OCEAN TWILIGHT ZONE

WOODS HOLE OCEANOGRAPHIC INSTITUTION

2020 Q4 REPORT

Introduction

DESPITE THE CHALLENGES POSED BY THE ONGOING COVID-19 PANDEMIC, the final quarter of 2020 was a busy and fruitful one. Over the past few months, the team published three new peer reviewed publications and laid the groundwork for a busy spring of field-work. This new push to return to sea will involve a full month of near-shore operations in Bermuda this February and March as well as a more traditional research cruise on Spain's R/V *Sarmiento de Gamboa* in May.

In addition to ramping back up our fieldwork, we've also expanded our scientific outreach efforts over the past quarter. After launching our new website in October 2020, we've been able to reach entirely new audiences and have enjoyed a significant increase in traffic. Over the last three months, we've published 12 new Creature Features, four new profiles of our team members, and six new articles, some of which have gone viral on social media.

Our social media feeds themselves are steadily growing as well, thanks in part to our researchers' virtual presence: OTZ principal investigator Heidi Sosik, for one, presented our team's work to hundreds of participants during a webinar from the International Union for the Conservation of Nature (IUCN) and gave a live talk with actor Pierce Brosnan on TED's instagram channel. That conversation, which took place in early December, has been viewed more than 100,000 times.

Quarter 4 at a glance

- **OTTO HAPPEL** has funded a one million dollar new partner project, **THE OCEAN TWILIGHT ZONE OBSERVATION NETWORK**, which will begin in the new year.
- **HEIDI SOSIK** presented new data from the OTZ team to hundreds of participants during a webinar from the **INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE** (IUCN).
- Our website and social media presence has grown significantly due to several successful campaigns.
- **HEIDI SOSIK** joined actor **PIERCE BROSNAN** on **TED'S INSTAGRAM** channel for a live discussion of ocean conservation and the OTZ Project. That conversation, which took place in early December, has been viewed more than 100,000 times.
- OTZ researchers published three new academic papers this quarter.

Hydromedusa - Leptothecata - Netocertoides brachiatum. Photo by Paul Caiger, Woods Hole Oceanographic Institution.

Upcoming field campaign

BERMUDA FIELD OPERATION AT 'STATION B'

Dana Yoerger and Allan Adams will be leading a group of engineers and scientists on a shore based field effort designed to rapidly advance technologies. This will be taking place from late February to late March.

R/V SARMIENTO DE GAMBOA

Ken Buesseler and Heidi Sosik will be leading a research cruise in the North East Atlantic with research focusing on how the twilight zone regulates the ocean carbon pump. They will be partnering with the NASA EXPORTS project who will be concurrently fielding two other research vessels in the same area. The cruise will be taking place in May.

Biomass Spotlight

What is biomass, and why is it so important for understanding the ocean twilight zone?

IN ORDER TO FULLY UNDERSTAND THE OCEAN TWILIGHT ZONE ECOSYSTEM, we'll need to know how much overall life, or "biomass", it can support. Establishing this metric is a key part of calculating the zone's impact on oceanwide food webs, deep-water fisheries, and even global climate. Getting an accurate sense of this number is a major challenge, however. Traditional net tows provide a skewed sampling of life in the twilight zone, since some species can easily avoid trawling nets, while others—like gelatinous salps and jellyfish—simply break apart when the nets are pulled in.

For this reason, our team uses a suite of complementary methods to measure biomass. In addition to net tows, we are developing new methods of harnessing shipboard acoustics; building miniature, submerged acoustic devices; gathering photographic and holographic images, and analyzing environmental DNA (eDNA) to find genetic material of animals we may have missed using other methods. Our work so far has shown that existing estimates of biomass could be too high—while a 2014 study suggests that there are 10 times more fish in the twilight zone than previously estimated, our research has found that may only be 2-3 times more.

Machine Learning

IN THE PAST TWO YEARS, THE INSTRUMENTS DEVELOPED BY THE OTZ TEAM have collected a vast amount of data on the ocean twilight zone. Together, the *Deep-See*, *Mesobot*, and ISIIS platforms have gathered nearly 100 terabytes of acoustic data and more than half a million images and holograms of mesopelagic life. In order to process this much information, however—and spot patterns that could answer key scientific questions—our team has also developed new machine learning techniques. These tools allow us to automate large parts of our analysis and significantly reduce the time needed to extract meaningful information. Instead of taking an individual researcher several minutes to identify organisms in a holographic image, computer-aided techniques take only a few seconds. Similar methods let our scientists analyze huge amounts of acoustic data in near real time while at sea, allowing them to adapt their sampling approaches based on what they are seeing. These tools will ultimately provide our team and other research groups a better and more detailed view of the mesopelagic's structure and estimated biomass.

Deep Listening: Andone Lavery

Andone Lavery got her start in condensed matter physics, which she admits is an unusual background for an oceanographer. As a principal investigator for the OTZ Project, she specializes in underwater acoustics, a field that uses sound waves to probe the ocean's waters.

Based on the reflections of those waves—and how they scatter when they hit an object—Lavery can gain amazing insights into ecosystems like the ocean twilight zone. But doing that accurately, she says, involves solving some thorny physics questions.

"The challenge with sonar acoustics really comes when you try to interpret all of that data," she notes. "Unlike cameras and other visual approaches, sonar doesn't provide an actual picture of the organisms that you're trying to study." Instead, Lavery says, she has to interpret readings of acoustic pressure waves in order to figure out what type of animals she's detecting, how big they are, and how many of them are present.

"Different species will resonate at different frequencies. If you can figure out which frequencies you hear resonating, you can effectively tell which species are down there," she adds.

With that in mind, Lavery is working not just to develop acoustic instruments and techniques to survey the twilight zone, but also on ways of improving our understanding of how organisms that live there scatter sound waves when a sonar beam hits them.

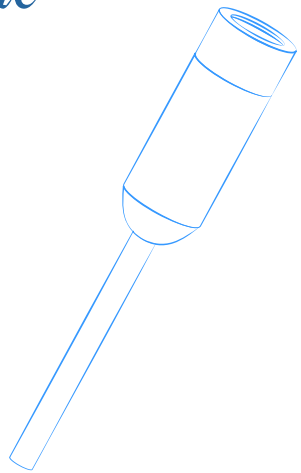
"That's a big one," she notes. "If we don't figure that out, we can't use acoustics as a tool to study twilight zone organisms."

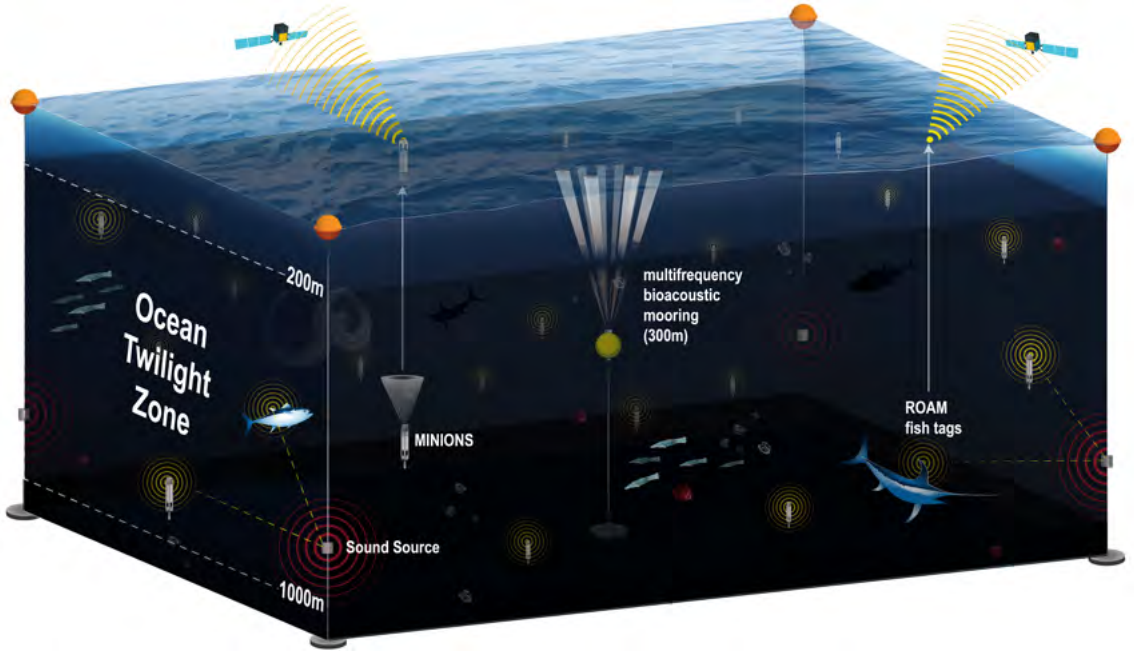
Not that this has stopped her from trying. After designing new broad-beam acoustic sensors for WHOI's *Deep-See* vehicle—and developing new, high-tech ways to analyze their data—Lavery may help reveal the true density of organisms living in the twilight zone.

RIGHT: NOAA Ship Henry B. Bigelow expedition co-lead, Andone Lavery, senior scientist at Woods Hole Oceanographic Institute and MIT-WHOI Joint Program PhD student, Rachel Kahn, watch data come in from Deep-See during a deployment (Photo by Erik Olsen)

New $1M grant

for an Ocean Twilight Zone Observation Network





Using funds from a new major grant, members of the Ocean Twilight Zone Project are coming together in the new year to build a scalable Ocean Twilight Zone Observation Network in the Northwest Atlantic.

This network, which is an extension of the Ocean Twilight Zone Project, will stretch across 250,000 square kilometers, allowing our researchers to collect unprecedented, around-the-clock data about the twilight zone over the course of months to years. The array will integrate moored sound sources and cutting-edge, multi-use receptor chips, which together will achieve a variety of scientific goals. Once installed, the network will let researchers track apex predators using new types of tagging devices, track a swarm of small optical and geochemical sensor packages, and incorporate a multi-frequency bioacoustic mooring.

These continuous observations will vastly improve biomass estimates of twilight zone fish and invertebrates, as well as our understanding of the ecosystem's role in sequestering carbon and the behaviors of the animals who live and feed there. Such information is essential to both develop and implement strategies for conservation and sustainable fisheries management in the high seas, and predict the trajectory and impacts of climate change.

Web, Earned Media, and Social Media

DATA BELOW FOR JANUARY 1, 2020 – DECEMBER 31, 2020

WEB

28 NEWS STORIES **35,625** PAGE VIEWS

EARNED MEDIA

270 STORIES WORLDWIDE **400,000,000** POTENTIAL REACH

DATA BELOW FOR OCTOBER 1, 2019 – DECEMBER 31, 2020

SOCIAL MEDIA

684,500 TOTAL IMPRESSIONS **302,256** TOTAL ENGAGEMENTS

154,513 IMPRESSIONS
185,475 ENGAGEMENTS

213,950 IMPRESSIONS
1,094 ENGAGEMENTS

161,313 IMPRESSIONS
10,319 ENGAGEMENTS

31,467 CLICKS
1,440 ENGAGEMENTS

HEIDI SOSIK joined actor PIERCE BROSNAN on TED'S INSTAGRAM channel for a live discussion of ocean conservation and the OTZ Project. The conversation has been viewed more than 103,000 times.

TOP MEDIA

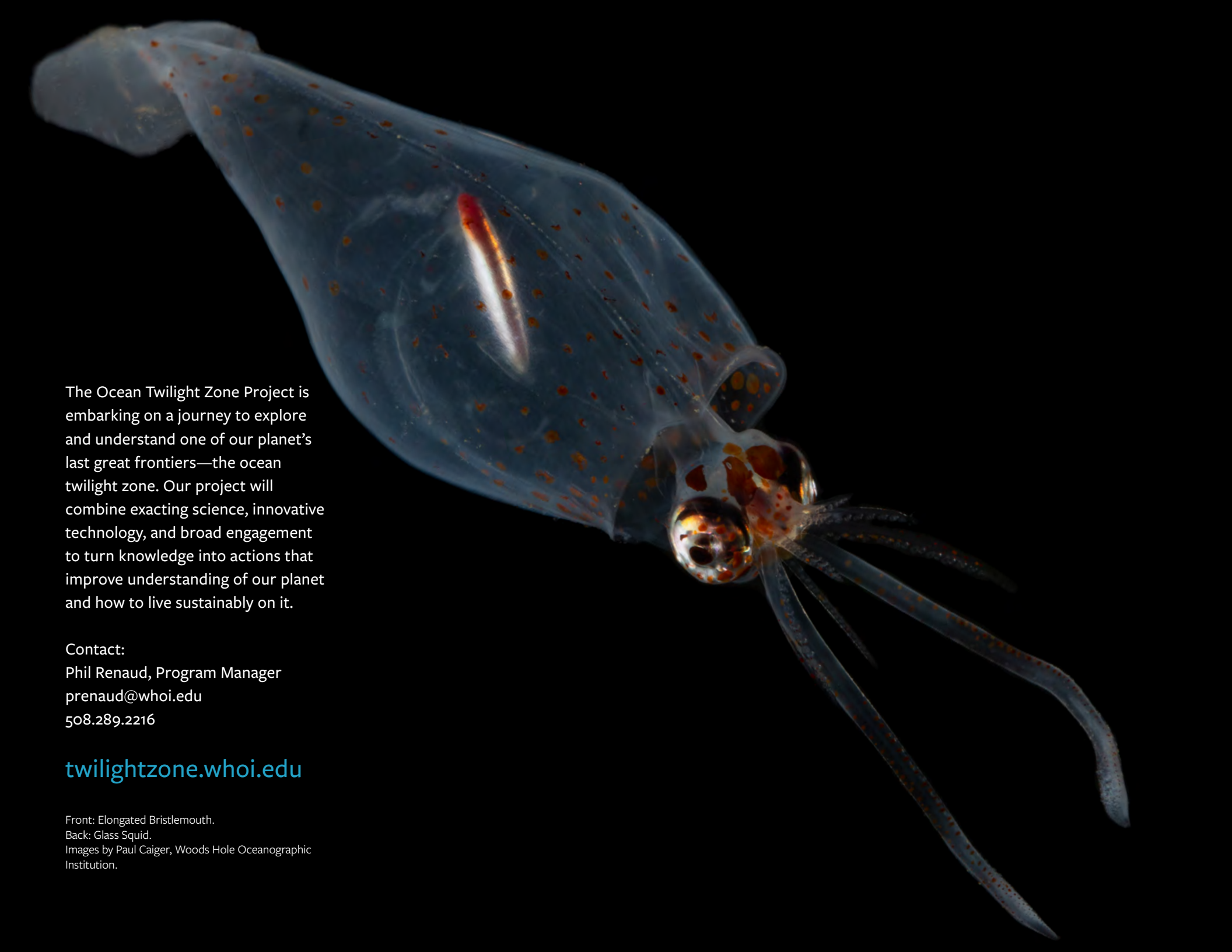
the dodo

A Promina photo was used by an animal lover community called The Dodo in their Snapchat TV series.

DODO HAS **9.8 million** FOLLOWERS

INSTAGRAM LIVE

144,739 IMPRESSIONS



The Ocean Twilight Zone Project is embarking on a journey to explore and understand one of our planet's last great frontiers—the ocean twilight zone. Our project will combine exacting science, innovative technology, and broad engagement to turn knowledge into actions that improve understanding of our planet and how to live sustainably on it.

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Front: Elongated Bristlemouth.
Back: Glass Squid.
Images by Paul Caiger, Woods Hole Oceanographic Institution.