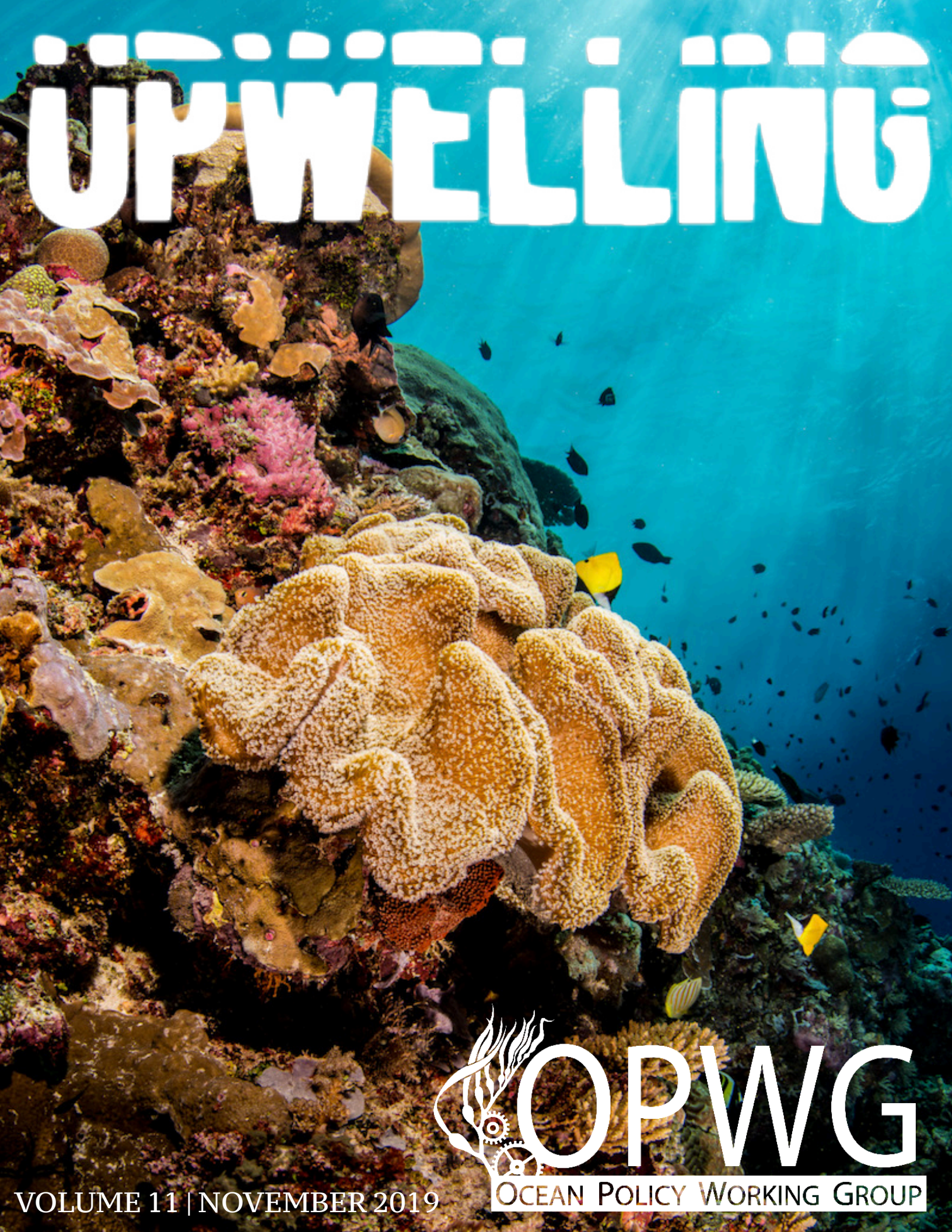
# UPWELLING



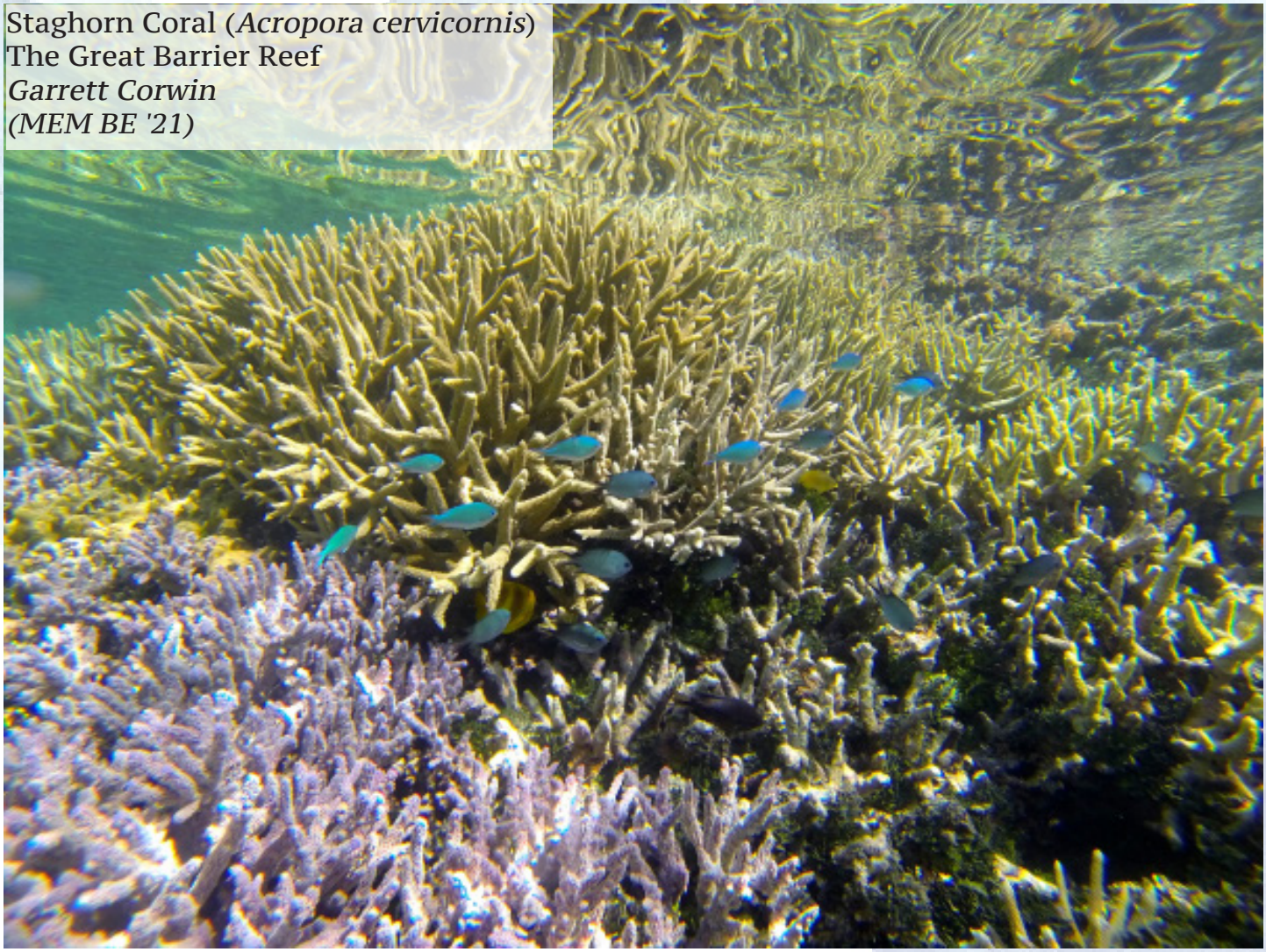
OPWG

OCEAN POLICY WORKING GROUP

VOLUME 11 | NOVEMBER 2019

# Cover Photo: Emily Melvin (MEM CEM '20)

Staghorn Coral (*Acropora cervicornis*)
The Great Barrier Reef
*Garrett Corwin*
*(MEM BE '21)*



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The Ocean Policy Working Group (OPWG) is a student organization at Duke University, designed to facilitate cross-disciplinary discussions on human interactions with the ocean. Throughout the academic year, the OPWG hosts a variety of events with the purpose of exposing the Duke community to pertinent issues in our oceans. This working group strives to be a hub for ocean resources and discussions.

# In This Edition



## A Note From The Editor:

The eleventh edition of UPWELLING showcases research, artwork, and work experience of graduate students from Duke University.

OPWG is excited to share with you Duke students' excitement for our oceans. I hope these pieces encourage you to explore marine conservation and learn more about the variety of ways marine professionals pursue their passions.


Thank you to the Nicholas School of the Environment and the Duke University Center for International Studies for their continual support of the Ocean Policy Working Group and UPWELLING.


Sincerely,

*Taylor Stoni*

Taylor Stoni
OPWG Publication Coordinator
MEM CEM '21

# Strengthening Duke's Ocean Leadership at the United Nations

*Guillermo Ortuno Crespo & Gabrielle Carmine*

We are in the midst of two global crises on climate and biodiversity. Fewer places represent the seriousness of these challenges better than the global ocean. The global ocean has absorbed much of the excess carbon dioxide and heat that humans have generated, while experiencing a ruthless loss of biodiversity to industrialized resource extraction, habitat destruction, and pollution. Human population is expected to increase to 9 billion by 2050 at a time where the annual per capita seafood consumption is at a high of 20kg and increasing. Our oceans need a break.

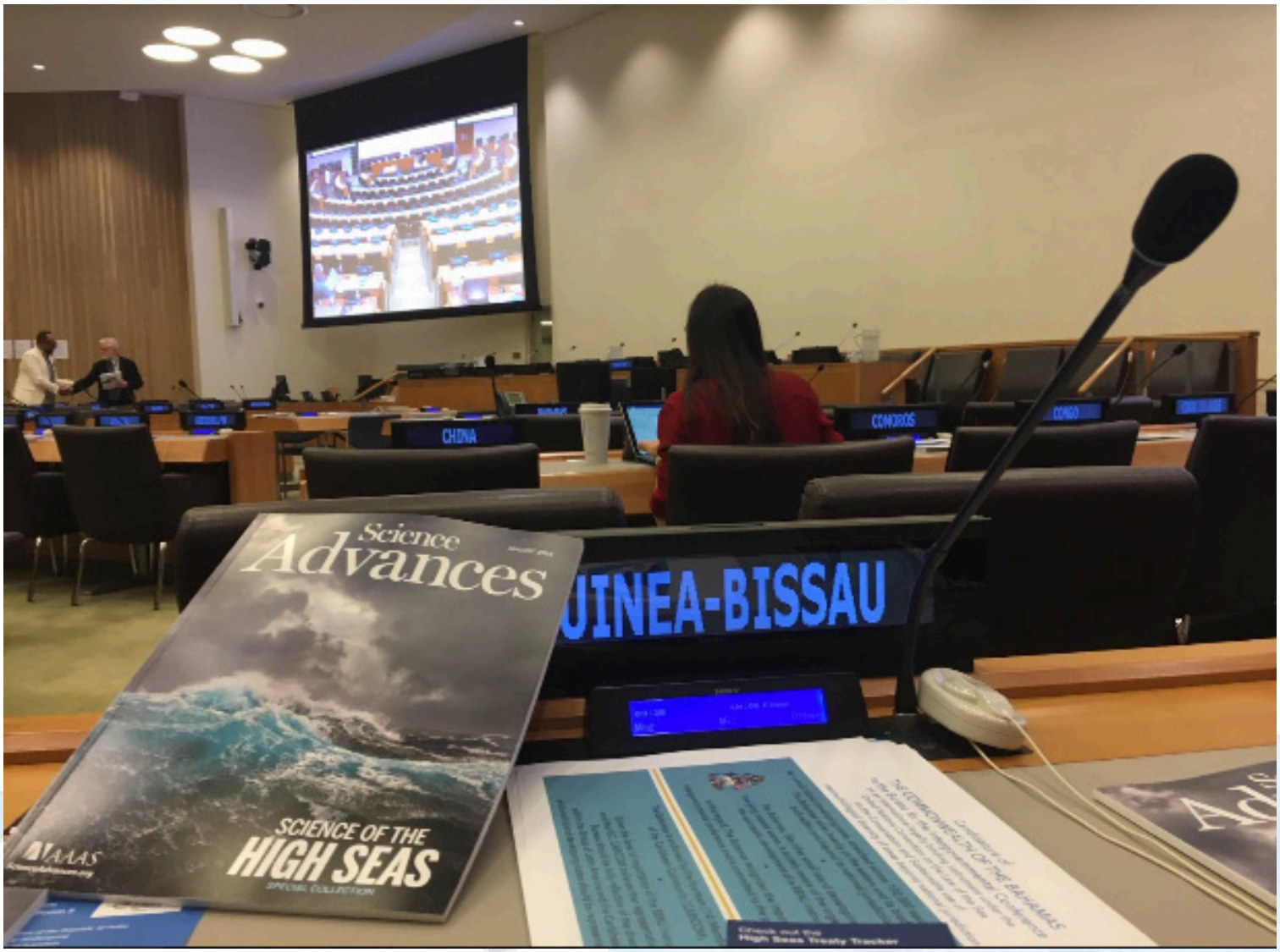
Addressing the current global ocean crisis will require engaging with all relevant actors and stakeholders. This means questioning the dysfunction of the ruling powers that mismanage our global oceans through the allowance of illegal trade, harmful subsidies, and governance loopholes. This is particularly urgent in international waters (a.k.a. the High Seas) where decades of commercial exploitation and legal loopholes have pushed theopen-ocean to its ecological limit.

Over the last few decades, the UN has established a fragmented patchwork of international management bodies that attempt to regulate sectoral activities in the High Seas. Their communication is poor which leads to significant gaps for governance of human activities on High Seas biodiversity. The UN is currently negotiating a new legally binding treaty that would potentially bridge this governance gap. This potential management of biodiversity on the High Seas would represent 46% of our planet. Throughout the negotiations, there have been repeated attempts by industrialized seafaring nations to weaken the scope of the treaty. Certain nations enjoy the perks of lawlessness maintained through the status quo on the High Seas.

Duke University has been at the forefront of High Seas governance and conservation discussions for the past decade. Over the last four years of negotiations, Duke researchers have contributed 15 manuscripts, book chapters, and policy briefs to help UN

Delegations better understand the oceanography and ecology of the open-ocean, as well as the existing tools and technologies to monitor and manage human activities on the High Seas.

Various research labs within Duke have gained the trust of several UN governing bodies and delegates at these meetings, making our University one of the few leading academic institutions at the UN in this space. However, Duke's contribution to this and other processes are not coordinated across schools. The emerging High Seas @ Duke initiative seeks to reinforce the vertical and horizontal integration across the Sanford School of Public Policy, Fuqua School of Business, The Law School, the Nicholas School, and the Nicholas Institute for Environmental Policy Solutions. This collaboration within the University will create new avenues for policy discussions and new points of entry within the High Seas debate. High Seas @ Duke is what the University needs to continue to be the leading academic institution for the High Seas at the UN and beyond.



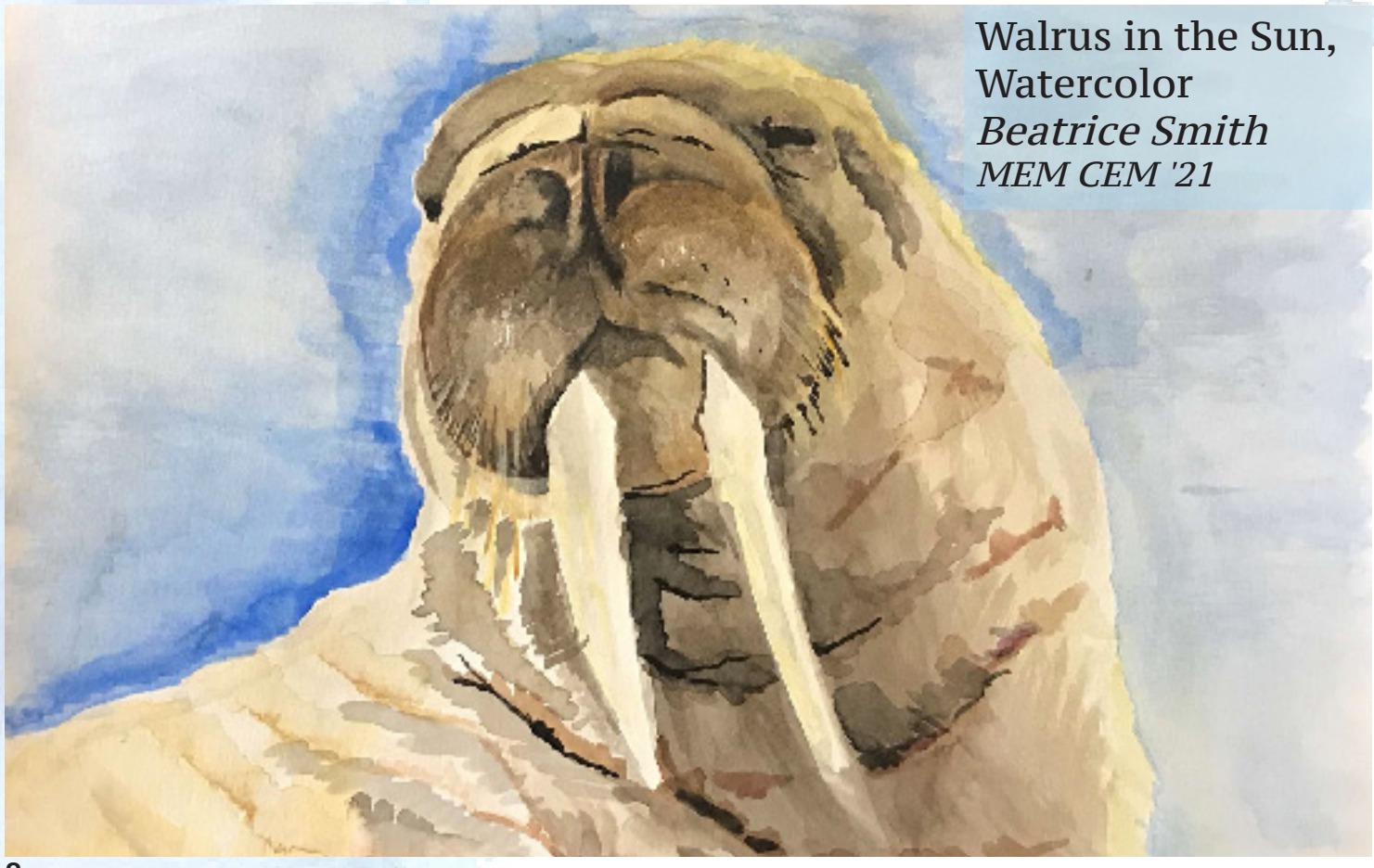
A stranded humpback whale was discovered in turagain arm of the Cook Inlet south of Anchorage, Alaska. A necropsy was performed to determine the whale was a 21ft long juvenile female, which likely stranded due to malnutrition.

Sonia Kumar (left) and Greg Merrill of Duke (right) performing a necropsy. Photo curtosey of Anchorage Daily News. Sonia Kumar is a technician for Alaska Veterinary Pathology Services and is removing blubber in this photo.

'On The Half Shell', Acrylic
*Alexie Rudman*
*MEM Alumni*

'Road Island Quahog', Acrylic
*Alexie Rudman*
*MEM Alumni*

Humpback Whale,
Watercolor
*Beatrice Smith*
*(MEM CEM'21)*



Walrus in the Sun,
Watercolor
*Beatrice Smith*
*MEM CEM '21*

Kim Corcoran ( MEM CEM '21) with Rainer the dolphin

Before coming to the Nicholas School of the Environment I worked as a Marine Mammal Intern at the Seas with Nemo and Friends, at Walt Disney World in Florida. In this position, I filled various roles from diet preparation for our dolphins and manatees, to presenting dolphin research and performing manatee conservation spiels to thousands of Disney's guests. I taught guests about marine conservation, what they can do to help reduce plastic pollution, and explained that manatees are protected by the Marine Mammal Protection Act.

After six months as a Marine Mammal intern, I transitioned to the Aquatic Research team at Disney, where I was facilitating cognitive research sessions. The dolphins voluntarily play various cognitive research games, which teach us more about how dolphins think, problem solve, see and interpret the environment they live in. The three dolphins learned how to play a matching game, where they were shown an object or a picture and asked to match that same picture from a group of three on the other side of the windows. They started out playing this game using 3D objects made out of PVC pipe that were submerged in the water. With 3D objects, the dolphins would use echolocation and eyesight to determine the difference between the three objects. Once they excelled at this game, they progressed into matching projected images of different species of fish that live in their environment. In these games, we saw the dolphins use different strategies to figure out what the correct answer was, just as we would on a multiple-choice exam. Through various research games, the science team has learned more about dolphin eyesight, hearing, communication, problem solving, and their natural social behaviors. Scientists are better equipped to protect wild dolphin populations with this information.

# Ready for Takeoff: Blue Carbon

*Bridgette Keane*

As the world moves towards crafting innovative strategies to reduce carbon emissions, many governments are exploring the idea of carbon trading systems, officially termed Emissions Trading Systems (ETS). These systems take the form of cap and trade markets that limit the amount of carbon emissions allowed. Emitters under the cap can trade the rest of their allowed emissions. In some systems, if emitters exceed the limit, they can purchase offsets, which are investments in projects that sequester carbon. One particularly rich area to explore for carbon offsets is blue carbon credits. Blue carbon refers to coastal ecosystems that are exceptionally effective at storing carbon, such as mangroves. However, the establishment of an ETS is complex, especially because it functions better on national or international scales since cap and trade systems require supply and demand dynamics. This requires accurate systems to keep track of emissions and offsets. One potential solution to aid monitoring offsets is the implementation of unmanned aerial vehicles, or drones.

Currently, the main methods for measuring carbon storage in vegetated coastal ecosystems focus on ground surveys and satellite imagery, and increasingly the use of drones equipped with various sensors. For this information to be used in an economic system, monitoring methods need to be repeatable, cost-efficient, and accurate. In many cases, drones have the potential to outperform

other methods across these areas as they are low-impact, high resolution, and becoming cheaper as technology advances. This is clear in comparison with ground surveys, which are time and resource-dependent, potentially dangerous for researchers, and limited in coverage capability. The closer competition is with satellite imagery, which provides different benefits than drones.

*Cost-efficiency*

The initial cost for drones is an expensive investment due to the drone and accessories. Still, with many flights over time that produce centimeter-resolution imagery, this cost is more evenly distributed and efficient for the accuracy obtained. This makes drones more competitive with satellite imagery, which can cost upwards of $100 for a 1km2 image with 1m resolution.

*Repeatability and Scalability*

Both satellite imagery and drones are more time-efficient in data collection than ground surveys and low or no impact. Drones are becoming increasingly practical with longer battery lives and advancements in automation, which suggests that they could be useful in Community-Based Forest Monitoring. While drones are optimal for project-based scales and could be scaled up by working with local organizations, they are not as readily scalable to a global project as satellite imagery.

*Accuracy*

Accuracy is a critical component of carbon measurements because uncertainty decreases the value of the carbon in the market. Drones and satellites both cover habitats better than ground surveys, but drones can be limited by permitting and satellite imagery can be limited by cloud cover (which also impacts repeatability). Drones and satellites both cover habitats better than ground surveys, but drones can be limited by permitting and satellite imagery can be limited by cloud cover (which also impacts repeatability). Drones, with the ability to fly at varying altitudes, provide higher resolution data than satellites and can produce 3D visualizations from spectral data that aid in determining above-ground biomass, which is used to calculate carbon storage.

*Application to Mangroves*

The carbon storage calculation is complicated by the ability to distinguish spectral values in mangrove environments, which are unique in that they have vegetation, soil, and water all in one dynamic zone.

I hope to continue to investigate this potential through the MaRRS lab with imagery collected in Belize.

(1) "Carbon Markets" (United Nations Development Programme, March 10, 2016), https://www.undp.org/content/dam/sdfinance/doc/Carbon%20Markets%20_%20UNDP.pdf.
(2) Alice R. Jones et al., "Coastal Carbon Opportunities: Using Drones to Measure Mangrove above-Ground Biomass and Carbon," Technical Report Series (Adelaide, South Australia: Goyder Institute for Water Research, 2019), http://www.goyderinstitute.org/_r2160/media/system/attrib/file/604/Goyder_TRS-19-13%20Coastal%20C%20Task2b_summary%20report_Final.pdf.
(3) "Carbon Markets."
(4) "Buying Satellite Imagery: Pricing Information for High Resolution Satellite Imagery," LAND INFO Worldwide Mapping, LLC, accessed October 31, 2019, http://www.landinfo.com/satellite-imagery-pricing.html.
(5) Jaime Paneque-Gálvez et al., "Small Drones for Community-Based Forest Monitoring: An Assessment of Their Feasibility and Potential in Tropical Areas," Forests 5, no. 6 (June 24, 2014): 1481–1507, https://doi.org/10.3390/f5061481.
(6) Jones et al., "Coastal Carbon Opportunities: Using Drones to Measure Mangrove above-Ground Biomass and Carbon."
(7) Edward Zimudzi et al., "Remote Sensing of Mangroves Using Unmanned Aerial Vehicles: Current State and Future Directions," Journal of Spatial Science, June 19, 2019, 1–18, https://doi.org/10.1080/14498596.2019.1627252.


Sage Riddick (MEM CEM '21) eradictating Lionfish (*Pterois volitans*) in Belize.


This past summer I took two groups of high schoolers to Belize to learn how to SCUBA dive and to participate in underwater community service. We worked with ReefCI, helping them perform surveys and eradicating lionfish. Although I was there to guide high schoolers, I was also able to learn more about lionfish.

Lionfish are one of the most invasive species in the marine world. They eat everything and anything and they do not have many known predators. Their stomach can expand up to 30 times its normal size and females can reproduce millions of eggs every three days or so. It is so hard to keep up with eradicating their population, but places like ReefCI are doing their part to put an end to this invasive species.

Why should you care? Since the early 2000s, lionfish have been taking over the North Carolina coast. Many places around North Carolina are trying to do their part by eradicating and feasting on the lionfish.

Whale Shark (*Rhincodon typus*)
Koh Tao, Thailand
*Garrett Corwin*
*(MEM BE '21)*

Scalloped Hammerhead Shark (*Sphyrna lewini*)
Darwin Island, Galápagos Archipelago
*Garrett Corwin*
*(MEM BE'21)*

# Submit to UPWELLING

UPWELLING is a biannual journal that allows the duke community to share their thoughts, opinions, and research pertaining to the oceans and policy. We are interested in any ocean-related work, including short research articles, OpEds, photographs, maps and other creative content. Content is fairly flexible, and topics may include summer internship experience, a conference you attended, the research that you are currently involved in, or other experiences. We welcome work from Duke University students in any department, researchers, faculty, alumni, and professors.

Please send submissions to dukeOPWG@gmail.com

## 2019-2020 OPWG Leadership

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**Outreach Coordinator**
Catarina Martinez

**Seminar Coordinator**
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## Ocean Policy Working Group

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