

Curriculum Vitae: Barbara A. Muhling

University of California Santa Cruz and NOAA Southwest Fisheries Science Center

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Research Interests

Climate change impacts on marine and coastal fishes
Multivariate statistics and predictive habitat modeling
Links between environment, climate, ecology and physiology across life stages in marine fishes
Sustainable fisheries management under climate change

Higher Education

PhD: Marine Science, Murdoch University, Australia, 2006, "Larval fish assemblages in coastal, shelf and offshore waters of south-western Australia"

BSc (hons): Marine Science, Murdoch University, Australia, 2001

Professional Experience

December 2016 – Present: *Project Scientist, University of California Cooperative Institute for Marine Ecosystems and Climate (CIMEC)*

- Develop models examining top predator distribution, behavior, and ecology in relation to oceanographic and trophic processes in the eastern North Pacific Ocean
- Support development of Management Strategy Evaluation for key managed species under climate change, in collaboration with staff at the NOAA Southwest Fisheries Science Center

March 2015 – December 2016: *Associate Research Scholar, Princeton University*

- Develop projections for climate change impacts on estuarine environments in the northeast United States, in collaboration with climate modelers
- Determine appropriate modeling protocols, and sources of uncertainty, for climate change impact modeling for marine and estuarine fish species

July 2012 – February 2015: *Associate Scientist, University of Miami: Cooperative Institute for Marine and Atmospheric Science (CIMAS)*

- Collaborate with climate modelers to project climate change impacts on spawning and feeding habitats of large, highly migratory pelagic fish species in the western central Atlantic
- Develop ecological models to link biological oceanography to adult and larval distributions, ecology and physiology

Sept. 2009 – July 2012: *Assistant Scientist, University of Miami: Cooperative Institute for Marine and Atmospheric Science (CIMAS)*

- Investigate climate change impacts on Atlantic tuna spawning grounds
- Describe links between early life stages of tropical Atlantic and Caribbean fish species and regional oceanographic structure

Sept. 2007 – Sept. 2009: *Post-doctoral Researcher, National Research Council*

- Use archival datasets to examine multiple anthropogenic drivers of larval and adult fish assemblages in the northern Gulf of Mexico
- Use otolith chemistry to reconstruct juvenile snapper habitat use in Florida Bay

Oct. 2006 – Sept. 2007: *Research Scientist, Dept. of Fisheries, Western Australia*

- Coordinate biodiversity sampling project for benthic ecosystems on eastern Indian Ocean temperate reefs

Other Professional Activities

- 2016 *Co-convener*: special session at 2016 Ocean Sciences Meeting, New Orleans: “Climate impacts on marine fish, fisheries and protected species”
- 2016 *Technical monitor*: NOAA RESTORE Act research project
- 2014 *Co-convener*: special session at 2014 Ocean Sciences Meeting, Honolulu, Hawaii: “Habitat modeling and ecosystem based resource management”
- 2014 *Co-convener*: NOAA workshop: “Continued AOML-SEFSC collaborative success: now and in the future”, Miami, FL
- 2013 *Organizing committee member*: 37th Annual Larval Fish Conference, Miami
- 2012 *Co-convener*: special session at 2012 Ocean Sciences Meeting, Salt Lake City: “New insights into early life stages and reproductive dynamics of large marine vertebrates”
- 2012 - present *Proposal reviewer*: NOAA Marine Fisheries Initiative (MARFIN), NOAA Saltonstall-Kennedy Grant Program, NOAA Bluefin Tuna Research Program, Oregon SeaGrant, ship-time proposals for *R.V Southern Surveyor*
- 2011 NOAA-NMFS Team Member of the Year Southeast region, 2011
- 2003 *Founder*: The Australian Institute for Marine Sciences (AMSA) Annual Student Workshop for graduate and undergraduate students in Western Australia
- Reviewer: Marine Ecology Progress Series, Fisheries Oceanography, Marine Pollution Bulletin, PLOS One, Fisheries Research, Fishery Bulletin, Scientific Reports, Dynamics of Atmospheres and Oceans, Journal of Plankton Research, Continental Shelf Research, Scientia Marina.

Publications

Upcoming

- Muhling**, B.A., Lamkin, J.T., Alemany, F., Garcia, A., Alvarez Berastegui, D., Reglero, P., Laiz Carrion, R. (submitted) Reproduction and larval biology in tunas, and the importance of restricted area spawning grounds. Reviews in Fish Biology and Fisheries.
- Malca, E., **Muhling**, B.A., Franks, J., Garcia, A., Tilley, J., Gerard, T., Ingram Jr., W., Lamkin, J.T. (submitted) Age and growth of larval bluefin tuna (*Thunnus thynnus*): Comparison of the Gulf of Mexico to the Straits of Florida, and Balearic Sea (Mediterranean). Fisheries Research.
- Muhling**, B.A., Gaitan, C.F., Stock, C.A., Saba, V.S., Tommasi, D., Dixon, K.W. (submitted) Potential temperature and salinity futures for Chesapeake Bay using a statistical downscaling framework. Estuaries and Coasts.

Peer Reviewed Articles

- Muhling**, B.A., Lindegren, M., Worsoe Clausen, L., Hobday, A.J., Lehodey, P. (in press) Impacts of climate change on pelagic fish and fisheries. Book chapter in Phillips, B., Perez, M. (eds) The Impacts of Climate Change on Fisheries and Aquaculture. Wiley-Blackwell.
- Hobday, A.J., **Muhling**, B.A., Hazen, E.L., Arrizabalaga, H., Eveson, J.P., Roffer, M.A., Hartog, J.R. (in press) Predicting the distribution of bluefin tunas in a changing ocean. Bluefin Futures Symposium Summary Book.
- Muhling**, B.A., Brill, R., Lamkin, J.T., Roffer, M.A., Lee, S.K., Liu, Y., Muller-Karger, F. (in press) Projections of future habitat use by Atlantic bluefin tuna from a mechanistic vs. a correlative distribution model. ICES Journal of Marine Science.
- Tommasi, D., Stock, C.A., Hobday, A.J., Methot, R., Kaplan, I.C., Eveson, J.P., Holsman, K., Miller, T.J., Gaichas, S., Gehlen, M., Pershing, A., Vecchi, G.A., Msadek, R., Delworth, T., Eakin, C.M., Haltuch, M.A., Seferian, R., Spillman, C.M., Hartog, J.R., Siedlecki, S., Samhoury, J.F., **Muhling**, B.A. et al. (in press) Managing living marine resources in a dynamic environment: the role of seasonal to decadal climate forecasts. Progress in Oceanography.

- Lowerre-Barbieri, S., DeCelles, G., Pepin, P., Catalan, I.A., Karnauskas, M., **Muhling**, B.A., Erisman, B. et al. (2016) Reproductive resilience: a paradigm shift in understanding spawner and recruit processes in exploited marine fishes. *Fish and Fisheries* doi:10.1111/faf.12180.
- Domingues, R., Goni, G., Bringas, F., **Muhling**, B.A., Lindo-Atichati, D., Walter, J. (2016) Variability of preferred environmental conditions for Atlantic bluefin tuna (*Thunnus thynnus*) larvae in the Gulf of Mexico. *Fisheries Oceanography* 25: 320-336.
- Muhling**, B.A., Liu, Y., Lee, S-K., Lamkin, J.T., Roffer, M.A., Muller-Karger, F. (2015) Potential impact of global warming on the Intra-Americas Seas: Part 2: Implications for Atlantic bluefin tuna and skipjack tuna adult and larval habitats. *Journal of Marine Systems* 148: 1-13.
- Gerard, T.G., Malca, E., **Muhling**, B.A., Mateo, I., Lamkin, J.T. (2015) Isotopic signatures in the otoliths of reef-associated fishes of southern Florida: Linkages between nursery grounds and coral reefs. *Regional Studies in Marine Science* 2: 95-104.
- Karnauskas, M., Schirripa, M.J., Craig, J.K., Cook, G.S., Kelble, C. R., Agar, J.J., Black, B.A. et al. , Enfield, D.B., Lindo-Aitchati, D., **Muhling**, B.A. et al. (2015) Evidence of climate-driven ecosystem reorganization in the Gulf of Mexico. *Global Change Biology* doi: 10.1111/gcb.12894.
- Laiz-Carrión, R., Gerard, T., Uriarte, A., Malca, E., Quintanilla, J.M., **Muhling**, B.A., Alemany, F. et al. (2015) Trophic ecology of Atlantic bluefin tuna (*Thunnus thynnus*) larvae from the Gulf of Mexico and NW Mediterranean spawning grounds: A comparative stable isotope study. *PLoS one* 10 p.e0133406.
- Liu, Y., Lee, S-K., Enfield, D.B., **Muhling**, B.A., Lamkin, J.T., Muller-Karger, F., Roffer, M.A. (2015) Potential impact of global warming on the Intra-Americas Seas: Part-1. A dynamic downscaling of the CMIP5 model projections. *Journal of Marine Systems* 148: 56-69.
- Muller-Karger, F.E., Smith, J.P., Werner, S.W., Chen, R., Roffer, M., Liu, Y., **Muhling**, B.A. et al. (2015) Natural variability of surface oceanographic conditions in the offshore Gulf of Mexico. *Progress in Oceanography* 134: 54-76.
- Muhling**, B.A., Liu, Y., Lee, S-K., Lamkin, J.T., Ingram, W. (2014) Climate change impacts on spawning grounds of Atlantic tunas in the northern Gulf of Mexico. *Bulletin of the Japanese Fisheries Research Agency* 38: 101-103
- Habtes, S., Muller-Karger, F.E., Roffer, M.A., Lamkin, J.T., **Muhling**, B.A. (2014) A comparison of sampling methods for larvae of medium and large epipelagic fish species during spring SEAMAP ichthyoplankton surveys in the Gulf of Mexico. *Limnology and Oceanography: Methods* 12: 86-101
- Johns, E.M., **Muhling**, B.A., Perez, R.C., Muller-Karger, F.E., Melo, N., Smith, R.H., Lamkin, J.T., Gerard, T.L., Malca, E. (2014) Amazon River water in the northeastern Caribbean Sea and its effect on larval reef fish assemblages during April 2009. *Fisheries Oceanography* 23: 472-494.
- Llopiz, J.K., Cowen, R.K., Hauff, M.J., Munday, P.L., **Muhling**, B.A., Peck, M.A., Richardson, D.E. (2014) Early life history and fisheries oceanography: New questions in a changing world. *Oceanography* 27: 26-41.
- Muhling**, B.A., Smith, R.H., Vasquez, L., Lamkin, J.T., Johns, E.M., Carrillo, L., Sosa-Cordero, E., Malca, E. (2013) Larval fish assemblages and mesoscale oceanographic structure along the Mesoamerican Barrier Reef System. *Fisheries Oceanography* 22: 409-428
- Muhling**, B.A., Reglero, P., Ciannelli, L., Alvarez-Berastegui, D., Alemany, F., Lamkin, J.T., Roffer, M.A. (2013) Comparison between environmental characteristics of larval bluefin tuna *Thunnus thynnus* habitat in the Gulf of Mexico and western Mediterranean Sea. *Marine Ecology Progress Series* 486: 257-276
- Muhling**, B.A., Lamkin, J.T., Richards, W.J. (2012) Decadal-scale responses of larval fish assemblages to multiple ecosystem processes in the northern Gulf of Mexico. *Marine Ecology Progress Series* 450:37-53

- Muhling**, B.A., Roffer, M.A., Lamkin, J.T., Ingram, G.W. Jr., Upton, M.A., Gawlikowski, G., Muller-Karger, F., Habtes, S., Richards, W.J. (2012) Overlap between Atlantic bluefin tuna spawning grounds and observed Deepwater Horizon surface oil in the northern Gulf of Mexico. *Marine Pollution Bulletin* 64:679-687
- Lindo-Atichati, D., Bringas, F., Goni, G., **Muhling**, B.A., Muller-Karger, F.E., Habtes, S. (2012) Varying mesoscale structures influence larval fish distribution in the northern Gulf of Mexico. *Marine Ecology Progress Series* 463: 245-257
- Liu, Y., Lee, S.K., **Muhling**, B.A., Lamkin, J.T., Enfield, D.B. (2012) Significant reduction of the Loop Current in the 21st century and its impact on the Gulf of Mexico. *Journal of Geophysical Research* 117: C05039, doi:10.1029/2011JC007555
- Muhling**, B.A., Lamkin, J.T., Quattro, J.M., Smith, R.A., Roberts, M.A., Roffer, M.A., Ramirez, K.A. (2011) Collection of larval bluefin tuna (*Thunnus thynnus*) outside documented western Atlantic spawning grounds. *Bulletin of Marine Science* 87: 687-694 3
- Muhling**, B.A., Lee, S-K, Lamkin, J.T. (2011) Predicting the effects of climate change on bluefin tuna (*Thunnus thynnus*) spawning habitat in the Gulf of Mexico. *ICES Journal of Marine Science* 68: 1051-1062
- Muhling**, B.A., Lamkin, J.T., Roffer, M.A. (2010) Predicting the occurrence of bluefin tuna (*Thunnus thynnus*) larvae in the northern Gulf of Mexico: Building a classification model from archival data *Fisheries Oceanography* 19: 526-539
- Ingram, G.W. Jr., Richards, W.J., Lamkin, J.T., **Muhling**, B.A. (2010) Annual indices of Atlantic bluefin tuna (*Thunnus thynnus*) larvae in the Gulf of Mexico developed using delta-lognormal and multivariate models. *Aquatic Living Resources* 23: 35-47
- Gerard, T.L., **Muhling**, B.A. (2010) Variation in the isotopic signatures of juvenile gray snapper (*Lutjanus griseus*) from five southern Florida regions. *Fishery Bulletin* 108: 98-105
- Beckley, L.E., **Muhling**, B.A. (2009) Larval fishes off Western Australia: influence of the Leeuwin Current. *Journal of the Royal Society of Western Australia* 92: 101-109
- Muhling**, B.A., Beckley, L.E., Gaughan, D.J., Jones, C.M., Miskiewicz, A.G., Hesp, S.A. (2008) Spawning, larval abundance and growth rate of *Sardinops sagax* off southwestern Australia: influence of an anomalous eastern boundary current. *Marine Ecology Progress Series* 364: 157-167
- Muhling**, B.A., Beckley, L.E., Koslow, J.A., Pearce, A.F. (2008) Larval fish assemblages and water mass structure off the oligotrophic south-western Australian coast. *Fisheries Oceanography* 17: 16-31
- Muhling**, B.A., Beckley, L.E. (2007) Seasonal variation in horizontal and vertical structure of larval fish assemblages off south-western Australia, with implications for larval transport. *Journal of Plankton Research* 29: 967-983
- Waite, A.M., **Muhling**, B.A., Holl, C.M., Beckley, L.E., Montoya, J.P., Strzelecki, J., Thompson, P.A., Pesant, S. (2007) Food web structure in two counter-rotating eddies based on δN_{15} and δC_{13} isotopic analyses. *Deep Sea Research Part II: Topical Studies in Oceanography* 54: 1113-1128
- Muhling**, B.A., Beckley, L.E., Olivar, M.P. (2007) Ichthyoplankton assemblage structure in two meso-scale Leeuwin Current eddies, eastern Indian Ocean. *Deep Sea Research Part II: Topical Studies in Oceanography* 54: 1113-1128

Teaching Experience

2008 – 2012: Dissertation Committee

- David Lindo, Ph.D candidate, Universidad de Las Palmas de Gran Canaria (awarded 2012)

2001 – 2005: Teaching Assistant/ Lab Leader, Murdoch University

- Classes: Introduction to Environmental Systems and Methods, Marine and Estuarine Biology, Ecology, Coastal and Marine Management

Recent Collaborations

United States

NOAA-GFDL, NOAA-NMFS, WHOI, University of Miami, University of Southern Mississippi, University of South Florida, University of South Carolina, Princeton University, CUNY

International

IEO (Spain), CSIRO (Australia), Murdoch University (Australia), ECOSUR (Mexico)

Relevant Skills Summary

- Predictive habitat modeling using artificial neural networks, classification and regression trees, Generalized Additive Models (DTREG, R software)
- Oceanographic data analyses, handling climate model output, other statistics (Matlab software)
- Individual-based models (Java Programming, Eclipse software)
- Multivariate assemblage analyses (PRIMER-E, R, Matlab, Permanova software)
- Spatial statistics, interpolation (Surfer software)
- Spatial analyses (ArcGIS software)

Recent Funded Research

Principal Investigator: “A new zooplankton community index and recruitment model to improve understanding of the stock-recruit relationship for western Atlantic bluefin tuna”, NOAA Fisheries and the Environment (FATE) Program, Sept. 2015 – Sept. 2016.

Principal Investigator: “Measuring larval bluefin tuna growth to improve a fishery-independent index, and help resolve uncertainty with the stock-recruitment relationship”, NOAA-NMFS Bluefin Tuna Research Program, Sept. 2015 – Sept. 2016.

Principal Investigator: “Accounting for the Influence of Feeding Success on the Growth and Survival of Bluefin Tuna Larvae in Stock Assessment Efforts”, NOAA-NMFS Bluefin Tuna Research Program, Sept. 2013 – Sept. 2014.

Co-investigator: “Management and conservation of Atlantic bluefin tuna (*Thunnus thynnus*) and other highly migratory fish in the Gulf of Mexico under IPCC climate change scenarios: A study using regional climate and habitat models”, NASA Grant #NNH10ZDA001N-BIOCLIM, Sept. 2011 – Sept. 2015