

Heather A. Broadbent

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EDUCATION

- 2012 **Doctor of Philosophy** in Marine Science/ Biological Oceanography, University of South Florida
Dissertation Title: A CTD Biotag for Mid-sized Marine Predators
- 2005 **Master of Science** in Marine Science, University of South Florida
Thesis Title: Development of a CTD System for Environmental Measurements Using Novel PCB MEMS Fabrication Techniques
- 1994 **Bachelor of Science** in Biology, minor Chemistry, Eastern Michigan University

RELEVANT WORK AND RESEARCH EXPERIENCE

- 2015-present **Research Associate**, University of South Florida, College of Marine Science
Working with the USF Autonomous Underwater Gliders group studying water column, climate change, hurricanes, harmful algal blooms and marine animal tracking. Worked on the Continental Shelf Characterization, Assessment and Mapping Project (CSCAMP). The project acoustically and visually maps the Eastern Gulf of Mexico. Work included assessing fish and sea turtle populations and habitats as collected by a towed video array system, C-BASS (Camera-based Assessment Survey System).
- 2012-2015 **Postdoctoral Scholar**, University of South Florida, College of Marine Science, Zooplankton Ecology Laboratory advised by Kendra Daly.
Examined Antarctic food web interactions between microalgal primary producers, zooplankton, fish and apex predators (i.e., killer whales, Adelie penguins, Weddell seals). Investigated the impact of the BP oil spill on the northern Gulf of Mexico ecosystem, focusing on the lower end of the water column food web.
Assessing benthic, microbial, phytoplankton, zooplankton communities in relation to oil concentrations.
- 2000-2011 **Scientific Researcher**, University of South Florida, College of Marine Science, Center for Ocean Technology
Research work was the development, fabrication and field testing of a miniature, low-cost CTD bioglogger that archives conductivity, temperature, depth, GPS location, compass direction, ambient light, 3-D accelerometer and wet/dry measurements while deployed on small to medium marine animals. Target animals are penguins, manatees, turtles and sharks. Tagged Magellanic penguins and Loggerhead turtles.
Developed processes to fabricate microsensors, microfluidics and microsystems using PCB/MEMS techniques.

TEACHING EXPERIENCE

- 2012 **Adjunct Instructor**, Saint Petersburg College
Taught two sessions of Introduction to Biology Laboratory, BSC1005L
- 2012 **Instructor**, University of South Florida, College of Marine Science, Oceanography
Camp for Girls. Taught a biology/ engineering lab for middle school aged girls.
Taught scientific method and experimentation in the field.
- 2000-2009 **Mentor**, University of South Florida, College of Marine Science
Mentored several high school students in the Executive Internship program.

FIELDWORK

- 2015-present *R/V Weatherbird II*, *R/V Bellows* and *R/V Hogarth*, Gulf of Mexico. Collecting C-BASS and environmental data for CSCAMP project during 24 research cruises. PIs: Steve Murawski, Chad Lembke, Stan Locker. Also, deploy gliders off of the west and east coast of Florida.
- 2014-2015 McMurdo Station, Antarctica (2nd field season). Conducted 3 months field work on Ross Sea annual sea ice in McMurdo Sound for an NSF project (SCINI Penguin). PIs: Stacy Kim, Kendra Daly, David Ainley, Grant Ballard, Robert Pitman.
- 2013-2014 Chief Scientist for 4 research cruises aboard the *R/V Weatherbird II* and *R/V Bellows* for the Center for Integrated Modeling and Analysis of Gulf Ecosystems (C-IMAGE) project. PI: Kendra Daly.
- 2012 McMurdo Station, Antarctica (1st field season). Conducted 3 months field work on Ross Sea annual sea ice in McMurdo Sound for an NSF project SCINI Penguin.
- 2011 *R/V Weatherbird II*, Gulf of Mexico, conducted field tests between USF Biotag CTD and shipboard CTD instrument. PI: Jose Torres.
- 2011 Casey Key, Florida. Worked with Mote Marine Laboratories, Sea Turtle Conservation & Research, tagging Loggerhead turtles. PI: Tony Tucker.
- 2009-2010 Punta Tombo, Argentina (2 field seasons). Worked with University of Washington, Penguin Project, tagging Magellanic penguins. PI: P. Dee Boersma.

FELLOWSHIPS/ GRANTS

- Sanibell-Captiva Shell Club Mary & Al Bridell Memorial Fellowship (\$10,000)
- Research grant, Office of Naval Research (\$133,000)
- Research grant, Office of Naval Research (\$129,000)
- C.W. Bill Young Fellowship for Ph.D. graduate research year 2008- 2010 (\$10,000)
- C.W. Bill Young Fellowship for M.S. graduate research (\$13,000)

PUBLICATIONS

Daly, K, Remsen, A, Outram, D, **Broadbent, H**, Kramer, K, 2020. Resilience of the Zooplankton Community During and After the Deepwater Horizon Oil Spill. Accepted to Marine Pollution Bulletin.

Broadbent, H.A., Grasty, Hardy, Lamont, Hart, Lembke, Brizzolarla, Murawski, 2020. West Florida Shelf pipeline serves as sea turtle benthic habitat based on *in situ* towed camera observations. *Aquatic Biology*, Vol. 29: 17-31, 2020.

Lembke, C., Grasty, S., Silverman, A., **Broadbent, H.**, Butcher, S. and Murawski, S., 2017. The Camera-Based Assessment Survey System (C-BASS): A towed camera platform for reef fish abundance surveys and benthic habitat characterization in the Gulf of Mexico. *Continental Shelf Research*, 151, pp.62-71.

Broadbent, H.A., Ketterl, T.P., Silverman, A.M. and Torres, J.J., 2013. Development of a CTD biotag: Challenges and pitfalls. *Deep Sea Research Part II: Topical Studies in Oceanography*, 88, pp.131-136.

Broadbent, H.A., 2012. A CTD biotag for mid-sized marine predators. Doctoral Dissertation, University of South Florida, Scholar Commons.

Broadbent, H.A., Ketterl, T.P. and Reid, C.S., 2010. A miniature rigid/flex salinity measurement device fabricated using printed circuit processing techniques. *Journal of Micromechanics and Microengineering*, 20(8), p.085008.

Broadbent, H.A., Ketterl, T.P., Reid, C.S. and Dlutowski, J., 2010, September. A low-cost, miniature CTD for animal-borne ocean measurements. In *OCEANS 2010* (pp. 1-7). IEEE.

Fries, D.P., Ivanov, S.Z., **Broadbent, H.**, Smith, M., Steimle, G. and Willoughby, R., 2010. PCBMEMS as a Flexible Path to Devices and Systems across Spatial Scales. *Additional Papers and Presentations, 2010(DPC)*, pp.000599-000642.

Broadbent, H.A., Ivanov, S.Z. and Fries, D.P., 2007. Fabrication of a LCP-based conductivity cell and resistive temperature device via PCB MEMS technology. *Journal of Micromechanics and Microengineering*, 17(4), p.722-729.

Broadbent, H.A., Ivanov, S.Z. and Fries, D.P., 2007, June. PCB-MEMS environmental sensors in the field. In *Industrial Electronics, 2007. ISIE 2007. IEEE International Symposium on* (pp. 3282-3286). IEEE.

Broadbent, H.A., Ivanov, S.Z. and Fries, D.P., 2007. A miniature, low cost CTD system for coastal salinity measurements. *Measurement Science and Technology*, 18(11), p.3295.

Fries, D.P., Ivanov, S.Z., Bhanushali, P.H., Wilson, J.A., **Broadbent, H.A.** and Sanderson, A.C., 2007. Broadband, low-cost, coastal sensor nets. *Oceanography*, 20(4), pp.150-155.

Fries, D., Ivanov, S., **Broadbent, H.**, Willoughby, R. and Sheehan, E., 2007, June. Micro ion-optical systems technology [MIST] for mass spectrometry using PCBMEMS. In *Industrial Electronics, 2007. ISIE 2007. IEEE International Symposium on* (pp. 3278-3281). IEEE.

Sanderson, A.C., Hombal, V., Fries, D.P., **Broadbent, H.A.**, Wilson, J.A., Bhanushali, P.I., Ivanov, S.Z., Luther, M. and Meyers, S., 2006, September. Distributed Environmental Sensor Network: Design and Experiments. In *Multisensor Fusion and Integration for Intelligent Systems, 2006 IEEE International Conference on* (pp. 79-84). IEEE.

Fries, D., **Broadbent, H.**, Steimle, G., Ivanov, S., Cardenas-Valencia, A., Fu, J., Weller, T., Natarajan, S. and Guerra, L., 2005, November. PCB MEMS for environmental sensing systems. In *Industrial Electronics Society, 2005. IECON 2005. 31st Annual Conference of IEEE* (pp. 5-pp). IEEE.

Broadbent, H.A., 2005. Development of a CTD system for environmental measurements using novel PCB MEMS fabrication techniques. Master's Thesis, University of South Florida. Scholar Commons.

Fries, C., Fries, D., **Broadbent, H.**, Steimle, G., Kaltenbacher, E. and Sasserath, J., 2003, January. Direct Write Patterning of Microchannels. In *ASME 2003 1st International Conference on Microchannels and Minichannels* (pp. 787-794). American Society of Mechanical Engineers.

Cardenas-Valencia, A.M., Fries, D.P., Steimle, G., **Broadbent, H.**, Langebrake, L.C. and Benson, R.F., 2003, January. Fabrication of Micro-Actuated Galvanic Cells as Power on Demand for Lab on a Chip Applications by Means of Novel PCB/MEMS Technology. In *ASME 2003 1st International Conference on Fuel Cell Science, Engineering and Technology* (pp. 279-286). American Society of Mechanical Engineers.

Fries, D., **Broadbent, H.**, Steimle, G. and Cardenas-Valencia, A.M., 2003. Liquid Crystalline Polymer-Based PCBMEMS. *POLYMER PREPRINTS-AMERICA-*, 44(2), pp.536-536.

CONFERENCE PRESENTATIONS

H. A. Broadbent, Grasty, Lembke, Brizzolarla, Murawski. "Characterization of sea turtle habitat use on the West Florida Shelf using benthic mapping techniques. GOMOSSES 2020, Tampa, FL, February 3-6, 2020.

H. A. Broadbent, S. Grasty, C. Lembke, A. Silverman, S. Murawski. "Sea turtle abundance and habitat assessment along the Gulfstream natural gas pipeline. Southeast Regional Sea Turtle Meeting 2018, Myrtle Beach, SC, February 12-16, 2018.

H. A. Broadbent, Grasty, Lembke, Brizzolarla, Murawski. "Characterization of sea turtle population and habitat using a camera-based assessment survey system (C-BASS). American Fisheries Society Meeting, Tampa, FL, August 20-25, 2017.

H. A. Broadbent, T. P. Ketterl, A. M. Silverman, J.J. Torres. "A CTD-tag to determine physical microstructure use by marine predators." 4th International Science Symposium on Biologging, Hobart, Tasmania, Australia, March 14-18, 2011.

H. A. Broadbent, S. Ivanov, D. Fries. “Miniature low-cost CTD biogger for environmental measurements.” Poster presentation at 3rd International Biologging Science Symposium, Pacific Grove, CA, September 1-5th, 2008.

H. A. Broadbent, S. Ivanov, D. Fries. “PCBMEMS Environmental Sensors in the Field.” Oral presentation at 2007 IEEE International Symposium on Industrial Electronics (ISIE2007), Vigo Spain, June 4-7, 2007.

H. A. Broadbent, S. Ivanov, G. Steimle, D. Fries. “Development of a miniature oceanographic CTD system.” Poster Presented at ASLO 2005 Aquatic Sciences meeting, Salt Lake City, UT, Feb. 20-25, 2005.

H. A. Broadbent, D. Fries, S. Ivanov, S. Natarajan, A. Cardenas, J. Fu, T. Weller, and G. Steimle. “LCP PCB/MEMS for Field Systems.” Presented at the IPC Annual Conference, Minneapolis, MN, USA, October 1, 2003.

H. A. Broadbent, G. Steimle, D. Fries, S Ivanov, S. Natarajan, A. Cardenas, M. Janowiak, T. Weller, R. Benson and J. Fu. “Maskless Lithographic LCP PCB/MEMS for Field Sensors.” Paper presented at the Liquid Crystalline Polymer Material Processing and Applications Symposium, PMTEC conference at Huntsville, AL, on October 29, 2002.

H. A. Broadbent, D. Fries, G. Steimle, S Ivanov, S. Natarajan, T. Weller. “PCB/MEMS Salinity Analyzer.” Poster presented at the conference for New Horizons for Environmental Analytical Chemistry through Miniturization and Nanotechnology, 6th Euroconference on Environmental Analytical Chemistry at Peer, Belgium on October 18-22, 2002.

PATENTS

Heather Broadbent, David Fries, Stan Ivanov, George Steimle, “Micro Sensor System for Liquid Conductivity, Temperature and Depth.” Patent No. 7,259,566, August 21, 2007.

David Fries, George Steimle, **Heather Broadbent**, “Method for Etching Microchannel Networks within Liquid Crystal Polymer Substrates.” Patent No. 7,425,276, September 16, 2008.

David Fries, Michelle Janowiak, George Steimle, **Heather Broadbent**, “Self-propelled Sensor Apparatus for In Situ Analysis of Environmental Parameters.” Patent No. 8,577,183 B2, October 15, 2013.