

## KC (Kevin) Bierlich

Geospatial Ecology of Marine Megafauna (GEMM) Lab, Marine Mammal Institute,  
Department of Fisheries, Wildlife, & Conservation Sciences, Oregon State University  
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### CURRENT POSITION

2021 – present

#### **Postdoctoral Scholar**

Marine Mammal Institute, Dept. of Fisheries, Wildlife, & Conservation  
Sciences, Hatfield Marine Science Center, Oregon State University  
Geospatial Ecology of Marine Megafauna ([GEMM](#)) Lab  
Supervisor: Dr. Leigh Torres

### EDUCATION

2016 – 2021

#### **Ph.D., Marine Science and Conservation**

Duke University, Nicholas School of the Environment  
Advisor: Dr. David W. Johnston, [Marine Robotics and Remote Sensing Lab](#)  
Dissertation Title: Incorporating Photogrammetric Uncertainty in UAS-  
based Morphometric Measurements of Baleen Whales

2016

#### **M.E.M., Coastal Environmental Management**

Duke University, Nicholas School of the Environment/Duke Marine Lab  
Advisor: Dr. David W. Johnston

2014

#### **B.S., Biology w/ minor in Environmental Science**

Sonoma State University, *Cum Laude*  
Advisor: Dr. Dan Crocker

### PUBLICATIONS

Cade, D.E., Kahane-Rapport, S.R., Gough, W.T., **Bierlich, K.C.**, Linksy, J.M.J., Johnston, D.W.,  
Goldbogen, J.A., Friedlaender, A.S. (*in review*). Ultra-high feeding rates of Antarctic minke whales  
imply a lower limit for body size in engulfment filtration feeders. PNAS.

Torres, L.G., Bird, C., Rodrigues-González, F., Christiansen F., Bejder, L., Lemos, L., Urbán  
Ramírez, J., Swartz, S., Willoughby, A., Hewitt, J., **Bierlich, K.C.** (*in review*). Range-wide comparison  
of gray whale body condition reveals contrasting sub-population health characteristics and  
vulnerability to environmental change. *Frontiers in Science*.

Segre P.S., Gough, W.T., Roualdes, E.A., Cade, D.E., Czapanskiy, M.F., Fahlbush, J., Kahane-  
Rapport, S.R., Oestreich, W.K., Bejder, L., **Bierlich, K.C.**, Burrows, J.A., ... Goldbogen, J.A. (2022).  
Scaling of maneuvering performance in baleen whales: larger whales outperform expectations.  
*Journal of Experimental Biology*. 225 (5): jeb243224. <https://doi.org/10.1242/jeb.243224>

**Bierlich, K.C.**, Hewitt, J., Bird, C.N., Schick R.S., Friedlaender, A.S., Torres, L.G., Dale, J., Goldbogen, J.A., Read, A., Calambokidis J., Johnston, D.W., (2021). Comparing uncertainty associated with 1-, 2-, and 3D aerial photogrammetry-based body condition measurements of baleen whales. *Frontiers in Marine Science*. 8:749943. doi: [10.3389/fmars.2021.749943](https://doi.org/10.3389/fmars.2021.749943)

Savoca, M. S. Czapanskiy, M. F., Kahane-Rapport, S. R., Gough, W. T., Falhbusch, J. A., **Bierlich, K. C.**, Segre, P. S., Di Clemente, J., Penry G. S., Wiley, D. N., Calambokidis, J., Nowacek, D. P., Johnston, D. W., Pyenson, N. D., Friedlaender, A. S., Hazen, E. L., & Goldbogen, J.A. (2021). Baleen whale prey consumption based on high-resolution foraging measurements. *Nature*, 599, 85–90. <https://doi.org/10.1038/s41586-021-03991-5>

**Bierlich, K.C.**, Schick, R.S., Hewitt, J., Dale, J., Goldbogen, J.A., Friedlaender, A.S., Johnston D.J. (2021). A Bayesian approach for predicting photogrammetric uncertainty in morphometric measurements derived from UAS. *Marine Ecology Progress Series*. DOI: <https://doi.org/10.3354/meps13814>

Gough, W. T., Smith, H. J., Savoca, M. S., Czapanskiy M. F., Fish, F. E., Potvin, J., **Bierlich, K.C.**, Cade, D. E., Di Clemente, J., Kennedy, J., Segre, P., Stanworth, A., Weir, C., & Goldbogen, J. A. (2021). Scaling of oscillatory kinematics and Froude efficiency in baleen whales. *Journal of Experimental Biology* 224 (13): jeb237586. doi: <https://doi.org/10.1242/jeb.237586>

Kahane-Rapport, S.R., Savoca, M.S., Cade, D.E., Segre, P.S., **Bierlich, K.C.**, Calambokidis, J.A., Dale, J., Friedlaender, A.S., Johnston, D.W., Werth, A.J. and J.A. Goldbogen. (2020). Lunge filter feeding biomechanics constrain rorqual foraging ecology across scale. *Journal of Experimental Biology*. 223(20). <https://doi.org/10.1242/jeb.224196>

Bird, C.N., and **Bierlich, K.C.** (2020). CollatriX: A GUI to collate MorphoMetriX outputs. *Journal of Open Source Software*, 5(51), 2328. <https://doi.org/10.21105/joss.02328>

Torres, W.I., & **Bierlich, K.C.** (2020). MorphoMetriX: a photogrammetric measurement GUI for morphometric analysis of megafauna. *Journal of Open Source Software*, 5(45), 1825. <https://doi.org/10.21105/joss.01825>

Segre, P.S., Potvin, J., Cade, D.E., Calambokidis, J., Di Clemente, J., Fish, F.E., Friedlaender, A.S., Gough, W.T., Kahane-Rapport, S.R., Oliveira, C., Parks, S.E., Penry, G.S., Simon, M., Stimpert, A.K., Wiley, D.N., **Bierlich, K.C.**, Madsen, P.T., Goldbogen, J.A. (2020). Energetic and physical limitations on the breaching performance of large whales. *eLife*, 9, p.e51760. <https://doi.org/10.7554/eLife.51760>

Gough, W.T., Segre, P.S., **Bierlich, K.C.**, Cade, D.E., Potvin, J., Fish, F. E., Dale, J., di Clemente, J., Friedlaender, A.S., Johnston, D.W., Kahane-Rapport, S.R., Kennedy, J., Long, J.H., Oudejans, M., Penry, G., Savoca, M.S., Simon, M., Videsen, S.K.A., Visser, F., Wiley, D.N., Goldbogen, J.A. (2019). Scaling of swimming performance in baleen whales. *Journal of Experimental Biology*, 222(20). <https://doi.org/10.1242/jeb.204172>

Gray, P. C., **Bierlich, K. C.**, Mantell, S. A., Friedlaender, A. S., Goldbogen, J. A., & Johnston, D. W. (2019). Drones and convolutional neural networks facilitate automated and accurate cetacean species

identification and photogrammetry. *Methods in Ecology and Evolution*, 10(9), 1490-1500.  
<https://doi.org/10.1111/2041-210x.13246>

**Bierlich, K. C.**, Miller, C., DeForce, E., Friedlaender, A. S., Johnston, D. W., & Apprill, A. (2018). Temporal and regional variability in the skin microbiome of humpback whales along the Western Antarctic Peninsula. *Applied and environmental microbiology*, 84(5), e02574-17.  
<https://doi.org/10.1128/aem.02574-17>

#### *Technical Reports:*

**Bierlich, K.C.** & Torres, L.G. (2021). Quick-guide to UAS-based photogrammetry of whales.

**Bierlich, K.C.**, Johnston, D.W. (2016). Using Unoccupied Aerial Systems (UAS) for Surveying Shorebirds in North Carolina; Marine Conservation Ecology Unoccupied Systems Facility; Duke University Marine Lab; Beaufort, NC USA. Cited by doi:10.3390/drones4020012

#### *Open-source datasets and code:*

**Bierlich, K. C.**, Schick, R. S., Hewitt, J., Dale, J., Goldbogen, J. A., Friedlaender, A. S., & Johnston, D. W. (2020). Data and scripts from: A Bayesian approach for predicting photogrammetric uncertainty in morphometric measurements derived from UAS. Duke Research Data Repository. V2 <https://doi.org/10.7924/r4sj1jj6s>

#### *Acknowledged in:*

Sykora-Bodie, S. T., & Morrison, T. H. (2019). Drivers of consensus-based decision-making in international environmental regimes: Lessons from the Southern Ocean. *Aquatic Conservation: Marine and Freshwater Ecosystems*. <https://doi.org/10.1002/aqc.3200>

Johnston, D. W. (2019). Unoccupied aircraft systems in marine science and conservation. *Annual review of marine science*, 11, 439-463. <https://doi.org/10.1146/annurev-marine-010318-095323>

Lindkvist, E., Basurto, X., & Schlüter, M. (2017). Micro-level explanations for emergent patterns of self-governance arrangements in small-scale fisheries—A modeling approach. *PLoS one*, 12(4). <https://doi.org/10.1371/journal.pone.0175532>

#### RESEARCH AWARDS, GRANTS, & FELLOWSHIPS

2021	<b>Oregon License Plate Fund</b> , Marine Mammal Institute (\$9,000)
2021	<b>Postdoctoral Scholar</b> , Marine Mammal Institute, Oregon State University
2016 – 2021	<b>Duke University Graduate Research/Teaching Assistantship Fellowship</b>
2020	<b>Nicholas School Dean’s Award for Outstanding Graduate Student Manuscript, Honorable Mention</b> , Duke University
2020	<b>Graduate Research Patent Royalties Quasi Endowment Fund</b> (\$5,500)
2020	<b>Graduate Research Assistantship</b> , NSF Award #1644209
2019	<b>Student Travel Grant</b> , World Marine Mammal Conference, Barcelona, Spain

2019 **Summer Research Fellowship for PhD Students**, Duke University (\$5,500)  
 2018 **Data Expeditions Teaching Grant**, Duke University (\$1,500)  
 2017 **Student Travel Grant**, SMM Biennial Conference, Halifax, Nova Scotia, Canada  
 2017 **Graduate Student Research Grant**, Duke University Wetland Center (\$5,000)  
 2017 **The Explorer's Club** (\$1,000)  
 2015 **Whale Bacterial Buddies Project**, WHOI crowdfunding campaign (\$5,000)  
 2015 **Michael K. Orbach Enrichment Fund**, (\$500)  
 2015 **Edna Bailey Sussman Fund** (\$4,550)  
 2014 – 2016 **Academic Scholarship**, Duke University (\$14,000)  
 2014 – 2016 **Research Assistantship**, Duke University (\$6,000)  
 2012 **Council of Ocean Affairs, Science, and Technology (COAST)** (\$2,500)

## CONFERENCE & WORKSHOP PRESENTATIONS

### First Author Presentations

**Bierlich, KC**, Dale, Julian, Friedlaender, Ari, Goldbogen, Jeremy, Johnston, David. Dwarf minke whales along the Antarctic Peninsula: Evidence of climate migration or historic misidentification? **Society for Integrative and Comparative Biology (SICB) Annual Meeting**, Austin, Texas, USA, Jan. 3-7, 2020

**Bierlich, KC**, Dale, Julian, Friedlaender, Ari, Goldbogen, Jeremy, Johnston, David. Guess who's coming to dinner. Dwarf minke whales along the Antarctic Peninsula: Evidence of climate migration or historic misidentification? **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020

**Bierlich KC**, Miller C, DeForce E, Friedlaender A, Johnston D, Apprill A. Seasonal and regional variability in the skin microbiome of humpback whales along the Western Antarctic Peninsula **Society for Marine Mammalogy (SMM) Biennial Conference**, Halifax, Nova Scotia, Oct 23 – 27<sup>th</sup>, 2017. *Video Presentation – selected as 1 of 8*

**Bierlich, KC**, Dale, Julian, Friedlaender, Ari, Goldbogen, Jeremy, Johnston, David. The morphology and external characters of Antarctic minke whales. **NSF Minke Whale Data Analysis & Synthesis Meeting**, Long Marine Lab, UC Santa Cruz, Santa Cruz, July 29, 2020

**Bierlich KC**, Johnston D, Miller C, DeForce E, Friedlaender A, Apprill A. Seasonal shifts in the core bacterial members on the skin of humpback whales, **The Ecology Symposium, Duke University**, December 2016

**Bierlich KC**, Johnston D, Miller C, DeForce E, Friedlaender A, Apprill A. The Whale Microbiome, **Palmer Antarctica Long Term Ecological Research Project (PAL-LTER) Annual Meeting**, New Brunswick, NJ, September 2016

### Co-authored Presentations (Oral and Poster)

Adams, D.S., **Bierlich, K.C.**, Dale, J., Johnston, D.W., Goldbogen, J.A., Friedlaender, A.S., Segre, P., Fish, F.E., Blob, R.W., Price, S.A. Control surface-body size relationship in toothed and baleen

whale species. **Society for Integrative and Comparative Biology (SICB) Annual Meeting**, (submitted).

Smith, H.; Gough, W.; Goldbogen, J.A.; Savoca, M.S.; Czapanskiy, M.; Fish, F.; Potvin, J.; **Bierlich, KC**; Kennedy, J. The Physics of Whale Movement: Drag and Thrust Production to Measure Whale Propulsive Efficiency. **Ocean Sciences Meeting, 2020**, San Diego CA, Feb. 19, 2020. *Poster Presentation*

Kahane-Rapport, SR; Savoca, MS; Cade, DE; Segre, PS; **Bierlich, KC**; Calambokidis, J; Friedlaender, AS; Johnston, DW; Werth, AJ; Goldbogen, JA. From Feast Mode to Least Mode: How lunge Filter Feeding Biomechanics Constrain Rorqual Foraging Ecology Across Scale. **Society for Integrative and Comparative Biology (SICB) Annual Meeting**, Austin, Texas, USA, Jan. 3-7, 2020. *Oral Presentation*

Smith, HJ; Gough, WT; Savoca, MS; Czapanskiy, MF; Fish, Fe; Potvin, J; Cade, DE; **Bierlich, KC**; Kennedy, J; Goldbogen, JA. The Physics of Whale Movement: Drag and Thrust Production to Measure Whale Propulsive Efficiency. **Society for Integrative and Comparative Biology (SICB) Annual Meeting**, Austin, Texas, USA, Jan. 3-7, 2020. *Poster Presentation*

Dale, Julian; **Bierlich, K.C.**; Johnston, David. This is not the drone you are looking for.... The challenges of adopting new UAS technologies in marine science. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

Gray, Patrick; **Bierlich, K.C.**; Mantell, Sydney; Friedlaender, Ari; Goldbogen, Jeremy; Johnston, David. Automated cetacean identification and measurement using drones and deep learning. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

Bird, Clara; **Bierlich, K.C.**; Dale, Julian; Friedlaender, Ari; Goldbogen, Jeremy; Johnston, David. A comparison of percent dorsal scar cover between populations of humpback whales (*Megaptera novaeangliae*) off California and the Western Antarctic Peninsula. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Poster Presentation*

Gough, William; Segre, Paolo; **Bierlich, K.C.**; Cade, David; Potvin, Jean; Fish, Frank; Dale, Julian; Di Clemente, Jacopo; Friedlaender, Ari; Johnston, David; Kahane-Rapport, Shirel; Kennedy, John; Long, John; Oudejans, Machiel; Penry, Gwenith; Savoca, Matthew; Simon, Malene; Videsen, Simone; Visser, Fleur; Wiley, David; Goldbogen, Jeremy. Scaling of swimming performance in the largest animals. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

Nazario, Emily; Cade, David; **Bierlich, K.C.**; Calambokidis, John; Dale, Julian; Goldbogen, Jeremy; Johnston, David; Kahane-Rapport, Shirel; Visser, Fleur; Friedlaender, Ari. Measuring nares expansion reveals variability in breath area and duration. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

Nichols, Ross; Cade, David; **Bierlich, K.C.**; Cimino, Megan; Larson, Greg; Modest, Michelle; Pallin, Logan; Pickett, Erin; Swaim, Zachary; Johnston, David; Nowacek, Doug; Read, Andy; Friedlaender, Ari. Humpback whale foraging in the Antarctic Summer. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

Kahane-Rapport, Shirel; Savoca, Matthew; Cade, David; Segre, Paolo; **Bierlich, K.C.**; Calambokidis, John; Czapanskiy, Max; Dale, Julian; Di Clemente, Jacopo; Fahlbusch, James; Friedlaender, Ari; Johnston, David; Nowacek, Doug; Penry, Gwenith; Werth, Alexander J.; Goldbogen, Jeremy. From feast mode to least mode: How lunge filter feeding biomechanics constrain rorqual foraging ecology across scale. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

Savoca, Matthew; Kahane-Rapport, Shirel; Cade, David; Czapanskiy, Max; Fahlbusch, James; Segre, Paolo; Calambokidis, John; Nowacek, Doug; Johnston, David; **Bierlich, K.C.**; Dale, Julian; Hazen, Elliott L.; Friedlaender, Ari; Goldbogen, Jeremy. Rorqual ingestion estimates based on direct measures of feeding rates and prey quality. **World Marine Mammals Conference (WMMC)**, Barcelona, Spain, Dec. 9– 12, 2020. *Oral Presentation*

#### [Workshops – planning committee](#)

**Research Summit on Collaboration**, Hatfield Marine Science Center, Newport, OR  
October 19, 2021

**Future of Remote Sensing Workshop for Tropical Conservation**, Duke University Marine Laboratory, March 19 – 22, 2017

#### [Workshops – participation](#)

##### **Reckoning with Race, Anti-racism Training**

Nicholas School of the Environment  
Duke University, September 18, 2020

##### **Living While Black**

Office for Institutional Equity  
Duke University, June 16, 2020

##### **The Effects of Climate Change on Marine Mammals**

World Marine Mammal Conference  
Barcelona, Spain, December 7, 2020

##### **Introduction to R and Tidyverse**

John Little, Center for Data and Visualization Sciences  
Duke University, March 18, 2020

##### **Visualization in R using ggplot**

Angela Zoss, Center for Data and Visualization Sciences  
Duke University, September 9, 2019

##### **Reproducible Research Workshop – R, R Studio, Git, GitHub**

Dr. Robert Schick  
Duke University Marine Laboratory, Dec. 3, 2018

##### **Exuding Confidence When Communication Science**

April Dudash

Duke University Marine Laboratory, April 23, 2018

**Pursuing Respect, Inclusion, Diversity & Equity (PRIDE) Training**

Duke University Center for Sexual and Gender Diversity, February 15 & 16, 2017

**Designing a Lesson Plan for NC K-12 educators**

SciREN (Scientific Research and Education Network)

Duke University Marine Laboratory & NC Aquarium at Pine Knoll Shores, January – February 2017

**Marine Planning Advancement Training Workshop**

Nicholas School of the Environment, Executive Education Program

Duke University, January 11 – 12, 2016

**Unmanned Aerial Systems: Powerful and Cost-Effective Tools for Marine Science and Conservation**

Society for Marine Mammalogy (SMM), Biennial Conference, San Francisco, CA, December 12, 2015.

**SMRU Consulting – Impact Assessment**

Society for Marine Mammalogy (SMM), Biennial Conference, San Francisco, CA

December 11, 2015.

[Conferences – participation](#)

**The Waterbird Society, Annual Meeting**, New Bern, NC September 20 – 23, 2016

**OCEANOISE2015**, Vilanova i la Geltrú, Barcelona, May 11–15, 2015

**Watkins Memorial Marine Mammal Bioacoustics Symposium**

New Bedford Whaling Museum, March 27 – 29, 2015

**The American Cetacean Society, 14<sup>th</sup> Annual Meeting**, Newport Beach, Ca, November 7 – 9, 2014

**PROFESSIONAL EXPERIENCE**

[Fieldwork & Expeditions](#)

2021-present **Marine Mammal Researcher**, Kodiak Island, AK USA

Geospatial Ecology of Marine Megafauna Lab, Marine Mammal Institute, Hatfield Marine Science Center, Oregon State University

Led scouting expedition to assess feasibility of establishing research project evaluating gray whales off of Kodiak Island, AK. Led shore- and boat-based fieldwork team scanning for gray whales. Piloted DJI Inspire 2 to collect video for behavioral observations and still images for photogrammetry analysis of gray whales to evaluate body condition. Collected photo ID to match unique individuals, fecal samples for hormone analysis, and benthic sampling to evaluate prey type.

2021-present **Marine Mammal Researcher & UAS Pilot**, Oregon Coast, USA

Geospatial Ecology of Marine Megafauna Lab, Marine Mammal Institute, Hatfield Marine Science Center, Oregon State University

Piloting DJI Inspire 2 to collect video for behavioral observations and still images for photogrammetry analysis of gray whales to evaluate body condition in response to anthropogenic stress (e.g. vessel traffic, ocean noise, seismic exploration) and environmental variability (changing prey availability). Collecting photo ID to match samples to unique individuals. Collecting fecal samples for hormone analysis. Prey sampling for identification and caloric content analysis. This work is part of the [GRANITE](#) Project: Gray whale Response to Ambient Noise Informed by Technology and Ecology

2017 – 2020 **Marine Mammal Researcher & UAS Pilot**, Western Antarctic Peninsula  
Duke University, University of California Santa Cruz, Stanford University, California Ocean Alliance, WWF Antarctica, NSF Long-Term Ecological Research Project Palmer Station.

Led small-team UAS operations for seven research excursions along the Western Antarctic Peninsula. Piloted a LemHex-44 hexacopter (>200 flights) to collect aerial images of humpback whales for photogrammetry analysis to evaluate early, mid, and late-season body condition. Successfully collected UAS images of >400 humpback whales. Also collected Photo ID to match individuals and collected skin/blubber biopsy samples for hormone, sex, and genetic analysis.

*Advisors:* Dr. Ari Friedlaender, Dr. David Johnson, Dr. Jeremy Goldbogen  
*Vessels:* R/V Laurence M. Gould (NSF), RCGS Resolute (One Ocean Expeditions) Akademik Ioffe (One Ocean Expeditions)

2018 -2019 **Marine Mammal Ecologist & UAS Pilot**, Western Antarctic Peninsula  
R/V Laurence M. Gould, NSF

Led small team UAS operations. Piloted a LemHex-44 hexacopter (>70 flights) to collect aerial imagery for photogrammetry analysis on the external characters, morphology, and body condition of Antarctic minke whales (>50). Collected skin/blubber biopsy samples for hormone, sex, and genetic analysis and Photo ID. Assisted in tagging efforts (CATS tags) to better understand biomechanics and ecological role.

2017 - 2018 **Marine Mammal Researcher & UAS Pilot**, Santa Barbara & Monterey, CA  
Hopkins Marine Station, Stanford University, Monterey, CA

Piloted a LemHex-44 hexacopter and controlled gimbal and camera on the FreeFly Alta 6 hexacopter to collect images of blue (n>32), humpback (n>60), and fin (n>3) whales tagged with CATS tags for photogrammetry analysis of morphology and body condition to relate to the kinematic and locomotion data collected from the tags.

2016 - 2018 **Cetacean Exhumation Field Team**  
**North Carolina Maritime Museum**, Beaufort, NC

Led small teams in exhuming cetacean skeletons that have been buried for two years after animal stranded. Exhumations included two bottlenose dolphins, one



Atlantic spotted dolphin, one white-beaked dolphin, and one short-finned pilot whale. Full skeletons used for research and display at the NC Maritime Museum.

2012 – 2014 **Field/Lab Technician**, Año Nuevo, CA  
**Sonoma State University**, Dr. Dan Crocker Lab  
Behavioral analysis, chemical immobilization, serum and biopsy collection, tagging, measuring weight and girth, collecting hair and whisker samples, and attaching satellite instruments of Northern elephant seals at. Analyzed samples in lab with colorimetric and fluorometric assays, radioimmunoassays, and ELISAs to determine different hormone concentrations.

2012 **Field Assistant**, Northern California Coast  
**UC Davis Bodega Bay Marine Lab**, Dr. Laura Rogers-Bennett Lab  
Ecosystem analysis of decimated habitat from a virulent red tide in Northern California. Organized dive cruises and managed transect routes and collection of coralline algae covered rock samples for evaluation of larval recruitment. Assisted in regrowth experiments for the endangered white abalone. Research supported by Dept. Fish & Wildlife and Council of Ocean Affairs, Science, and Technology (COAST).

2011 **Scientific Aid**, Northern California Coast & SF Bay Area  
**California Department of Fish and Wildlife**, Santa Rosa, CA  
Surveyed angler effort along Northern California coast, San Francisco Bay, and Farallon Islands. Species identification, sample collections, data entry, and proficiency in fishing regulations.

#### Additional Research Experience

2020 **Research Assistantship**, Dr. Doug Nowacek & Dr. David Johnston  
**Duke University Marine Lab**, Beaufort, NC  
Photogrammetry analysis on the morphology and external characters of humpback and Antarctic minke whales in images collected from UAS.

2015 – 2018 **Guest Student Investigator**, Dr. Amy Apprill Lab  
**Woods Hole Oceanographic Institution**, Woods Hole, MA  
Examined the skin microbiome of over 200 skin samples from humpback and minke whales to identify a shared core group of microbial members on the skin. Created a DNA library using molecular techniques such as DNA extraction, DNA isolation, PCR, electrophoresis, and DNA sequencing. Analyzed sequenced data using mothur, PRIMER 7, and R.

2017-2021 **Photogrammetry Analyst**, Marine Robotics and Remote Sensing Lab  
**Duke University Marine Lab**, Beaufort, NC  
Photogrammetry analysis on the morphology, external characters, and body condition of humpback and Antarctic minke whales in images collected from UAS.

2017 – 2018 **Photogrammetry Analyst**, Dr. Jeremy Goldbogen Lab  
**Stanford University, UC Santa Cruz, Cascadia Research Collective**

Photogrammetry and morphometric analysis of tagged blue, fin, and humpback whales off the coast of California to study functional morphology.

- 2017 – 2018 **UAS Remote Sensing Analyst**  
**Duke University Wetland Center**  
Quantifying NIR reflectance error associated with variation in tidal height in salt marshes using fixed wing UAS equipped with multispectral sensors.
- 2015 – 2016 **Research Assistant, UAS in Shorebird Conservation**  
**Duke University Marine Lab**, Marine Robotics and Remote Sensing Lab  
Collaboration with NC Wildlife Resources Commission for developing a protocol to survey shorebirds using drones. Included UAS research design and implementation, flight planning, mission execution, generation of 3D orthomosaics, and data analysis.

#### INVITED TALKS

**25<sup>th</sup> Annual Salmon Bowl**, The National Oceanic Sciences Bowl (NOSB), *hosted by Oregon State University*, February 5, 2021

**Keynote Presentation:** Studying Earth's Largest Creatures in Changing Climates

**Hatfield Marine Science Center Research Seminar**, December 2, 2021

**Presentation:** Incorporating uncertainty associated with drone-based measurements to better monitor the health of whales. <https://www.youtube.com/watch?v=L846RZc0SIo>

**Stanford University, Hopkins Marine Station**, August 1, 2018

**Presentation:** Using drones to measure body condition changes in baleen whales

**NSF RV Laurence M. Gould**, Western Antarctic Peninsula, June 16, 2018

**Presentation:** Drones and whales in Antarctica

**UNC Chapel Hill, Institute of Marine Sciences**, September 21, 2017

**Presentation:** Sizing up! How drones can help measure whales

**Oceana, Weekly Science Seminar Series**, Washington DC, October 25, 2016

**Presentation:** Seasonal and geographic influences on the skin microbiome of humpback whales in Antarctica: Towards a health-diagnostic tool

**Stories for People and Nature (SNAP)**, Duke University, October 17, 2016

**Presentation:** "ohSNAP!" Photoessay: Iceland and Yosemite National Park

#### SERVICE AS REVIEWER

**Journal of Aquatic Mammals**  
**Marine Ecology Progress Series**

## TEACHING EXPERIENCE

### **Aquaculture**, Teaching Assistant

Dr. Zackary Johnson, Duke University Marine Laboratory (Fall 2019)

### **Measuring whales with drones, photogrammetry workshop**

Drones in Marine Biology, Ecology, & Conservation, Duke University (Summer 2018 & 2019)

### **Comparative Physiology**, Teaching Assistant

Dr. Josh Osterberg, Duke University Marine Laboratory (Spring 2019)

### **Coastal Watershed Science and Policy**, Teaching Assistant

Dr. Dana Hunt, Duke University Marine Laboratory (Spring 2017 & 2018)

### **Molecular Biology**, Teaching Assistant

Dr. Tom Schultz, Duke University Marine Lab (Fall 2017)

### **Drones in Marine Biology, Ecology and Conservation**, Teaching Assistant

Dr. David Johnston, Duke University Marine Lab (Summer 2017)

### **SciREN (Scientific Research and Education Network)** (2017)

Developing lesson plans that meet the North Carolina teaching standards for K-12 educators.

### **Marine Megafauna**, Teaching Assistant

Dr. Andre Boustany, Duke University (Fall 2016)

## STUDENTS MENTORED

**Wally Fiori** – undergraduate at Oregon State University

**Ally Kane** – masters student at Oregon State University

**Abby Coffey** – masters student at Oregon State University

**Amanda Mayfield** – undergraduate at Oregon State University

**Clara Bird** – Duke University (now a PhD Student at Oregon State University)

**Anna Windle** – MEM Duke University (now a PhD student at University of Maryland)

**Allison Duprey** – UNC Chapel Hill (now a masters student at Oregon State University)

**Anne Harshbarger** – Duke University (now a PhD student at Duke University)

## SOCIETIES AND LEADERSHIP

**AAAS/Science Program for Excellence in Science**

**Society for Marine Mammals**

**Society for Integrative and Comparative Biology**

**Arctic Boundaries Working Group** – Co-founder

**The Coastal Society** – Event Coordinator, Duke Student Chapter

**Academy of Model Aeronautics**

**American Cetacean Society**

## CERTIFICATES

### **FAA Part 107 US Commercial Drone Pilot**

Experience piloting MikroKopter LemHex-44, DJI Inspire 2, SenseFly eBee plus, DJI Phantom 3, DJI Phantom 4 Pro, and DJI Mavic Pro, 3DR Iris, Parrot Disco, and Parrot Bebop 2

- >250 missions flown (~3780 minutes)
- Variety of cetacean species including bottlenose dolphins and blue, humpback, Antarctic minke, Dwarf minke, killer, and gray whales

**Van Safety Driver**, Duke University

**Certificate in Marine Planning Advancement Training**, Duke University

**Advanced Scuba Diver**, NAUI

**Open Water Scuba Diver**, PADI

## OUTREACH

**Memoirs from above: drone observation of blue, humpback, Antarctic minke, and gray whales.**

GEMM Lab Blog

<https://blogs.oregonstate.edu/gemmlab/2021/11/01/memoirs-from-above-drone-observations-of-blue-humpback-antarctic-minke-and-gray-whales/>

**Little whale, big whale, swimming in the water: A quick history on how aerial photogrammetry has revolutionized the ability to obtain non-invasive measurements of whales.**

GEMM Lab Blog

<https://blogs.oregonstate.edu/gemmlab/2021/06/28/little-whale-big-whale-swimming-in-the-water-a-quick-history-on-how-aerial-photogrammetry-has-revolutionized-the-ability-to-obtain-non-invasive-measurements-of-whales/>

**Scouting mission to Kodiak: Reconnaissance of potential gray whale research in Kodiak, Alaska.**

GEMM Lab Blog

<https://blogs.oregonstate.edu/gemmlab/2021/10/11/scouting-mission-to-kodiak-reconnaissance-of-potential-gray-whale-research-in-kodiak-alaska/>

**Science and Technology Summer Camp, Oregon SeaGrant, 7/20/21**

**Duke Marine Robotics and Remote Sensing Lab Facility Tours, 2016 - 2019**

**One Ocean Expeditions, March 2019**

**One Ocean Expeditions, December 2018**

**California Ocean Alliance, Marine Mammal Scientist in Training Camp, 8/2/2018**

**One Ocean Expeditions, November 2017**

**Down East Library, Beaufort, NC, 6/21/2017**

Public lecture and demonstration of using UAS for local conservation.

**Coastal Connections, NC State CMAST, 4/27/2017**

Developed lesson plan for local K-12 educators to share with their classroom. Activity included exploring different drone images to count penguin colonies in Antarctica

**Brewster Middle School, Camp Lejeune, 4/18/2017**

Overview of how drones can be used for science and conservation. Interactive presentation followed by a demo.

**SciREN Coast, 2/19/2017**

Developed lesson plan for local K-12 Educators to use drones in science and conservation. Lesson plan included free downloadable PowerPoint embedded with interactive videos.

## MEDIA COVERAGE

**Journal of Experimental Biology**, March 2, 2022

Gargantuan whales more maneuverable than they ought to be

<https://journals.biologists.com/jeb/article/225/5/jeb244075/274594/Gargantuan-whales-more-maneuverable-than-they>

**LA Times** December 17, 2021

Unprecedented die-offs, melting ice: Climate change is wreaking havoc in the Arctic and beyond

<https://www.latimes.com/environment/story/2021-12-17/north-pacific-arctic-ecosystem-collapse-climate-change>

**News Times**, November 30, 2021

Whales eat far more than thought

[https://www.newportnewstimes.com/community/whales-eat-far-more-than-thought/article\\_df338c80-41b0-11ec-8176-4797ca6ecc6c.html](https://www.newportnewstimes.com/community/whales-eat-far-more-than-thought/article_df338c80-41b0-11ec-8176-4797ca6ecc6c.html)

**Duke Graduate School**, April 8, 2020

PhD Students Create A Whale of A Program

<https://gradschool.duke.edu/about/news/phd-students-create-whale-program>

**The Washington Post**, December 28, 2019

We learned a lot about whales this year

<https://www.washingtonpost.com/science/2019/12/28/we-learned-lot-about-whales-this-year/>

**Coastal Review Online**, September 18, 2019

Researchers Automate Whale Data Collection

<https://www.coastalreview.org/2019/09/researchers-automate-whale-data-collection-2/>

**ABC News**, May 21, 2019

Scientists are ‘racing against the clock’ to collect crucial data on life in Antarctica

<https://abcnews.go.com/International/scientists-racing-clock-collect-crucial-data-life-antarctica/story?id=63150911>

**World Wildlife Fund (WWF)**, May 21, 2019

New technology helps WWF and partners study whales in one of the most remote places on the planet

<https://www.worldwildlife.org/stories/new-technology-helps-wwf-and-partners-study-whales-in-one-of-the-most-remote-places-on-the-planet>

**ABC Nightline**, May 20, 2019

Part 1: Researchers brave brutal conditions to research climate change in Antarctica.

<https://abcnews.go.com/Nightline/video/researchers-brave-brutal-conditions-research-climate-change-antarctica-63167400>

Part 2: Antarctic whales an indicator for world environmental health.

<https://abcnews.go.com/Nightline/video/antarctic-whales-indicator-world-environmental-health-scientists-part-63167468>

**World Wildlife Fund (WWF)**, May 8, 2019

The next generation of Antarctic scientists.

[https://www.wwf.org.au/news/blogs/the-next-generation-of-antarctic-scientists?utm\\_source=Twitter&utm\\_medium=organic\\_social&utm\\_campaign=antarctica&utm\\_content=link-gs.i0cnw0](https://www.wwf.org.au/news/blogs/the-next-generation-of-antarctic-scientists?utm_source=Twitter&utm_medium=organic_social&utm_campaign=antarctica&utm_content=link-gs.i0cnw0)

**World Wildlife Fund (WWF)**, April 18, 2019

Soaring to new heights in Antarctica.

<https://www.wwf.org.au/news/blogs/in-photos-soaring-to-new-heights-in-antarctica-gs.i0cbrz>

**PBS News Hour**, July 3, 2017

Drones are revolutionizing how we study humpback whales (Video).

<https://www.pbs.org/newshour/show/drones-are-revolutionizing-how-we-study-humpback-whales>

**National Centers for Coastal Oceans Science**, January 17, 2018

Melting Antarctic Sea Ice Threatens Minke Whales. <https://coastalscience.noaa.gov/news/melting-antarctic-sea-ice-threatens-minke-whales-video/>

**PBS News Hour**, January 24, 2018

Finding a complete dolphin skeleton to study isn't easy, unless you have a dolphin graveyard.

<https://www.pbs.org/newshour/science/finding-a-complete-dolphin-skeleton-to-study-isnt-easy-unless-you-have-a-dolphin-graveyard>

**PBS News Hour**, January 17, 2018

This graveyard gives scientists insight into lives of stranded dolphins.

<https://www.pbs.org/newshour/show/this-graveyard-gives-scientists-insight-into-lives-of-stranded-dolphins>

**Wetland Wire**, Volume 16, Number 1, Summer 2017

<https://nicholas.duke.edu/wetland/WWsummer2017.pdf>

**Duke University Wetlands Center Headlines**, June 5, 2017

<https://nicholas.duke.edu/wetland/headline1702.htm>

**Coastal Review Online** February 23, 2017

Science Network Links Researchers, Teachers.

<http://www.coastalreview.org/2017/02/sciren-connects-researchers-teachers/>



## REFERENCES

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