

LAURA E. BAGGE

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EDUCATION

- 2017 **Ph.D. Biology**
Duke University, Durham, NC, GPA: 4.0
Advisor: Dr. Sönke Johnsen
Dissertation: Clearly camouflaged crustaceans: The physical basis of transparency in hyperiid amphipods and anemone shrimp
- 2011 **M.S. Marine Biology**
University of North Carolina Wilmington, GPA: 4.0
Advisor: Dr. D. Ann Pabst
Thesis: Thermal and phase-change properties of the blubber of short-finned pilot whales (*Globicephala macrorhynchus*) and pygmy sperm whales (*Kogia breviceps*)
- 2008 **B.S. Marine Biology (with honors); *summa cum laude***
University of North Carolina Wilmington, GPA: 3.95
Advisor: Dr. D. Ann Pabst
Honor's Thesis: Thermal properties of the blubber of female short-finned pilot whales (*Globicephala macrorhynchus*)
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PROFESSIONAL / POSTDOCTORAL EXPERIENCE

- 2020 - National Resource Council (NRC) Fellow at the Air Force Research Lab, Eglin
Postdoc Advisor: Rhoe Thompson and Martin Wehling
Description: I continued my research on the circularly polarized light reflectance of and wing interference patterns from insects and their potential visual detection mechanisms and relevance for bioinspired target sensors, and led my team to publish our first results in *Applied Optics*, as well as disseminated the results at various AFRL events (Biotech Days, RW Fair, Geekfest) and continued to build collaborations for continuing work with RX in Dayton, Ohio and other groups here at Eglin (microscopy team at the HERD).
- 2019 - 2020 Postdoctoral Associate, Department of Mechanical and Aerospace Engineering
University of Florida and Air Force Research Lab, Postdoc Advisor: Martin Wehling
Description: I researched how circularly polarized reflectance or wing interference patterns may be exploited by insects for recognition purposes and how this may result in bioinspired designs for improved specificity in engineered target detector systems. I gained additional microscopy analysis experience because I was selected to participate in international training opportunities (learning a new 3D imaging software and measuring the ultrastructure of beetles at the Swiss Light Source). I presented at 2 international and another 2 national conferences in 2019.
- 2017 - 2018 Postdoctoral Scholar, Department of Chemical Engineering and Materials Science
University of California Irvine, Postdoc Advisor: Alon Gorodetsky
Description: As the lead postdoctoral researcher on this DARPA-funded grant, I applied techniques from the fields of chemical engineering and materials science to broaden my study of camouflage to include dynamically tunable color-changing cells in squid. I explored how the ultrastructural arrangement of proteins in the cells is responsible for the formation of colors (see my co-authored publication - Chatterjee et al. 2018). In addition, I supervised several chemical engineering graduate students, where I learned how to guide research projects and teach students how to publish their work, all while communicating science across disciplines. I also disseminated technical updates to DARPA at various program reviews.

PUBLICATIONS

Peer-reviewed:

Bagge, L.E., Kenton, A.C., Lyons, B.A., Wehling, M.F., and Goldstein, D.H. (2020). Mueller matrix characterizations of circularly polarized reflections from golden scarab beetles. *Applied Optics* 59(21): F85-F93. (OSA's Editor's Pick Award).

Bagge, L.E. (2019). Not as clear as it may appear: Challenges associated with transparent camouflage in the ocean. *Integrative and Comparative Biology*. 59(6): 1653-1663. (Editor's Choice).

Chatterjee, A.*, Norton-Baker, B.*, **Bagge, L.E.**, Patel, P., and Gorodetsky, A.A. (2018). An introduction to color-changing materials and devices from the cephalopod protein reflectin. *Bioinspiration and Biomimetics*. 13: 045001. (*indicates graduate student mentees)

Bagge, L.E., Kinsey, S.T., Gladman, J., and Johnsen, S. (2017). Transparent anemone shrimp (*Ancylomenes pedersoni*) become opaque after exercise and physiological stress in correlation with increased hemolymph perfusion. *Journal of Experimental Biology*. 220: 4225-4233. (Cover article).

Netburn, A.N., Kinsey, J.D., Bush, S.L., Djurhuus, A., Fernandez, J., Hoffman, C.L., McVeigh, D., Twing, K.I. and **Bagge, L.E.** (2017). First HOV Alvin study of the pelagic environment at Hydrographer Canyon (NW Atlantic). *Deep Sea Research Part II: Topical Studies in Oceanography*. 150: 30-40.

Bagge, L.E., Osborn, K.J., and Johnsen, S. (2016). Nanostructures and monolayers of spheres reduce surface reflections in hyperiid amphipods. *Current Biology*. 26: 3071-3076.

Bagge, L.E., Koopman, H.N., Rommel, S.A., McLellan, W.A., and Pabst, D.A. (2012). Lipid class and depth-specific thermal properties in the blubber of two species of odontocete cetaceans, the short-finned pilot whale (*Globicephala macrorhynchus*) and the pygmy sperm whale (*Kogia breviceps*). *Journal of Experimental Biology*. 215: 4330-4339.

In advanced preparation or in review (available upon request):

Bagge, L.E., Kier, W.M., Wehling, M.F., and Johnsen, S. Ultrastructural modifications for transparency in anemone shrimp. To be submitted to *Journal of Arthropod Structure and Development*.

Schweikert, L.E., **Bagge, L.E.**, Wheeler, B.R., Grace, M.S., Holford, T., Bolton, M.M., Bracken-Grissom, H.D., and Johnsen, S. An optical feedback mechanism for regulating skin color change. To be submitted to *Proceedings of the Royal Society B*.

In early preparation (invitations to submit to special journal issues in 2021):

Bagge, L.E., Kenton, A.C., Lyons, B.A., Wehling, M.F., and Goldstein, D.H. Mueller matrix characterizations of scarab beetles. To be submitted to "Best of AFRL" inaugural special edition of the Journal of DoD Research and Engineering (JDR&E).

Bagge, L.E., Kenton, A.C., Lyons, B.A., Wehling, M.F., and Goldstein, D.H. Circularly polarized vision in beetles. To be submitted to *J. Phil. Trans* (Special Edition related to the Matched Filters Grant).

Bagge, L.E., Wehling, M.F., and Goldstein, D.H. Cuticle ultrastructure in *Chrysina resplendens*. To be submitted to *Applied Optics* (AFRL Special Edition, editor and POC Jeffery Allen).

Popular science (non-peer-reviewed):

Bagge, L.E. (2016). A living cloak of invisibility. *Biosphere*. 21:24-35

SELECT 1st AUTHOR CONTRIBUTED PRESENTATIONS (* indicates best presentation award)

2020	*Air Force Research Laboratory GeekFest, “Best of AFRL”, virtual meeting
2020	*Air Force Research Laboratory RW Fair, “Top Geek”, virtual meeting
2020	Air Force Research Laboratory Biotech Days, Dayton, Ohio
2020	Society of Integrative and Comparative Biology, Austin, Texas
2019	IEEE RAPID Conference, Miramar Beach, Florida
2019	International Conference on Invertebrate Vision, Bäckaskog, Sweden
2019	Thirteenth International Conference on Light and Color in Nature, Bar Harbor, Maine
2018	Society for Integrative and Comparative Biology, San Francisco, California
2017	Society of Integrative and Comparative Biology, New Orleans, Louisiana
2016	Twelfth International Conference on Light and Color in Nature, Granada, Spain
2016	Living Light Conference, San Diego, California
2016	Society for Integrative and Comparative Biology, Portland, Oregon
2014	Society for Integrative and Comparative Biology, Austin, Texas
2013	*Society for Integrative and Comparative Biology, San Francisco, California
2011	Society for Integrative and Comparative Biology, Salt Lake City, Utah
2011	Southeast and Mid-Atlantic Marine Mammal Symposium, Conway, SC
2009	Society for Marine Mammalogy Biennial Conference, Quebec City, Canada
2009	*Southeast and Mid-Atlantic Marine Mammal Symposium, Wilmington, NC

INVITED PRESENTATIONS

2020	“Magic Skins,” Donuts with Doolittle Institute Presentation Series, Niceville, Florida
2019	“Breaking Camouflage,” University of Florida, REEF, Shalimar, Florida
2019	“Adaptation and Evolution in Biological Materials” Symposium, Annual Meeting for the Society of Integrative and Comparative Biology, Tampa, Florida
2018	“Invertebrate Optics: Transparent camouflage and polarization vision,” Air Force Research Laboratory, RWWI, Eglin Air Force Base, Florida
2018	“Clearly Camouflaged,” University of California, Santa Barbara
2018	“Ultrastructural modifications in transparent animals,” La Sierra University, Riverside, California
2015	“Avoiding Predators,” Guilford College, Greensboro, North Carolina

TEACHING EXPERIENCE

- 2021 **Mentor**, “Insect Vision Characterization”, AFRL Scholars Program
(mentor for Undergraduate students completing a summer research project)
- 2021 **Instructor of Record**, “Bioinspired Sensing Systems” Short Course
University of FL Research Engineering and Education
(to be held as a virtual course in Spring 2021)
- 2016 **Bass Fellow, Instructor of Record**, “Extreme Animal Adaptations”
(Advanced Physiology course: sole instructor and course designer)
Department of Biology, Duke University
- 2015 - 2017 **Preparing Future Faculty Program**, Duke University and Guilford College
- 2015 - 2017 **Certificate in College Teaching Program**, Duke University
- 2015 **Teaching Assistant**, “Organismal Evolution”
Department of Biology, Duke University
- 2013 - 2014 **Teaching Assistant**, “Animal Physiology Lab”
Department of Biology, Duke University
- 2011 **Teaching Assistant**, “Human Anatomy and Physiology II Lab”
Department of Biology and Marine Biology, University of NC Wilmington
- 2010 **Teaching Assistant**, “Human Anatomy and Physiology I Lab”
Department of Biology and Marine Biology, University of NC Wilmington
- 2009 **Teaching Assistant**, “Animal Physiology Lab”
Department of Biology and Marine Biology, University of NC Wilmington
- 2006 - 2007 **Instructor, Marine Quest Program**, University of NC Wilmington
K-8 teacher, and developer of new curricula in STEM

OUTREACH

- 2019 – present **AFWISE (Air Force Women in Science)**; board member in 2019
- 2011 – 2017 **Rho Tau GWIS (Graduate Women in Science)**; secretary 2012-2014 and
WISE (Women in Science and Engineering); 2011-2012 leader for WiS Biology
Events: USA science and Engineering Festival; Brilliant and Beautiful Foundation
SMART Scholars Science Workshop; Girl Scouts Outreach at Meredith College
- 2014 – present **Selected scientific outreach presentations:**
Skype a Scientist (2019, 2020)
Invited Talk, Postdoc Symposium, Awarded “Best Talk”, Irvine, CA (2018)
Invited Talk, Tarbut V’Torah Community Day School, Irvine, CA (2018)
Duke INSPIRE’s Outreach Event. Awarded “Favorite Scientist” (2017)
Live Q&A session with NC Museum of Natural Sciences, Daily Planet (2016)
Coastal Carolina Dive Symposium (2015)
Nerd Nite Triangle (2014)

AWARDS, HONORS, AND FELLOWSHIPS

Research Grants and Fellowships:

2020	National Academies of Sciences, Engineering, Medicine, NRC Fellow
2016	Bass Instructional Fellowship
2016	Society for Integrative and Comparative Biology Grant-in-Aid
2014	Smithsonian NMNH Rathbun Student Grant for Crustacean Research
2014	The Crustacean Society Fellowship in Anatomy/Paleobiology
2013	Sigma Xi Grant-in-Aid of Research
2012 - 2016	Ray J. Tysor Summer Research Fellowship, Duke University
2012 - 2015	Biology Grant-In-Aid, Duke University
2012	Fernald Fellowship, Friday Harbor Laboratories

Presentation, Conference Travel, and Other Awards:

2020	“Top Geek” Award, AFRL RW Fair
2019	Light and Color in Nature Conference Travel Award
2016	Domestic Dissertation Travel Award
2013	The Crustacean Society Best Student Poster at SICB
2013	Ray Huey Best Poster Award, Division of Ecology and Evolution SICB
2010	Graduate School Travel Grant, UNCW
2010	Graduate Student Association, UNCW
2009	NC Maritime Museum Scholarship
2009	Biology Graduate Student Association, UNCW
2007 - 2008	Corbett Scholarship, UNCW
2007 - 2008	Bolles Marine Biology Scholarship, UNCW
2006 - 2008	SMART Grant, and Merit Scholarship

SELECTED MEDIA COVERAGE

Science News: “See-through shrimp flex invisible muscle” by Susan Milius, April 19, 2014.

Science (AAAS): “When they try to escape, these invisible shrimp become visible” by Elizabeth Pennisi, Jan 6, 2016.

National Geographic: “This Ocean Creature Makes Its Own Invisibility Cloak” by Mark Strauss, Dec 9, 2016.

Smithsonian Magazine: “The Master of Disguise of the Ocean Reveals Its Secrets” by Emily Underwood, Jan 2017.

Optics and Photonics News: “Sea creatures’ nanostructures fool predators” by Patricia Daukantas, Nov 2016.

Environmental Monitor: “How midwater crustaceans vanish from predators” by Daniel Kelly, Nov 2, 2016.

Physics World: “Bacteria nanospheres may help camouflage tiny crustaceans” by Michael Allen, Nov 2016.

Smithsonian.com: “These sea creatures have a secret superpower: invisibility cloaks” by Jackson Landers, Oct 27, 2016.

Science Daily, Phys.org, Daily Mail: “Midwater ocean creatures use nanotech camouflage,” Oct 27, 2016.

Duke Research Blog: “Researchers get Superman’s X-Ray Vision” by Robin Smith, Feb 2, 2018

RESEARCH AND FIELD EXPERIENCE

2014 - 2017	Visiting Student Researcher, Smithsonian National Museum of Natural History
2016	Selected Early Career Scientist on UNOLS Training Cruise, <i>R/V Atlantis</i> , Scientist in the Deep Submergence Vehicle <i>Alvin</i> on dive #4831
2013, 2014	Field Assistant at Carrie Bow Cay, Caribbean Coral Reef Ecosystem Program
2014	Visiting Scientist at the Smithsonian Marine Station at Ft. Pierce, FL
2011, 2012	Scientist and AAUS Diver on the <i>R/V Kilo Moana</i> , HI and <i>R/V Endeavor</i> , RI

PROFESSIONAL SERVICE AND SOCIETIES

The Optical Society of America
Society for Integrative and Comparative Biology
The Crustacean Society
Sigma Xi
Duke AAUS Dive Control Board Member
Reviewer for *Current Biology*, *Journal of Experimental Biology*, *Applied Optics*, *Functional Ecology*, *PeerJ*, and *Scientific Reports*
Special Topics Editor for *Applied Optics*

SUMMARY OF SKILLS AND EXPERIENCE

- Fifteen years of experience working in a biological laboratory as an intern, undergraduate research assistant, graduate assistant, or postdoctoral manager, specifically on integrative biophysics-inspired research topics about how animals are adapted to their environments. This research involves collaborations with other disciplines (chemistry, materials science, physics, optical engineering). Ten years of experience researching questions directly relevant to the Natural Systems Sensing Lab (NSSL) about vision in animals, with three years working as a vision-focused biologist and independent postdoctoral researcher in engineering-focused labs.
- Fifteen years of experience with scientific technical writing (e.g. technical research papers, peer reviewed journal papers, proposals for grants). Eight years of experience disseminating first-authored research in peer-reviewed journals.
- Eleven years of demonstrated excellence in scientific communication and interpersonal skills as evidenced by winning best presentation awards at national and international scientific conferences.
- Fourteen years of teaching and mentoring experience and approximately eight years of managing research projects involving undergraduate mentees.
- Ten years of experience in advanced microscopy techniques (SEM, TEM, microCT, confocal, other histology) and image analysis (ImageJ, Amira, SlicerMorph). Two years direct experience with microscopy at the HERD as well as knowledge of current NSSL instrumentation (spectropolarimeter, QSI cameras, SPOC, ERG) and assisting with planning for future NSSL capabilities (microspectrophotometry), as well as collaborating with RW government employees and contractors on data collection, analysis, modeling, and writing publications that will further the mission of AFRL/RW.