DOSITS Webinar: 20th Anniversary Webinar
(November 30, 2022)

Question and Answer Summary
(Questions asked/answered in real-time during the webinar or in the Q&A box)

Answered live during the webinar

Question: Professor Roberts: **What are the mitigation actions we could adopt to reduce the risk to inverts?**
Answered by **Louise Roberts**: Great question, also a pretty tricky one, right? Because we're thinking about as I said in my presentation not only are these exposed to water borne sound they are also exposed to vibrations. So when we're thinking about mitigation, we have to consider both of those aspects. The difficulty that we have is many of the existing mitigation methods are not kind of tailored towards invertebrates or fish. They are mostly kind of geared towards marine mammals. So, things like bubble patterns around piles, for example and things like ramping up a sound you're forcing animals away from an area, gradually those things are kind of less useful for less mobile animals, particularly invertebrates. Many of them are sessile, so they can't go anywhere anyway. And so that's kind of our difficulty is that the current measures kind of don't address fish and invertebrates very well. But one of the best ways I think we can mitigate is to develop knowledge regarding the exposure levels that will affect these animals. And so, once we know those for sure, then we can design our mitigation strategies accordingly. In regard to seabed vibrations, as far as I'm aware, there are no known devices currently to mitigate against those vibrations. But what we could think about doing is kind of avoiding works in biologically sensitive areas, and things like that. So, kind of biologically mitigate in the short term whilst we develop those more detailed methods.

Question: Brandon, I can bring you in here and expand this to ask: **Are there mitigation measures particularly that we should be looking at in general?**
Answered by **Brandon Southall**: Yeah, I think you know the evolution of some of the mitigation approaches in the marine mammal realm have been in the right direction, right where we've kind of gone from these really near source, fine-scale, based purely on injury, kind of mitigations that had to do with just sort of what was obvious at the time. Like, put more visual observers to see animals that are right next to the source towards things that look more at what are the seasonal, and what are the spatial temporal use patterns of animals around activities, and are there mitigations that can relate to timing activities to reduce impacts using risk assessment? And/or actual quieting technologies just reduce the footprint. So, there's been some evolution, and in some of those and in some implementation of new tools; infrared imaging for low visibility conditions and thinking towards mitigation that actually reduces risk in a kind of an informed way that I think is going the right direction.

Question: Are there climate change models or noise stress/response approaches that allow separation of ocean noise effects on marine biota from the consequences of ocean climate shifts that are maybe forcing prey/predators in time & space? I know that's very difficult. But maybe you can talk about opportunities or places where you know multivariate models are being used to look at these kinds of things.
Answered by **Brandon Southall**: There are a couple of clear examples of climatic shifts that have put animals into new environments that have both winners and losers, right? There's some animals that are using areas of the Arctic now that are doing really well in places that they've shifted into. Conversely, other animals like North Atlantic right whales that have shifted some of their distribution to places where they encounter new threats. So, I think you know, being aware

of that, I mean it is difficult to disentangle some of these drivers of what we know of natural variability overlaid with this shifting climate and predicting how those things are going to play out, like in dynamic areas where we don't always fully understand, especially high productivity areas that are pretty dynamic. So it is tricky. But I think, looking at some of the kind of examples that we we've seen, particularly in the Arctic, including identifying hotspots that are likely to occur, based on things we've seen like with right whales is something we need to do. It's a challenging thing, though. Louise, any thoughts or others? **Louise Roberts**: Yeah, I guess I'd say in relation to fish and invertebrate, we really still know so little about noise impacts. It's very difficult to start considering them alongside other impacts. And I think we certainly have a lot more data that we need before we can start kind of interacting that in larger models.

Question: How difficult is it to tag wild dolphins? Brandon, can you talk about tagging more broadly?
Answered by **Brandon Southall**: It's definitely possible. There are a wide variety of tags. Some of them are archival and less invasive, and they're deployed with suction cups, and they stay on, for you know a day or a few days. Others have barbs that hold on. If you want to monitor, for you know weeks or months, you have to do that, because these are, you know, hydrodynamic animals that shed their skin all the time. Or they're glued on in the case of pinnipeds. So, you definitely can deploy different types of tags on animals all the way down to some of the smaller Delphinids. The species that I talked about, like common dolphins and bottlenose dolphins, we have actually been able to deploy some of these suction cup tags that we've put on larger animals like baleen whales and beach whales, they just take them off right away. They're very agile, and they'll spin or they'll jump, and they'll remove them. They're adapted to not having things on them, remoras or anything. You see remoras on a whale, they probably think a tag is just another remora. You don't see remoras on common dolphins. But there's kind of an interesting evolution of this. When we moved into that study the recognition was common dolphins make up a large proportion of the Navy's predicted impact. We should probably know more about direct measurements. Liz Henderson, who was on here a bit ago had made some measurements using passive acoustics with animals like common dolphins. But you know we wanted to get some more controlled exposure data on sonar for these species that make up a big portion of what the Navy thinks that they're impacting. We decided let's try it with the tag. So we did deploy these tags on common dolphins, on bulllnose dolphins, they lasted a minute to maybe ten. They just they just don't really work, and the barb tags have been deployed on some of those animals. But I think as we thought about doing this and other methods we kind of came, or at least I came to the realization, and maybe this should have been obvious earlier, these are group living organisms, highly social, dynamic group responding kind of organisms. It would kind of be like if you wanted to measure a flock of birds you'd have to tag every bird, you know, or every fish in the school of fish. Some of the fish people have definitely dealt with this where they're looking at C-start responses of individual fish. But looking at the dynamics, the spacing, the clustering, the speed, the relative orientation of the group. The group is really the unit of analysis for some of these types of social animals. So you could tag them. It doesn't work very well, and it's probably not the right kind of approach to be able to use tagging individuals unless you're going to tag a lot of them. **Louise Roberts**: Yes, I can add to that. You can tag invertebrates as well to varying degrees of success. But I've certainly tagged a few crustaceans in my time, but we can also use similar approaches, it's just as tricky.

Question: Using passive acoustic monitoring: what are & where do you source your trusted, low-cost hydrophones and recorders?
Answered by **Brandon Southall**: I'll add something, you know. There's a variety of commercial off-the-shelf kind of technologies, including things that are as simple as hydrophones that you can plug into your iphone, and there are interfaces to do that. So, there's definitely low tech and

low cost kinds of sensors out there. You do get what you pay for sometimes, you know, and it depends on the longer you want to put something in and leave it out, and the more harsh the environment you want to put it in. We've all had recorders flood, and we've all had failures of things that we were frustrated with. ITC makes a lot of commercially available hydrophones. We work a lot with Soundtrap, David Mann and Loggerhead Instruments have a lot of great low cost, very accessible, easy to use recorders. Some of the times, and this is true with tags, too, you know. It seems like there's people all over the world doing this kind of work. But when you really boil it down, it's a pretty small market for some of these things. And looking at it from the economic and production side of things there's not a huge market for a lot of these things. So sometimes the kinds of low-cost things that we tend to see are maybe one step closer to the bench than something in what is a bigger market. Those are some of the ones out there that a lot of people in the field use. Louise? **Louise Roberts**: So I didn't do too much passive acoustic monitoring myself. But I know a lot of researchers use a Cetacean Research Technology hydrophones and Aquarium Audio hydrophones as well, like the H2O and they're kind of generally popular, and they're not too expensive in some cases. Looking at field recorders I've used Zoom and Tascam hand-held field recorders. I found them to be really good. And again they kind of span a range of price brackets. But also, there are some new exciting devices for kind of more autonomous recorders. Things like the AudioMoth and the HydroMoth which are little devices you can leave out and do long-running recordings with. And I know there's been some success of people using those. Myself, I've recently been tinkering with making hydrophones just from pISO disks, and you can buy those for a dollar and make them waterproof and stick them in the water and see what you can hear. So there's all kinds of things you can do. It just really depends on your application, and it kind of depends on how scientific you want to be with your recordings.

Answered in the Q&A during the webinar

Question: For Dr Roberts: **How well do sound vibrations travel through the seafloor relative to sound transmission through the ocean?**
Answered by **Louise Roberts**: Great question- so we think they travel pretty well through the seafloor, particularly vibrational waves in the interface between the sediment and the water. Have a read of this paper for an overview: https://asa.scitation.org/doi/10.1121/10.0004773.

Question: Re. Professor Roberts' presentation: **After being damaged, does the statocyst heal by itself?**
Answered by **Kathy Vigness-Raposa**: I think we likely need more studies to ascertain that for sure, but there was some evidence of healing in the following paper which looked at damage to cephalopod statocysts: https://www.sciencedirect.com/science/article/pii/S0967064512001877. The authors found what they thought was the beginning of the healing process around 2 days after exposure.

Question: For Dr Roberts: **Does the effect of sea floor vibrations bear similar "linkage" (mechanical, propagation) to the Air / Ocean transition models?**
Answered by **Louse Roberts:** Thanks for your question- there are certainly physical parallels to air/ground research, although I'm not familiar with air/ocean models. For air/ground, there is a biological discipline known as biotremology which looks at how animals use substrate-borne vibrations to communicate and interpret their environment. Most of these animals are using Rayleigh waves, surface waves in the boundary between the two.

Question: Chris/Holly: **Is there a place you can point to that lists all wired offshore networks for North America?** I was aware of the ONC networks, but not Monterey. TY!
Answered by **Holly Morin**@Shannon Donovan - YouTube gets cranky about sharing links. There are definitely a variety of cabled observatories in the Pacific and Atlantic basins. If you go to the Ocean Observatories Initiative site.

Question: Can you detect climate change through change of sound speed due to temperature change in the water?
Answer: Thank you for your question. This can absolutely be done. This was the focus of the Acoustic Thermometry of Ocean Climate (ATOC) study, and they measured water temperature changes of 0.6 deg Celsius in the North Pacific.

Question: Are there any species-based specific sounds at the stage of reproduction (in marine mammals)?
Answer: Thanks for your question! There are some great pages on the DOSITS website that address how animals use sound for communication, including reproduction: https://dosits.org/animals/use-of-sound/how-do-marine-animals-use-sound/.