OCEAN CONSERVATION RESEARCH

Science and technology serving the sea

Seismic airgun impacts to marine zooplankton – preliminary report.
January 29, 2021

In the fall of 2019 we had an opportunity to gather data concurrent with a survey being conducted in the Cook Inlet. At the time, Hilcorp had contracted with the seismic survey vessel, Polarcus Alima to survey approximately 200 mi.^{2} of the waters in the lower Cook Inlet. We had deployed four instrument moorings to monitor the acoustics of the entire survey, and scheduled a day out to sample zooplanktons directly in front of, and directly behind the survey vessel using "bongo nets" with 150µm and 333µm mesh collection jars.

The Cook Inlet is a challenging body of water due to the 23' tidal swings with the ebb tide being highly mixed with fresh water from glacial melt, which continues to flow into the flood tide, which is predominantly salt water. This lends to wild sea states, particularly during the flood tide due to the forced mixing of unequal water densities – which was when we were doing the sampling.

We had limited sampling time in front of the survey vessel due the tidal state, because while the Alima was pulling the array at ~4kts, I suspect the tide was carrying us toward her at another 5kts. So we only had the opportunity for two sampling stations in front of the survey, one at 20m and one at 50m.

We were able to get three samples aft of the survey – as close as we could get – watching the tailing buoys fly by us. Two samples at 20m, and one at 50m. I figured that as the air guns were being towed at 14m depth, the 20m samples would be more representative of close proximity damage, so we opted to do two samples at that depth.

When we got back to the lab (UA Homer) my first anecdotal observation of the samples did reveal significantly higher mortality in the aft samples. Unfortunately, their video equipment was not working at the time, so I was unable to record this.

We also had a lag between the landing and the counts due to a delay of 24 hours before we received the neutral red dye used to segregate live from dead samples (transportation in Alaska is unpredictable), and an addition 12 hours to prep the dye. We stored the samples in a cooler, with the understanding that whatever impact the time lag and storage would be equal in both the before and after samples – and there was a lot of living critters after the delay, so I believe this assumption was not too far off.

We also had a lot of mortality due to physical damage in the 150µm mesh (darker shaded bands in the data), so we just looked at the 333µm mesh samples.

Box 559, Lagunitas, California 94938
V. 415.488.0553 F. 415.488.1725
www.OCR.org

Unfortunately, data does not substantiate our hypothesis that airgun surveys cause high mortality in the zooplankton. There are a number of possibilities – one having to do with the extreme mixing of the water. But the Alima was towing directly into the tide and with the air guns firing every seven seconds, I would anticipate – given the population densities of the beasts, and the tides flowing in the transect direction, that there would be some indication of impacts if there were impacts.

We asked Hilcorp for the p190 files which would give us a time record of the airgun firings, but so far they seem reluctant to divulge them. We had four moorings deployed for, ~48 days, and with the exception of one mooring, the clock drift wasn't too bad, so given all of the fresh/saltwater mixing, I was hoping to do tomography on the tidal swings through some portion of the survey.

But thinking this through, whether we can model it or not, the mixing was pretty severe – as it usually would be on the flood tide. The airgun array was 300-400m astern of the boat, and the streamers stretched out to 3200m, so there is a lot of mixing going on in that 2800 - 3600m between the airgun array and where we could drop the nets. I think this is where the project failed to harvest meaningful data.

The attached video is a small airgun. My suspicion is that if damage is done, it would be as the bubble retracts, because while the critters are built for positive pressure gradients, they are not built for negative pressure gradients – so they are subject to negative barotrauma.

I've been speaking with zooplankton specialist Alexei Pinchuk, with UA, Juneau about doing a lab-based zooplankton/airgun project where we would film zooplankton being exposed to an airgun using high-speed video. This would give us cleaner data on the interactions between airgun pulses and the physiology of the zooplankton.

Any thoughts you have on any of this would be appreciated.

Deep appreciation goes out to:

Deborah Boege-Tobin – Professor of Biology Univ. Alaska, Kachemak Bay campus. Queen Be of the science department by my estimation. Very generous with their facilities and personnel

Coowe Walker – Univ. of Alaska Kachemak Bay National Estuarian Research Reserve Manager Alaska Center for Conservation Science, UAA. Did important personnel coordination and lent us Chris Guo

Chris Guo - Univ. Alaska. Plankton Wrangler and preparation of the samples

Jesse Ross – U. of New Hampshire – Plankton Wrangler

Beth Sharp – Operation Coordinator with Hilcorp and helped us coordinate with the Polarcus Alima

Kris Holderied - NOAA Federal and Director at NOAA Kasitsna Bay Laboratory – Kris always seemed to be in the horizon when things were heading in the right direction.

Sue Saupe – Science Director of Cook Inlet Regional Citizen's Advisory Council. Sue was also coordinating back-stage a lot. So while I don't exactly know how she knew, she always had the right answers and the right tools when stuff was needed.

Rob Campbell – Biological Oceanographer with Prince Williams Sound Science Center – Oversight and direction of the plankton analysis.

Marian Shafer – She was on the Zooplankton boat taking notes and pictures, and was involved in the sample prep.

Hilcorp Biologist Jennifer Dushane

Also a deep debt of gratitude to Bob Shavelson with Cook Inlet Keeper for his hospitality, vessel coordination, and support.