Nickels Catherine (Orcid ID: 0000-0003-1628-387X)

Should I stay or should I go? Improving estimates of fish habitat preference

By: Catherine Nickels (catherine.nickels@noaa.gov)

NRC Postdoctoral Fellow stationed at NOAA NMFS Southwest Fisheries Science Center

Practically, it should be easy to distinguish between a fish that wants to stay at a particular location, and a fish that has a good reason to leave. If you attached an acoustic tag to the first fish, and listened with a receiver in its preferred habitat, that fish would mostly stay within detectable range. A fish that wants to leave would swim away quickly, never to be heard from again.

But what about a fish that didn't care where it was? This fish would appear to swim aimlessly and might stay around for a while purely by chance. How can you tell the difference between this fish, which does not actively prefer the receiver site, and one purposely staying near an important habitat?

Scientists use passive acoustic telemetry– tagging and tracking animals with acoustic devices – to monitor animal movement (Fig. 1). One use of movement information is to determine habitat preference, which can help guide marine spatial planning. In order to use passive acoustic telemetry to infer habitat preference, "you need to have an understanding of what non-preferential movement looks like," said Alli Cramer, a PhD candidate in Steve Katz's lab at Washington State University.

What would we expect data to look like for the fish that has no site preference? And how can we differentiate between habitat indifference and true habitat preference? Cramer and Katz presented answers to those questions at the 2020 Ocean Sciences Meeting in San Diego, CA.

According to Cramer and Katz, your experimental setup can make a big difference in whether you can distinguish unmotivated movement from habitat preference. One key parameter is how far your study animal can move between acoustic pings, termed the step size. The tag volume is also important, which determines how far away it can be heard. The relationship between these two parameters is the relative step size. For example, a fast-swimming shark would travel farther between acoustic pings than a slower flounder and have a larger relative step size with the same tag volume. For a given fish, such as the shark, step size would be larger with a tag loud enough to hear 50 meters away compared to 500 meters.

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Cramer and Katz simulated the movement of fish with no site preference using a simple random walk, similar to how early robot vacuums were programmed to wander aimlessly through rooms. Movement directions in the computer simulations were random while relative step size and study length varied between trial runs. They discovered that in trials with small relative step sizes (the slow flounder from above), the random walkers were unlikely to travel out of the receiver's hearing range, even over longer periods. A larger relative step size (the shark) increased the chance that the randomly-moving fish exited and resulted in a lower estimate of preference.

Regardless of step size, there was an initial time-period of every trial before any unmotivated fish were likely to pass the receiver's hearing limit. During this initial phase, it was impossible to differentiate random movement from site preference. Only after this initial "burn in" time could preference be accurately interpreted during data collection from real fish. "When is that sweet spot […] where you can more confidently infer resident behavior? That's what we're working on now," Cramer said.

Cramer and Katz are currently working on an equation that other researchers can use to determine the appropriate tag volume and study length to identify habitat preference in species with different swimming speeds. For example, slow flounder may need low volume tags so that fish without a preference for the habitat have a better chance of moving out of range. Using a more guided approach to study design will strengthen conclusions about habitat preference in future passive acoustic telemetry studies and allow researchers to identify important habitats with more confidence.

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Figure Captions:

Figure 1. (a) A scientist suturing a sevengill shark after inserting an acoustic tag. (b) A diver deploying a passive acoustic receiver. Images courtesy of Stephen Katz.

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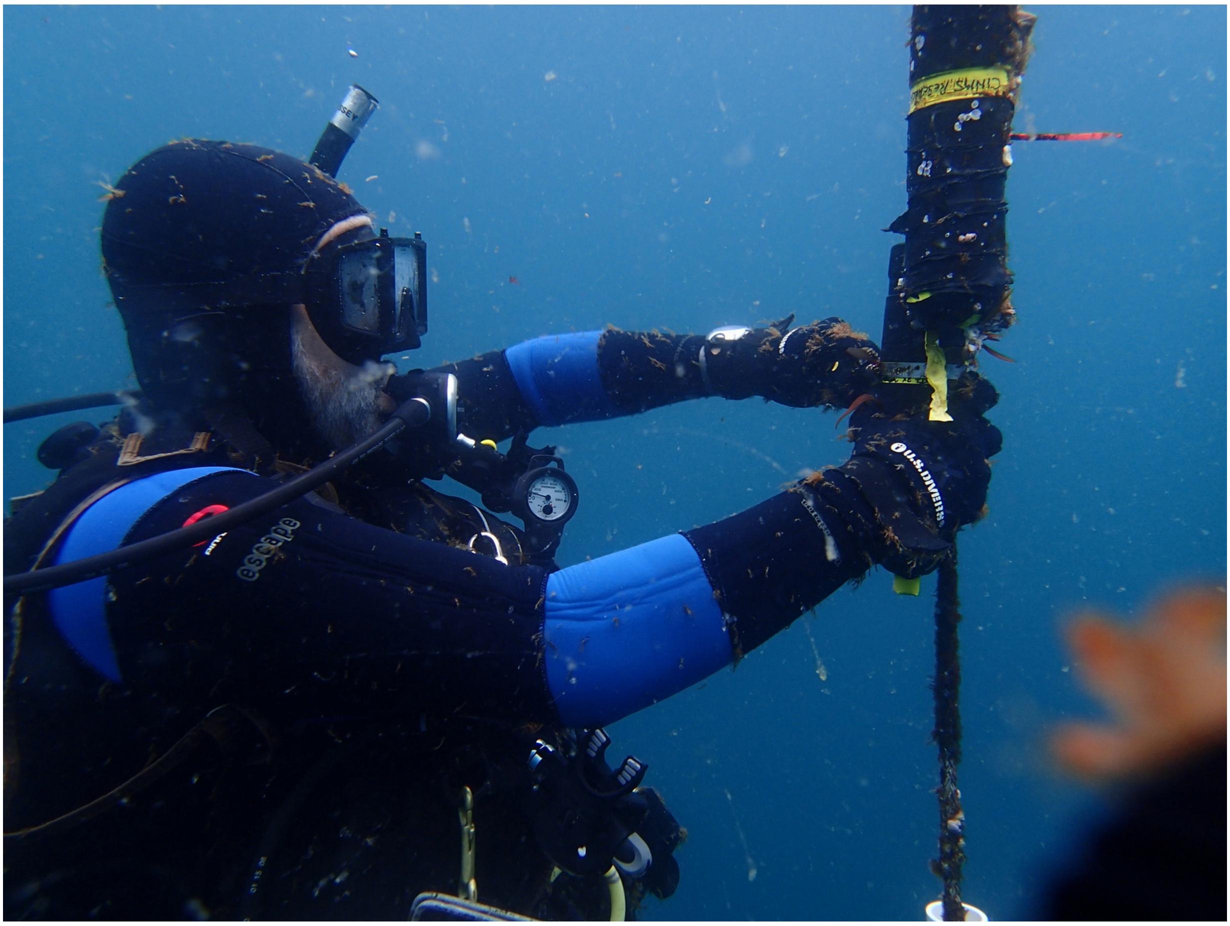

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