facebook, they have a group page called Access Partnership where they share highlights from each of the cruises when they come back to shore. That's one place that I find out exactly what's going on with whales and zooplankton and everything they're catching out there. Check out Access Partnership.

Well, I want to take a pause here to play our Positively Ocean episode. Liz Fox is a volunteer with me and she is a based in Berkeley, and curates a story each month to highlight something that's working well for the oceans. So stick around here for a Positively Ocean.

Positively Ocean Episode - Students become "Ocean Guardians" through National Marine Sanctuary School grants

Liz Fox: Hi. This is Liz Fox at Positively Ocean where we celebrate the ocean and look at what's working well. Schools are back in session and students seem to be taking cues from the ocean like sardine schools that dart about seemingly in unison or orca pods knocking a seal off an ice float. Whether evading predators or hunting prey, groups of ocean animals investigate their surroundings, communicate and cooperate their response to insure the packs wellbeing. Now on Alameda Island in the San Francisco Bay, human students do it, too, because saving the ocean might help save us. Through NOAA's Ocean Guardian program, students districtwide study environmental science and apply the lessons to their shoreline backyards that are overrun with invasive fennel and Russian Thistle. They remove it, sow marsh gum plants in their place, and report back to the herd through presentations to other classes, parents and district administrators, and at community fairs. Besides the skills they learn conducting science and communicating it, they are building ocean conservation into their personal identities and it's infectious. Jennifer Hartigan is the Lincoln Middle School teacher who helped bring the program to Alameda in 2013. Her students practice their presentation, and by the end of the year, the whole school knows what the Ocean Guardians are up to.

Jennifer Hartigan: I love seeing them grow with that. Some students are really interested in taking that challenge.

Liz Fox: This year the Alameda Unified School District opened the Ocean Guardian program to elementary and high school classrooms. It's California's second school district to adopt the program, which has grown from a local culture of environmental stewardship and created more. It helps a lot that Alameda is also in a statewide program for environmental literacy. Alameda found that the state's blueprint to help connect students to their local environment coincides nicely with the Ocean Guardian curriculum. Seaberry Nachbar is at the very nexus of the movement. She directs the Ocean Guardian program that she started in 2010 and sits on the committee to design the state's environmental literacy vision.

Seaberry Nachbar: and you see over and over again that when kids are provided the opportunity, the knowledge, the resources and

the support to make differences, they do. They step up to the plate.

Liz Fox: So three weeks into the year, in Hartigan's Ocean Guardian class, 7th and 8th grade students brainstorm designs for T-shirts that they'll wear throughout the year. As the young teens clicked and dragged clip-art and developed slogans, silence fell over the lab classroom replacing the awkward jitteriness of lunch period just minutes before. Then "oohs" and "aahs" followed the design reveal, and Hartigan reminded students that the final T-shirt would be a group effort taking bits and pieces of what everyone likes best to create a single logo. Although a shirt may seem like a simple garment to identify Ocean Guardians, it and the program it represents become part of the youths' character.

Jennifer Hartigan: Middle school students are very open to new ideas. So I think if we can connect with them and light fire at this age, then we can hope to teach the next generation about conservation, about preservation, about the hard work that has to be done.

Liz Fox: Hartigan says she watches the kids' passion for the environment grow with their understanding, and she's got company. Over 7 years, Nachbar has also witnessed the transformation in many of the nearly 48,000 students who have participated in the program.

Seaberry Nachbar: And we see that connection made. The kids are like "oh I get, I get it. I understand that. I'm on this little creek and that this creek is going to flow to a river and the river is going to flow to the bay and the bay is going to flow to the ocean." It opens up their perspective.

Liz Fox: But as ocean science demands, Nachbar wanted data that showed the yearly difference Ocean Guardians make. She's tallied the numbers for the life of the program including more than 400,000 single use plastic bottles that were spared or more than 300,000 square feet of non-native plants removed. Besides curriculum support, the Ocean Guardian program provides grants; more than \$800,000 to date to help schools implement their vision. One school was able to buy a new dishwasher to end Styrofoam tray use in the lunchroom. And grant funds are especially important for providing transportation and substitute teachers to low income schools, Nachbar said.

Seaberry Nachbar: For a lot of these students, the schools that they're in can be less than a mile from the beach, but they haven't created that personal connection with the ocean environment. And we're providing them this blue mind.

Liz Fox: Just getting the kids to the shore may set the ocean up for a brighter future. Researchers in Germany who study schools of fish recently observed individual's actions and interactions more closely than ever before. Using high-speed cameras and computer models, they concluded that the group's well-being depends on many single creatures exploring, making connections, communicating and cooperating. And that's an example of folks doing right by the ocean. Until next time, I'll be searching for all things Positively Ocean. For Ocean Currents radio this is Liz Fox reporting in Alameda, CA.

(Music)

Jennifer Stock: There you have it. Kids are leading the way again through education, engaging their school communities and finding some sustainable solutions to reduce waste and to help habitat through Ocean Guardian grants. I'll just add for that, if there are any educators in the listening audience here, that this Ocean Guardian grant is an opportunity for schools to apply for small grants to help implement these projects. The time period to keep an eye on is April 2018 for an announcement for a call for applications. You can go to sanctuaries.noaa.gov/education/oceanguardian to get more information. You can also just Google "Ocean Guardian program sanctuaries" to get right to that as well. It's a really fantastic program and it's always fun to hear some of the stories of the different schools of what they are doing.

My guest today, Aurora Torres, was mentioning that she's really building this collaborative, international team to look at this sand mining issue on the multiple scales that it crosses. They are building a team and are looking for collaborators to join that team. And maybe you are one of these people that offer something to help with that. The way to contact her that is easy through Twitter is with her Twitter handle @Aurora_TorresM. She was mentioning the paper that she was just talking about and it's called "A Looming Tragedy Of The Sand Commons." You can Google that and also get her direct email through that as well. "A Looming Tragedy Of

The Sand Commons” and that’s the article that actually tipped me off to cover this on Ocean Currents.

Ocean Currents is the first Monday of every month, 1 to 2 p.m. We have a Twitter feed. You can follow Ocean Currents, and I share out links there from articles that relate to the topics we’ve talked about on the show here at Ocean KWMMR. You can get more information on the program and other things that we're talking about here on this show. I love hearing from listeners. So if you have ideas for topics, questions or comments, please email me, cordellbank@noaa.gov. Thank you so much for listening. Enjoy this ocean, bay or whatever body of water you can get into safely in these last few months before later fall hits and winter. This has been Ocean Currents for community radio, KWMMR, West Marin. Thanks for tuning in.

(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, KWMMR. Views expressed by guests on this program may or may not be that of the National Oceanic and Atmospheric Administration, and are meant to be educational in nature. To contact the show's host, Jennifer Stock, email me at jennifer.stock@noaa.gov. To learn more about Cordell Bank National Marine Sanctuary, go to cordellbank.noaa.gov.

(Music)

Jennifer Stock:

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