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Duke University Marine Lab, 135 Duke Marine Lab Rd, Beaufort NC, 28516

Research Interests: marine biodiversity, applied machine learning, eco-evolutionary dynamics, population genetics, computer vision, adaptation, phenotypic plasticity, generative artificial intelligence

EDUCATION

2025-Present **Duke University**
Ph.D., Marine Science and Conservation
Advised by Dr. Juliet Wong

2021-2025 **Duke University**
B.S Marine Science and Conservation, B.S Biology (Evolutionary Biology concentration), Minor in Computer Science
GPA**:** 4.0, *summa cum laude*
Senior Thesis: *Generative diffusion models for dataset augmentation and cetacean detection*, advised by Dr. David Johnston

RESEARCH EXPERIENCE

2023-2025 **Undergraduate Researcher**, Duke University Marine Lab, Beaufort, NC
Advised by Dr. David Johnston

- Awarded $8,000 NC Space Grant over 2024-2025 school year to create AI-generated images and improve cetacean detection models
- Fine-tuned generative AI diffusion models and developed a pipeline for large-scale, high-quality cetacean image generation
- Founded and mentored the “Smartwhales” team, five undergraduate researchers investigating broader applications of AI-generated imagery in ecology and conservation

2024 **NSF REU**, Rutgers University, New Brunswick, NJ
Advised by Dr. Josh Kohut

- Used machine learning models to predict fish community structures on New Jersey coast using environmental DNA and oceanographic data
- Assessed nonlinear machine learning and deep learning methods for eDNA data dimensionality reduction; open-sourced all code and data on GitHub

2024 **Research Assistant**, Duke University Marine Lab, Beaufort, NC
Advised by Dr. Dan Rittschof

- Performed DNA extractions and sequencing of 7 Sardinian blue crabs to investigate geographic origins of invasive Mediterranean crabs using COI haplotypes

- Preparing publication analyzing haplotype data of blue crabs from across the east coast as well as invasive crabs from Sardinia and Turkey

2024 **Research Assistant**, Duke University Marine Lab, Beaufort, NC
Advised by Dr. Tom Schultz
- Collected, extracted, and genotyped both local oyster species and farmed *C. virginica* at the Duke Aquafarm using COI barcoding and Nanopore sequencing
- Used machine learning variational autoencoder analysis to identify three genetically distinct bottlenose dolphin populations in the Western North Atlantic
- Created video tutorials to assist independent study students with remote computing and bioinformatics

2023 **Bonaventura Fellow**, Duke University Marine Lab, Beaufort, NC
Advised by Dr. Tom Schultz
- Identified over 32,000 chromosomal-level genetic variants in 12 Atlantic bottlenose dolphins belonging to three separate populations, culminating in oral presentation
- Filtered variants based on size and read quality for individual genotyping and analysis of population-level differentiation

2022-2023 **Bass Connections Team Member**, Duke University, Durham, NC
Advised by Dr. Zackary Johnson
- Assisted with designing a waterproof "PlanktoScope" to photograph plankton species off the dock at the Duke Marine Lab
- Led installation of Raspberry Pi and modification of an image segmentation pipeline for plankton identification

2022 **Data+ and Climate+ Project Member**, Duke University, Durham, NC
Advised by Audrey Thellman
- Developed a data pipeline starting from raw field camera images of small streams and ending in images with labeled ice and snow cover using image masking, markup, and machine learning
- Demonstrated pipeline functionality with user interface in R Bookdown, presented applications to USGS researchers for quantifying ice melt

PUBLICATIONS

1. **Sun, H.**, H Houliston, D Johnston. "Diffusion-based generative AI advances automated wildlife detection in remote sensing." *in prep.* Target Journal: *Frontiers in Ecology and Environment*. Anticipated Submission: **June 2025.**

PRESENTATIONS

1. **Sun, H.**, H Houliston, D Johnston 2025. "Generative diffusion models for dataset augmentation and cetacean detection: prospects and perspectives for ecology." Duke

Nicholas School of the Environment Undergraduate Honors Thesis Defense, Oral and Poster Presentation

2. **Sun, H.**, H Houliston, D Johnston 2025. "Generative diffusion models for dataset augmentation and cetacean detection." North Carolina Space Symposium Poster Presentation
3. **Sun, H.**, H Houliston, D Johnston 2025. "Generative diffusion models for dataset augmentation and cetacean detection." Southeast and Mid-Atlantic Marine Mammal Symposium (SEAMAMMS) Oral Presentation
4. **Sun, H.**, J Kohut, J Adolf 2025. "Machine learning identifies fish communities from environmental DNA (eDNA)." Association for the Sciences of Limnology and Oceanography (ASLO) Poster Presentation
5. **Sun, H.**, D Johnston 2024. "Using generative artificial intelligence (AI) to improve training data for North Atlantic Right Whale detection." North Carolina Sea Grant Coastal Conference Lightning Talk
6. **Sun, H.**, S George, D Rittschof, T Schultz, M Moran, Z Darnell, R Bilgin 2024. "Blue crab (*Callinectes sapidus*) COI haplotype analysis of origins of invasives in the Mediterranean." Western Society of Naturalists Poster Presentation
7. **Sun, H.**, D Johnston 2024. "Using generative artificial intelligence (AI) to improve training data for species detection models." Invited Speaker, Nicholas School of the Environment Board of Visitors Oral Presentation
8. **Sun, H.**, J Kohut, J Adolf 2024. "Machine learning identifies fish communities from environmental DNA (eDNA)." Rutgers RIOS NSF REU Final Poster Presentations
    a. Selected as 1 of 4 students with exceptional poster and oral presentations to present at the 2025 ASLO Meeting in Charlotte
9. **Sun, H.**, B Garomsa, H Ontiveros, A Thellman, W Slaughter 2022. "River ice phenology in a changing climate: A data pipeline for field camera ice and snow classification." Duke Plus Programs Final Poster Presentations

SELECTED AWARDS

2025 Duke University Marine Science and Conservation Award ($500)
2025 NSF Graduate Research Fellowship ($159,000)
2024 ASLO Multicultural Program (~$1500)
2024 North Carolina Space Grant Undergraduate Research Scholarship ($8,000)
2022 Duke University Rachel Carson Scholar ($6,000)

SERVICE AND OUTREACH

2024-Present **Growing Equity in Science and Technology (GEST) Leadership,** Duke University Marine Lab, Beaufort, NC

- Plan and volunteer at an annual outreach event for local middle school students to participate in hands-on STEM activities with professional scientists and faculty
- Co-lead website and technology sub-committee tasked with managing social media accounts and website, designed an educational scientific newsletter for students

2023-2025 **Marine Lab Scholars Program Executive Board,** Duke University, Durham, NC
- Helped plan events such as group dinners, guest speakers, and holiday parties for scholars; reviewed over 100 applications and interviewed ~15 prospective scholars
- Served as a mentor and/or 'pod parent' for a total of seven new scholars, providing advice regarding research and professional development

2024 **Resident Advisor,** Duke University Marine Lab, Beaufort, NC
- Fostered a safe campus environment and led tours and orientation for both 20 undergraduate students and visiting students
- Planned regular community events for residents including aquarium visits, trivia nights, and birthday parties

2021-2023 **Graphics Team Member**, Duke Climate Coalition, Durham, NC
- Designed visuals to be posted on social media related to various environmental issues both on campus and worldwide

TEACHING

2025 **AI and Applying Machine Learning to Oceans Science**, Durham, NC
- Gave a 1-hour talk about AI fundamentals and applications in marine science as part of Duke Oceans Week 2025, including an interactive coding demonstration

2025 **Technology to Study Marine Animals**, SciREN Coast, Beaufort, NC
- Prepared lesson plans about AI, automated whale detection, and synthetic imagery for a networking event with local teachers, won runner-up for best booth

MENTORSHIP

2024-Present **Max Niu**, Duke '28, Smartwhales team undergraduate researcher, Marine Lab Scholars Program mentee, Duke Bonaventura Fellow

2025 **Hope Hauck,** Duke '28, Marine Lab Scholars Program mentee

2024-2025 **Sara Norton,** Duke '25, Smartwhales team undergraduate researcher

2024-2025 **Sasha Provost,** Duke '25, Smartwhales team undergraduate researcher

2024-2025 **Rose Cassidy**, Duke '27, Smartwhales team undergraduate researcher

2024-2025 **Ellery Lei**, Duke '27, Smartwhales team undergraduate researcher, Marine Lab Scholars Program mentee

2024 **Cat Gamard,** Duke ‘25, Marine Lab Scholars Program mentee
2024 **Porter Porter**, Duke ‘25, Marine Lab Scholars Program mentee
2024 **Dhruv Rungta,** Duke ‘26, Marine Lab Scholars Program mentee
2024 **Thomas Tan,** Duke ‘26, Marine Lab Scholars Program mentee

PROFESSIONAL EXPERIENCE

2024 **Aquafarm Assistant,** Duke University Marine Lab, Beaufort, NC
- Perform weekly maintenance on the Duke oyster farm, including flipping oyster bags and replacing broken bags and lines
- Coordinate student volunteers for farm trips, help plan and manage community oyster roast events, support multiple student research projects using the farm

2022-2024 **Plant Growth Assistant,** Donohue Lab at Duke University, Durham, NC
- Raised *Arabidopsis thaliana* in greenhouses and extracted DNA from tissue
- Led paper discussions in lab meetings relating to plant epigenetics, maternal effects, and thermal tolerance

SKILLS AND INTERESTS

PROGRAMMING LANGUAGES (in order of experience): Python, Java, R, Bash, C/C++, MATLAB, LaTeX
TOOLS: Git, Linux, ImageJ, genome bioinformatics, remote computing, web development (HTML/CSS/JS, Typescript, React, Node.js)
LIBRARIES: PyTorch/TensorFlow, numpy, pandas, matplotlib, OpenCV, scikit-learn, Jupyter, Diffusers, xarray/xroms
LAB WORK: Tissue sampling/DNA extraction, PCR, gel electrophoresis, restriction digestion, Nanopore sequencing
OTHER: Competitive debate, graphic design, Mandarin Chinese (fluent), Spanish (proficient)
HOBBIES: Basketball, Chinese cooking, stargazing, Scrabble, table tennis, acoustic guitar

REFERENCES

David Johnston, Professor of the Practice of Marine Conservation Ecology, Duke University | david.johnston@duke.edu | (252) 646-1007

Tom Schultz, Associate Professor of the Practice of Marine Molecular Conservation, Duke University | thomas.schultz@duke.edu | (619) 823-1514

Josh Kohut, Dean of Research in the School of Environmental and Biological Sciences, Rutgers University | kohut@marine.rutgers.edu | (848) 932-3496

Meagan Dunphy-Daly, Rachel Carson Scholars Program Director, Duke University | meagan.dunphy-daly@duke.edu | (248) 515-1734