

**DOSITS Webinar:
Passive Acoustic Monitoring, Applications for Marine Mammals Fishes
April 8, 2021
Presenter: Dr. Sofie VanParijs**

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

Questions asked/answered live by Dr. Sofie VanParijs during the webinar:

Question: In principle, can you reliably identify particular species by their sounds?

Answer: You can absolutely do that as long as you have identified those sounds to that given species. For example, if we are thinking about right whales, we have spent a lot of time recording near them, putting tags on them, and understanding what sounds they make. So yes, but as I said at the start there's a lot of sounds out there that we still cannot identify reliably to species so there's a lot of work yet still to be done to match those two, particularly when it comes to fish.

Follow-up Question: With a species that's fairly well known, can we quantify how certain we are about the identification?

Answer: We can and we do actually try and do that, particularly for the endangered species. It is really important to know that when we say there is an animal there that it is actually likely to be there. Obviously, we can never be 100% certain because we have problem species like humpback whales. They are kind of like the nightingales of the sea, they tend to change their song or take sounds from other animals, so there can be a year in which humpbacks decide they're going to sing like right whales and then you're just like ah-ha, but there are other years where they decide not to, and so there can be those species. I mean it's a beautiful thing that they're so creative, but it can also be tricky.

Question: If anthropogenic noise frequencies overlap with the frequencies of the species of interest, do you filter the noise to extract the sounds you were actually interested in, and if, yes, what methodology do you use for that?

Answer: So, we do and we don't. It depends. Sometimes we're interested in understanding how much that these sounds mask sounds we're interested in. But a lot of the automated detection software that we use do filter. It's kind of called conditioning the spectrograph. So, what they do is they take out all kinds of repetitive and continuous background noise and they leave all the sounds that are not continuous in there. So that's kind of how that conditioning happens. There are several different approaches for that.

Question: This question relates to the definition of PAM (Passive Acoustic Monitoring) stated earlier in the talk and its long-term use. How do PAM platforms deployed over periods of weeks or months fit the definition?

Answer: Gliders can be out there for three months or so. I guess if you just have a recorder out there for a few days, what does it really tell you? The definition of monitoring is kind of keeping an eye on things over time right, so we need to ask ourselves is one week sufficient or is a month sufficient? I think it depends on those questions. So, largely for us in terms of these large whales, we're interested in looking at changes over the years, and that's kind of why we use long term, but I think you can argue what long term actually means. When we first started using passive acoustic technology, you could not have it out there for a long time. But what's happened is that, increasingly, as the memory kind of grows in these devices, we can put it out for longer and longer and longer...and that's kind of why I use that definition.

Question: How do you reduce the flow noise from gliders and tow vehicles, so that you're not getting as much interference, particularly for low frequency?

Answer: Absolutely. It's been, I think, a long process by my colleagues at the Woods Hole Oceanographic Institute who are experts in this, and they would need to be here to tell you exactly how. One of the ways is that they put the hydrophone or recording instrument internally so the hydrophone is kind of near the nose. They have created a whole bunch of different ways in which to cut out flow noise. Particularly for those Slocum gliders, when it has to dive, the engine will engage and you will hear this whirring noise when it comes to the surface. Similarly like it can be noisy. So, what my colleague does is he actually stops the recording whenever that noise happens so basically just blocks it out. So, there's lots of different kind of tweaks and different ways they have used to do that, but they are still struggling. To do that with wave gliders because they produce a lot of low-frequency noise and it's been very hard for them to isolate that on those wave gliders. It's an ongoing project...

Question: Have you ever tried to identify fish, not by the sounds they intentionally make, but by their swimming signature?

Answer: No. I have not. I don't actually know how much swimming signature they produce? I do know that there were seals that can use their whiskers to feel the flow noise of swimming fish and that's how they actually catch fish. They use their vibrissae for that. Other than that, I don't think that it would produce an awful lot of noise, so I think it would be quite a quiet mechanism. In a noisy ocean, that might be a hard thing to use as a kind of a cue.

Question: Has PAM been used in the deep sea to identify species distribution?

Answer: Absolutely. Many of my colleagues worked further out. Some of them put recorders out on the mid-Atlantic Ridge, so kind of in the middle of the Atlantic or in deeper water. The main thing is that you need usually much bigger kind of built recorders that are able to deal with that level of pressure. Colleagues of mine at the Scripps Oceanographic Institute, they are constantly putting out their type of recorders in the deep ocean and have collected an awful lot of really valuable information.

Question: This question is specific to a species shift shown in one of your PAM data examples. There was a species shift in 2010; was that a change in environmental factors, or could you tell us something more about that?

Answer: Yes, this was when we showed a species shift in right whales and we actually also saw it in all the other baleen whales. I think, for right whales, it was really thought that their food changed their distribution, therefore they went and followed where they were better able to feed. For some of the other species, were not as sure, because they don't feed on copepods like right whales do. And so, I don't think it's a clear answer to it, but we have seen species shift just due to warming oceans. So there's been a lot of changes like in fish species being found further north, and so I think it's part of that changing oceans. Whether it's food whether its temperature, those there are the different drivers that are really causing animals to use new locations more regularly.

Question: You showed how much data, you have been accumulating recently and the archive necessities, is there a particular reason why the amount of data recorded dropped from 2018 to 2019 and maybe in 2020 as well? Was there a change in storage technology compression?

Answer: I wish there was a change in storage technology, that would be wonderful. It was actually we had a study where we were recording that full frequency range, I showed you with the soundscapes. And when you record full frequency, it takes up way way more space, than if you just kind of look at maybe the lower frequency components. So, it was just that we had a large study over three years, that was just much more comprehensive in terms of data storage needs. And that's not something that we could keep going. Our colleagues at Scripps who do that deep water ocean recording, they have they have those extensive recorders so their data storage needs are way higher than ours.

Question: Do you triangulate the signals for precision, or is presence in the area enough for the scope of what you're looking for?

Answers: For most of what we do just presence in the area is really valuable and instrumental. We have done several studies, where we have triangulated calling individuals, and that often is really useful when you're trying to look at whether a call comes from a specific species or a specific individual. That can be really valuable, so you can get these acoustic movement tracks through the water. A colleague of mine, Denise, looked at minke whales and how they called relative to each other and how they produced calls, as they were really calling one individual to another. So, you can ask a lot of interesting questions. It is a lot more labor intensive to triangulate and to localize so it's kind of if we do that, we have to have a specific question in mind that that's going to be useful for.

Question: Could you talk more explicitly about PAM density estimations, what do you think are the major hurdles getting to animal abundance estimations or density from PAM data?

Answer: So, I think the major hurdle is that you need an animal that produces sound at regular, reliable intervals. So, a lot of echolocating animals like sperm whales or beaked whales do just that, because they echolocate and forage a lot of the time, you can actually

use that as your abundance estimator. Yet, for baleen whales who vocalize really for behavioral purposes, it's all about keeping in touch with each other, figuring out who's around. It's much more sporadic and there isn't that kind of metronome-like information you can gather for them. So, it makes it much harder to get to density because there could be a large aggregation of whales and only a few individuals might be calling or they might call very infrequently or there could be a small aggregation of whales that never shut up. So it's really just based on the different behavioral contacts of the different species.

Question: Would PAM be a useful tool for monitoring crab and lobster fisheries can we use it for invertebrates?

Answer: Invertebrates make sounds but not an awful lot that I'm aware of. You know, often it's things like sea urchins crunching up against the rock that they're trying to get the algae from. I don't know enough about different species of lobsters. I know some do make sounds and others don't, so I think it'd be a difficult one, because they're not as routinely acoustically active. But I do think in certain contexts if you have the right species and it makes sound but it basically makes sounds, absolutely, that would be a really interesting technique. I think crabs are tend to be nosier.

Question: Is the automatic monitoring system able to detect beaked whales and perhaps Cogia species? How much acoustic data is transmitted over the bandwidth or are you just getting detections from the satellite deployment?

Answer: Absolutely well answer first of absolutely you can do it for beaked whales. I don't know that it's been done Cogia yet, but there are many different acoustic gliders that are out there listening for beaked whales. We mainly just look at baleen whales because those just tend to be the species that are a focus for us. What we have in terms of what data gets sent back is, onboard, there is acoustic software that looks for those specific sounds. When it hears those it tags them and it cuts those out so all it sends back is really the fact that it's heard that specific sound and we'll get that kind of snippet that gets cut send back to us, so we can check it. Obviously, you can always go back to the recordings later on when you retrieve the recorder or the glider. Because the information you send up is expensive, so you only have so much. I think we have 8 KB or 8MB, so we have a choice really to make as to how much information, we want to get relayed and how often. I think, the more you want to spend the more information you can send, you can get basically this kind of cost versus data benefits.

Question: If you could put out a monitoring program somewhere where would you choose to put it, that we don't currently have one where would it be?

Answers: I think we have one in most places. I think I'd put them out somewhere where I would like to go. You know, off Australia, or the Antarctica sounds pretty nice too. Though I have a colleague who's already got acoustic monitoring off there. I think it really depends on the question, right? What exciting new questions can we ask? We've started to look at things like monitoring for illegal vessel activity and such. So, you can always ask new questions using passive acoustics, which is why it's such an exciting tool. It's about seeing how creative, can you be so I think it would really depend on you know, can I find a really cool question somewhere nice? Sure, sure I can. Carribean?

Question: How much experience have you had with remote PAM on survey vessels and how positive was your experience?

Answer: When I think of remote PAM on survey vessels, they are towed arrays. They can be a really valuable tool for collecting information out of really hard-to-reach areas. I've got colleagues at the Pacific Island Fisheries Science Center that go out to Guam, and who go out to some of those really remote Pacific areas and it's an instrumental way to be able to collect information because you just can't have a plane and fly out there regularly right. There are all sorts of technical issues with towed arrays, but you know when they work, they're great.

Question: Do you know of plans to look for potential integration of passive acoustic instruments with say wind farm buoys or to deploy them in some way on fishing vessels or anything like that?

Answer: I think there's a number of different efforts are ongoing like that, trying to amalgamate PAM. Just as we did for the study that I showed, lots of different people's recordings, and we definitely are having these discussions for wind farms at the moment. But there's also the international quiet ocean group that are looking at kind of changes as a result of COVID and how that might have quieted the ocean that are interested in collecting different scientist's deployment locations and are hoping to be able to do that kind of a comprehensive look over large areas in that way.

Question: You showed us that what I assume is a website that's under development where there's additional data. Do you have a timeline for the publication of that website?

Answer: I sure hope so! We were just talking about when is our IT department going to make this go live. So I think in the next month or two, as long as it's within our power to get them to do this. There will be a link on our NOAA website to it, so please go back to that. We will advertise it as widely as we can when it becomes live. We're not far off we're really waiting on our IT department at the moment.

Question: Can we determine the physiological condition of a marine mammal or fish using PAM? Are there any indications we've seen about whether an individual is stressed or so on?

Answer: So really interesting question. It's a hard one to answer. I think we do have certain studies that have shown that under stress animals respond differently, which means they may vocalize more or less, depending on what kind of stress signals are out there. What we've done a lot of on is looking at kind of loss of acoustic space out there due to anthropogenic sounds and noises. There are also some studies that are trying to relate stress hormones to different levels of acoustic activity. So, some of those have been able to show that, yes, increased stress shows decreased acoustic activity or changes in behavior. It's a hard thing to link but it's definitely there I think we're just not able to fine-tune things enough. We don't have a good enough understanding of the ocean habitat really and the animals in it to be able to do that well yet.