# Matthew T. Duggan

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## Research Interests

My research focuses on understanding how marine ecosystems communicate and perceive their environment through sound. I use passive acoustic monitoring, 360 video, and machine learning to decode fish vocalizations across shallow to deep coral reefs, linking acoustic behavior to ecological function. I'm particularly interested in developing accessible, low-cost technologies for long-term underwater sensing, enabling global participation in ocean soundscape research.

## Education

**Cornell University** Ithaca, NY
Ph.D. in Natural Resources Expected May 2027
K. Lisa Yang Center for Conservation Bioacoustics GPA: 4.0/4.0
Department of Natural Resources and the Environment

**University of South Carolina (Honors College)** Columbia, SC
B.S. in Biological Sciences; Leadership Distinction in Research Graduation: May 2022
B.S. in Computer Sciences GPA: 4.0/4.0

## Publications

### Peer-Reviewed Publications

Dantzker, M., Duggan, M., Delikaris-Manias, S., & Rice, A. (2025). Deciphering complex coral reef soundscapes with spatial audio and 360° video. *Methods in Ecology and Evolution*, Advance online publication. https://doi.org/10.1111/2041-210X.70149

Maile, R., Duggan, M., & Mousseau, T. A. (2023). The successes and pitfalls: Deep learning effectiveness in a Chernobyl field camera trap application. *Ecology and Evolution*, 13(7), e10454. https://doi.org/10.1002/ece3.10454

Regier, P.*, Duggan, M.*, Myers-Pigg, A., & Ward, N. D. (2023). Effects of random forest modeling decisions on biogeochemical time series predictions. *Limnology and Oceanography: Methods*, 21(9), 960–976. https://doi.org/10.1002/lom3.10523

Hodgson, M., Vitzilaios, N., Myrick, M., Richardson, T., Duggan, M., ... Kitzhaber, Z. (2022). Mission planning for low-altitude aerial drones during water sampling. *Drones*, 6(8), 209. https://doi.org/10.3390/drones6080209

Duggan, M., Groleau, M., Shealy, E., Self, L., Utter, T., Waller, M., ... Mousseau, T. A. (2021). An approach to rapid processing of camera trap images with minimal human input. *Ecology and Evolution*, 11(17), 12051–12063. https://doi.org/10.1002/ece3.7970

**In Preparation** Faber, M.*, Duggan, M.*, Parry, D., Tolkova, I., Curtis, A., Rice, A., Klinck, H. *Foundational Acoustic Ecological Function from a Deep Sea Fish.*

**Software & Data Resources** Duggan, M. and Garcia, M. (2023). *BioSNR: Bioacoustic Basic Operations with Decibels and the Passive Sonar Equation.* CRAN.

Cammarata, J., Davis, J., Duggan, M., Hodges, L., and Urton, I. (2022). Interactive SC Historical Map Application. *Scholar Commons*, 519.

## Relevant Experience

**FishEye Collaborative, Curaçao Sea Aquarium** — Willemstad, Curaçao
*Project Lead* — Nov 2023 – Present

- Deployed, maintained, and engineered a deep reef multimodal system to characterize fish sounds.
- Prototyped a cost-effective, long-term PAM system that can record the coral reef portfolio.
- Completed over 700 recorded scuba dives.

*Advisor: Dr. Marc Dantzker*

**Rice Lab, Smithsonian Institution & Cornell University** — Ithaca, NY
*Primary Investigator* — Aug 2022 – Present

- Founded and continue to deploy a >3 year PAM program across three biodiverse vertical coral regions in Curaçao from 0–300 meters.
- Developing an unsupervised ML ensemble to detect and classify species-specific fish call events in behavioral contexts (e.g., spawning, agonistic behavior) in shallow and deep reefs.
- Developed an inexpensive MEMS PAM recorder deployable to $> 250$ meters.

*Advisor: Dr. Aaron Rice & Dr. Carole Baldwin*

**Hodgson Lab, University of South Carolina** — Columbia, SC
*Assistant Researcher* — May 2022 – Aug 2022

- Built Python scripts to convert ROSBAG files from a custom UAS into a GeoPackage (SQLite) database.
- Inferred onboard phytoplankton laser spectrometry data for water-quality mapping using a Raspberry Pi 4B.

*Advisor: Dr. Michael Hodgson*

**Senner Lab, University of South Carolina** — Columbia, SC
*Assistant Researcher* — Oct 2020 – Aug 2022

- Constructed and optimized Hidden Markov Models and random forests on black-tailed Godwit movement data to predict nesting success, behavioral plasticity, and predictability.
- Measured generalization from precise GPS data ($< 30$ m) to irregular Argos data ($> 100$ m).

*Advisor: Dr. Nathan Senner*

**Ward Lab, Pacific Northwest National Laboratory** — Sequim, WA
*Undergraduate Researcher* — May 2021 – Aug 2021

- Used random forests to study biogeochemical signal influences within the National Estuarine Research Reserve System (NERR).
- Predicted ammonia, phosphate, nitrate, and chlorophyll *a* with 53–83% Nash–Sutcliffe efficiency during severe weather events.

*Advisor: Dr. Nicholas Ward*

**Mousseau Lab, University of South Carolina** — Columbia, SC
*Undergraduate Researcher* — Nov 2020 – May 2021

- Observed differences in germination success for chronically irradiated seeds from the Chernobyl Exclusion Zone across exposure gradients.
- Assisted with experimental design, fabrication of incubation vessels, daily monitoring, and final visualizations.

*Advisor: Dr. Timothy Mousseau*

**Mousseau Lab, University of South Carolina** Columbia, SC
*Undergraduate Researcher* Nov 2018 – Mar 2021

- Analyzed 4,000,000+ camera-trap images from Fukushima (Japan), Chernobyl, Fort McCrady (SC), and Clarks Hill (SC).
- Developed a CNN achieving an average F1 score of 86% for 21 indicator species (McCrady and Clarks Hill projects).

*Advisor: Dr. Timothy Mousseau*

## Presentations

Duggan, M. (2025, May). *Species-specific acoustic classification with 360 video and surround audio.* Acoustic Society of America (Talk).

Duggan, M. (2024, February). *Coral reefs of Curaçao.* Tropical Biology Consortium (Talk).

Duggan, M., Wilde, L., Verhoeven, M., Piersma, T., & Senner, N. (2022, January). *Animal movement: A window into behavior.* USC Undergraduate Research Symposium (Talk).

Duggan, M., Wilde, L., Verhoeven, M., Piersma, T., & Senner, N. (2021d, October). *Inferring successful breeding of a precocial bird with tracking data.* 7th International Biologging Society (Virtual talk).

(2021c, August). *Predicting shorebird nesting behaviors with movement data.* American Ornithological Society (Virtual talk).

Duggan, M., Regier, P., Myers-Pigg, A., & Ward, N. (2021b, July). *Utilization of random forests to predict nutrient concentration with water-quality predictors.* PNNL Student Leadership Symposium (Virtual talk).

Duggan, M., Wilde, L., Verhoeven, M., Piersma, T., & Senner, N. (2021a, April). *Hidden Markov models and random forests with movement data.* Discover USC (Virtual iPoster).

Duggan, M., Groleau, M., & Mousseau, T. (2019, September). *Detecting deer (Odocoileus virginianus) in Fort McCrady and Clarks Hill, SC.* Sustainable Showcase (Poster).

## Awards & Fellowships

Smithsonian National Museum of Natural History Predoctoral Fellowship (2025). *Depth Dependent Morphology of Fishes Sound Production Mechanisms.*

Cornell University Athena Grant (2025). *Graduate student dissertation support for recording deep reef environments.*

Synchro Low-Cost Tech Procurement and Evaluation (2024). *Beta Testing and Manufacturing for FinDrop: Accessible Acoustic Monitoring for Mesophotic Marine Environments.*

Fulbright Fellowship (2024). *Empowering Biodiverse, yet Underserved EU Region of Curaçao with Marine Technology Stewardship.*

WILDLABS Tier II Award (2024). *Development for FinDrop: Accessible Acoustic Monitoring for Mesophotic Marine Environments.*

D. Ross Robertson Grant for Deep Neotropical Reef Fish Research (2023). *Smithsonian fellowship for deep-reef fish vocalizations in Curaçao.*

National Science Foundation Graduate Research Fellow (NSF GRFP) (2022). *Inferring Communication Events from Vocalizations and Movement.*

Magellan Scholar Grant (2021). *Concluding Successful Nesting of Limosa limosa with Geolocation Data.*

Barry M. Goldwater Scholar (2021). *National award recognizing excellence in undergraduate research in STEM fields.*

SC Space Grant Consortium Mini-REAP (2020). *Effects of Ionizing Radiation on Plant Germination.*

## Certifications

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| SeaBASS Marine Bioacoustics Summer Program | Jun 2024 |
| CPR & AED | Aug 2023 |
| PADI Rescue Scuba Diver | Aug 2023 |
| Nitrox Diver | Apr 2023 |
| Smithsonian–AAUS Scientific Diver | Apr 2023 |
| Pilot 107 (Drone) Operator | Oct 2022 |

## Technical Strengths

**Computer Languages:** R, Java/Dart, Python, C++, LaTeX **Data Management:** SQL, Hadoop, Linux, Git