

Sarah Bodenstein, Ph.D.

TABLE OF CONTENTS

Last Revised: September 2024

Sea Grant Oyster Hatchery
135 LSU Drive
Grand Isle, LA 70358

Email: sboden2@lsu.edu

www.sarahbodenstein.com

www.laseagrant.com/oyster-research-lab

ACADEMIC & RESEARCH APPOINTMENTS	1
EDUCATION.....	1
CURRENT POSITION & PERSONAL STATEMENT.....	1
PUBLICATIONS.....	2
RESEARCH EXPERIENCE.....	3
TEACHING EXPERIENCE	3
OTHER WORK EXPERIENCE	3
MENTORSHIP EXPERIENCE.....	4
PROFESSIONAL SERVICE	4
SKILLS	4
GRANTS & AWARDS	5
CONFERENCES	6

ACADEMIC & RESEARCH APPOINTMENTS

Jul 2023 – Pres.

Postdoctoral Researcher. Louisiana State University and Louisiana Sea Grant

EDUCATION

Jun 2019 – May 2023

Ph.D. Louisiana State University Agricultural Center, School of Renewable Natural Resources, at the Aquatic Germplasm and Genetic Resources Center. *Integrating Germplasm Repositories into Oyster Aquaculture Systems at the Pathway, Center, and Network Levels.* Advisors: Terrence R. Tiersch and Jerome F. La Peyre

Aug 2017 – Jun 2019

M.Sc. Auburn University, School of Fisheries, Aquaculture and Aquatic Sciences, at the Auburn University Shellfish Laboratory. *Comparing Responses of Triploid and Diploid Eastern Oysters, Crassostrea virginica, to Common Farm Stressors.* Advisor: William C. Walton

Aug 2012 – May 2016

B.S. University of Miami, Rosenstil School of Marine and Atmospheric Science

CURRENT POSITION & PERSONAL STATEMENT

(40 HRS PER WEEK)

I am a postdoctoral researcher at Louisiana State University and Louisiana Sea Grant. I have a background in invertebrate physiology, aquaculture, shellfish hatchery production, coastal fisheries, cryopreservation, and industrial engineering research. My current work combines traditional aquaculture science and industrial engineering to optimize oyster hatchery operations, with the expectation for broader application to other facilities. My primary research involves investigating management practices of juvenile oysters to improve adult oyster quality and uniformity, contributing to increased consumer demand and industry profitability. Collaborative research also explores the interrelationships between early life stage production methods, grow-out yields, and the eating quality of oyster products, with potential relevance to other aquaculture species. In addition to my own research, I have facilitated collaboration across multiple federal and non-profit organizations to address the translational gap between cryopreservation research and application in aquaculture. My long-term research goal is to continue the application of production management tools to benefit coastal restoration and economic development, and to protect our native genetic resources.

PUBLICATIONS

- Bodenstein, S.**, Abdullayeva, F., Murphy, J. M., Varga, Z. M., & Tiersch, T. R. (2023). Modeling of cryopreservation pathway operation at an aquatic biomedical stock center for zebrafish. *Cryobiology*, 104792. <https://doi.org/10.1016/j.cryobiol.2023.104792>
- Bodenstein, S.**, Callam, B. R., Walton, W. C., Rikard, F. S., Tiersch, T. R., & La Peyre, J. F. (2023). Survival and growth of triploid eastern oysters, *Crassostrea virginica*, produced from wild diploids collected from low-salinity areas. *Aquaculture*, 739032. <https://doi.org/10.1016/j.aquaculture.2022.739032>
- Bodenstein, S.**, Casas, S. M., Tiersch, T. R., & La Peyre, J. F. (2023). Energetic budget of diploid and triploid eastern oysters during a summer die-off. *Frontiers in Marine Science*, 10, 1194296. <https://doi.org/10.3389/fmars.2023.1194296>
- Bodenstein, S.**, Nahmens, I., Callam, B. R., & Tiersch, T. R. (2023). Simulation analysis of high-throughput oyster cryopreservation at three scales of production. *Aquaculture International*. <https://doi.org/10.1007/s10499-023-01139-y>
- Bodenstein, S.**, Nahmens, I., & Tiersch, T. R. (2022). Simulation Modeling of a High-Throughput Oyster Cryopreservation Pathway. *Journal of Shellfish Research*, 41(2), 209–221. <https://doi.org/10.2983/035.041.0206>
- Bodenstein, S.**, Tiersch, T. R., Reza Hossain, M., Hamilton, M. G., Yeasin, M., Akhter, M. M., Trinh, T. Q., & Mahmuddin, M. (2023). A cryopreserved sperm repository strategy for WorldFish genetically improved carp [Penang, Malaysia]. WorldFish. <https://digitalarchive.worldfishcenter.org/handle/20.500.12348/5501>
- Bodenstein, S.**, Walton, W. C., & Steury, T. D. (2021). Effect of farming practices on growth and mortality rates in triploid and diploid eastern oysters *Crassostrea virginica*. *Aquaculture Environment Interactions*, 13, 33–40. <https://doi.org/10.3354/aei00387>
- Coxe N., Liu Y, Arregui L., Upton R., **Bodenstein S.**, Voss S.R., Gutierrez-Wing T., and Tiersch T.R. (2024) Establishment of a practical sperm cryopreservation pathway for the axolotl (*Ambystoma mexicanum*): A community-level approach to germplasm repository development. *Animals*. (Accepted)
- Koch, J. C., Arregui, L., **Bodenstein, S.**, Gutierrez-Wing, T., Liu, Y., Upton, R., & Tiersch, T. R. (2024). Integrating the Components Necessary for Germplasm Repository Program Development to Safeguard the Genetic Resources of Aquatic Species. In *Cryobiology for South American Neotropical Fish Species* (1st Edition, p. 26). CRC Press. <https://www.taylorfrancis.com/chapters/>
- Koch, J. C., Oune, A. M., **Bodenstein, S.**, & Tiersch, T. R. (2023). Untangling the Gordian Knot of Aplysia sea hare egg masses: An integrated open-hardware system for standardized egg strand sizing and packaging for cryopreservation research and application. *HardwareX*, 16, e00476. <https://doi.org/10.1016/j.ohx.2023.e00476>
- Liu Y., Koch J.C., Arregui L., Oune A., **Bodenstein S.**, Gutierrez-Wing T., and Tiersch T.R (2024) Exploring Pathways toward Open-Hardware Ecosystems to Safeguard Genetic Resources for Biomedical Research Communities Using Aquatic Model Species. *Journal of Experimental Zoology Part B: Molecular and Developmental Evolution*. <https://doi.org/10.1002/jez.b.23234>
- Vaidya, R.V., **Bodenstein, S.**, Rasulova, D., Peyre, J.F.L., Kelly, M.W. (2024) Comparative transcriptomic analyses reveal differences in the responses of diploid and triploid eastern oysters to environmental stress during a summer mortality event. <https://doi.org/10.1101/2024.01.31.578323>
- MANUSCRIPTS IN ADVANCE STAGES OF PREPARATION

- Bodenstein, S.**, Hu, E., Tiersch, T.R. (2024) Developing the Fertilization Dose Concept for Application in Aquatic Species. *Aquaculture Reports (In Preparation)*
- Bodenstein, S.**, Poulos, W., Jimenez, F., Stout, M., Liu, Y., Varga, Z.M., Cibelli, J., Tiersch, T. R. (2024) Developing a generalized pathway for nuclear transfer-cloning in zebrafish (*Danio rerio*). *Plos One (In Review)*
- Bodenstein, S.**, Waguespack, S., Robinson, E. (2024) Evaluating Microalgae Production and Resource Partitioning in an Oyster Hatchery. *Journal of Applied Phycology (In Preparation)*
- Lucente, D., eds. 2024. Guidelines for ex situ banking of aquatic genetic resources. FAO Animal Production and Health Guidelines, No. XX. Rome. (In Preparation)

RESEARCH EXPERIENCE

Jul 2023 – Pres LOUISIANA SEA GRANT & LSU (40 HRS PER WEEK)

Currently working as a postdoctoral researcher with Dr. Elizabeth Robinson at Louisiana Sea Grant's Oyster Laboratory and the Michael C. Voisin Oyster Hatchery on Grand Isle, LA. Research projects include using industrial engineering tools to model, evaluate, and improve microalgae production in a bivalve hatchery setting. Other projects include inducing stress on juvenile oysters at the nursery stage to evaluate the effects on adult growth and survival in the field. Results could point to husbandry techniques that allow hatcheries to produce seed with higher tolerances to stressful environmental conditions caused by climate change. This project also aims to develop software to automatically count oyster seed subsamples to increase efficiency and accuracy, as well as facilitate commercial oyster nursery development along the Gulf Coast. Outreach work in this position includes creating 3D-printed models of the oyster lifecycle, as well as hatchery fact sheets for K – 8th aquaculture and environmental education.

Jun 2019 – May 2023 AQUATIC GERMPLASM AND GENETIC RESOURCES CENTER (40 HRS PER WEEK)

Worked as a graduate student with Dr. Terrence R. Tiersch and Dr. Jerome F. La Peyre to develop a pathway, using oysters as a model, for repository integration in existing aquaculture systems. This interdisciplinary work focused on a system-wide approach and integrated physiology, aquaculture, cryopreservation, and industrial engineering research. Led efforts to generate tools which included process maps and simulation models of high-throughput cryopreservation, open hardware devices, recommendations for repository development at different production scales, analysis of phenotypic and physiological data from cryopreserved oyster lines, database management guidelines, evaluation of oyster hatchery needs, and frameworks of the exchange of materials and information between repositories and communities. Also led projects working with NIH biomedical stock centers and international nonprofits (WorldFish) to incorporate cryopreservation and repository storage technology into current operations.

Aug 2017 – Jun 2019 AUBURN UNIVERSITY SHELLFISH LAB (40 HRS PER WEEK)

Worked with William C. Walton to study potential causes of differential mortality rates between triploid and diploid eastern oysters in the northern Gulf of Mexico. Conducted field studies comparing mortality and growth by ploidy across three sites in the Gulf. Additionally, studied shell-closing strength to assess differences in physiological responses to stress between diploid and triploid oysters. Other experience included working in an oyster hatchery, nursery, and off-bottom farm site.

TEACHING EXPERIENCE

2021 CO-LEADER OF A GRADUATE-LEVEL SEMINAR CLASS, OPEN-SOURCE STRATEGIES (6 HRS PER WEEK)

Co-led a class focused on developing strategies to communicate hardware designs with user communities in an open-source framework. Developed the syllabus and class assignments to cover the core concepts of the open-source movement, the tools that enable open-source design and distribution, and the fundamentals of understanding and adapting to user needs.

OTHER WORK EXPERIENCE

2022 – 2023 CENTER FOR AQUACULTURE TECHNOLOGIES & SOL AZUL HATCHERY (9 MONTH PROJECT)

Worked with Dr. John Buchanan and Carlos Pulgarin at the Center for Aquaculture Technologies and Philippe Danigo at the Sol Azul oyster hatchery to transfer cryopreservation and repository storage technology to an oyster hatchery in La Paz, MX. Led research efforts that included providing recommendations for equipment and supplies purchases, as well as in-person, cryopreservation training.

2022 – 2023 *WORLD FISH*

(7 MONTH PROJECT)

Worked with Dr. Matthew Hamilton at WorldFish to identify key stakeholders and pathways for the use of cryopreserved sperm repository technology for carp genetic improvement and dissemination in Bangladesh. Led a project to develop relationship maps (an industrial engineering tool) that detailed interactions (exchange of materials and information) among suppliers, producers, and customers, and their facilities.

2020 – 2024 *NIH AQUATIC BIOMEDICAL MODELS*

(2.5 YEAR PROJECT)

Worked with Aquatic Germplasm and Genetic Resources Center and multiple NIH aquatic biomedical stock centers to transfer cryopreservation and repository storage technology to each center and their respective research communities. In addition, this work includes facilitating network development among the centers to ensure the sustainability of developed repositories. Leading research efforts to outline production pathways, analyze production scales, create and share technology, as well as identify network needs and goals.

2024 – Pres. *NATIONAL FRAMEWORK FOR CONSERVING AQUATIC RESOURCES*

(ONGOING PROJECT)

Currently working with Dr. Harvey Blackburn and Dr. Caird Rexroad at USDA ARS to develop a whitepaper document that outlines a national framework for conserving and utilizing aquatic genetic resources to enhance resiliency to climate change in the United States.

MENTORSHIP EXPERIENCE

2019 – 2023 *MENTORING UNDERGRADUATE STUDENT WORKERS*

Mentored several student workers while working as a PhD student. The mentorship roles included training students to perform research related to oyster aquaculture, oyster physiology, cryopreservation, open hardware fabrication, data analysis, and simulation modeling. The mentorship roles also included guiding students through the scientific writing process, including writing undergraduate grant proposals and final reports (K. Cagnolatti, M. Conde, M. Constans, C. Gryder, and G. Minze), as well as coauthoring manuscripts (F. Abdullayeva).

2023 – Pres. *MASTER'S THESIS COMMITTEE MEMBER*

Serving as a committee member at LSU and mentoring a Master's student (J. Kim) in the development, research, and writing of a thesis chapter concerning oyster aquaculture economics and dynamic energy budget modeling.

PROFESSIONAL SERVICE

EDITORIAL REVIEWER FOR JOURNALS

2023 Aquaculture
2024 Aquaculture Environment Interactions

REVIEWER FOR GRANTS

2022 Served on review panel for a National Sea Grant Award
2023 Reviewed a grant for a Sustainable Agriculture Research and Education Award

SKILLS

QUANTITATIVE & WRITTEN

Statistical modeling (e.g., generalized linear, mixed effects models, partial least squares regression, and linear regression) of phenotypic, physiological, and environmental data in R and MATLAB to evaluate the effect of water quality conditions on oyster growth and metabolism. Constructing discrete-event simulation models using collected time study data to evaluate production efficiency and recommend solutions to identified constraints. Experience in developing hypotheses, collecting data, and performing statistical analysis to draw

conclusions from research results. Publishing peer-reviewed manuscripts, creating outreach materials, as well as presenting oral and poster presentations (in person and virtually). Open technology skills including 3D printing using fused-deposition modeling and stereolithography printing, as well as creating 3D models using Fusion 360 and Blender.

LABORATORY & HATCHERY

Collecting physiological oyster data including oxygen consumption, clearance rate, absorption efficiency, ammonia excretion rate, valve gapping behavior, condition index, gametogenic stage, and *Perkinsus marinus* infection level. Oyster husbandry skills including: broodstock conditioning, maintaining research animals in the laboratory, oyster spawning and larval care, setting oyster larvae, raising oyster spat, and algae production. General laboratory skill including microscope analysis of oyster sperm motility and egg condition, flow cytometer analysis of sperm and algae viability, and cryopreservation of gametes for a variety of aquatic species (e.g., oysters, *Aplysia*, axolotls, catfish, and zebrafish).

FIELD

Experience working on oyster farms including routine farm maintenance and setting up new long-line and floating bag systems. Field work experience including collecting oyster mortality and growth data *in situ*. SCUBA diving Advanced Open Water and Nitrox certifications.

PUBLIC OUTREACH

Experience planning, designing, and presenting an interactive, informational display that illustrated the oyster lifecycle and hatchery production for Louisiana Sea Grant's 2023 Ocean Commotion event (K – 12). Experience developing and administering surveys to aquaculture professionals assessing potential interests and concerns about implementing cryopreservation into current operations.

LEADERSHIP

Experience leading research projects including setting goals and objectives, partitioning work, reviewing and evaluating work, and combining collaborator efforts. Coordinating collaboration across multiple federal facilities to develop workshops, meetings, and peer-review papers focusing on safeguarding genetic resources and shellfish aquaculture.

GRANTS & AWARDS

DATE	TITLE	GRANTING AGENCY	POSITION	AWARD AMOUNT
2019	Gordon Gunter Outstanding Poster Presentation Award at World Aquaculture Society Conference 2019	National Shellfish Association	Recipient	\$250
2019	Second Place Student Poster Presentation Award at World Aquaculture Society Conference 2019	World Aquaculture Society	Recipient	1-year membership
2019	Completion of the National Science Foundation's Innovation Corps (NSF I-CORPS) Course	NSF I-CORPS	Author & Participant	\$2,000
2020	Salinity and Temperature Tolerances of Eastern Oysters Bred from Native Louisiana Broodstock	Louisiana Sea Grant, UROP	Author & Supervisor	\$3,000
2021	Custom Design, Fabrication and Testing of Environmental Data Systems for Use in Oyster Aquaculture	Louisiana Sea Grant, UROP	Supervisor	\$3,000

2024	Integrating 3D-printed Technology into Aquaculture Literacy Resources for Louisiana Teachers	North American Association for Environmental Education	Author & Supervisor	Applied (\$20,000)
2024	Developing a Quality Management Package for Recordkeeping and Seed Conditioning in an Oyster Nursery	FY 2024 Sea Grant Supplemental Funding	Author & Supervisor	\$159,000

CONFERENCES

DATE	TITLE	FORMAT	CONFERENCE	LOCATION
2019	Comparison of shell-closing strength for diploid and triploid Eastern oysters, <i>Crassostrea virginica</i>	Poster	World Aquaculture Society	New Orleans, LA
2019	Investigating Summer Mortality in Triploids Oysters Across the Northern Gulf of Mexico	Oral	World Aquaculture Society	New Orleans, LA
2020	Developing a Germplasm Repository Framework for Aquaculture Species	Poster	American Fisheries Society-Louisiana Chapter	Online
2021	Using germplasm repositories to support Eastern oyster <i>Crassostrea virginica</i> , aquaculture: the biological information component	Oral	American Fisheries Society-Louisiana Chapter	Online
2021	Characterizing Eastern oysters, <i>Crassostrea virginica</i> , bred from native Louisiana broodstock under different salinity regimes: effect of stock and cohort	Oral	National Shellfish Association	Online
2022	Effect of ploidy and cohorts produced at two hatcheries on the physiology of the Eastern oyster, <i>Crassostrea virginica</i>	Oral	World Aquaculture Society	San Diego, CA
2022	Using simulation modeling of high-throughput Eastern oyster cryopreservation to develop germplasm repositories	Oral	World Aquaculture Society	San Diego, CA
2022	Simulation modeling of high-throughput cryopreservation facilitates oyster germplasm repository development	Oral	American Fisheries Society-Louisiana Chapter	Thibodaux, LA
2022	Simulation Modeling of Zebrafish Cryopreservation Development and Operation	Poster	Aquatic Models of Human Diseases	Woods Hole, MA
2023	Simulation analysis of high-throughput oyster cryopreservation at three scales of production	Oral	World Aquaculture Society	New Orleans, LA
2024	Evaluating microalgae production and resource partitioning in an oyster hatchery	Oral	World Aquaculture Society	San Antonio, TX
2024	Supporting oyster aquaculture along the Gulf coast through four core programs at the Louisiana Sea Grant Hatchery	Poster	American Fisheries Society-Louisiana Chapter	Thibodaux, LA