

Ryan B. Carnegie
Curriculum Vitae

CONTACT INFORMATION

Name: Ryan B. Carnegie
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Date: 21 March 2016
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EDUCATION

2000 Ph.D., University of Maine, Marine Biology

1994 M.A., Virginia Institute of Marine Science, College of William & Mary, Marine Science

1990 B.A., Rutgers University, Biology with a minor in English

ACADEMIC POSITIONS

2011 Research Associate Professor, Department of Environmental and Aquatic Animal Health (renamed "Aquatic Health Sciences" in 2014), Virginia Institute of Marine Science

2010 Research Assistant Professor, Department of Environmental and Aquatic Animal Health, Virginia Institute of Marine Science

2008 Associate Research Scientist, Department of Environmental and Aquatic Animal Health, Virginia Institute of Marine Science

2003 Assistant Research Scientist, Department of Environmental and Aquatic Animal Health, Virginia Institute of Marine Science

2002 Assistant Research Scientist, Aquaculture Genetics and Breeding Technology Center, Virginia Institute of Marine Science

2001 Postdoctoral Fellow, Program in Marine Biomedicine and Environmental Sciences, Medical University of South Carolina

2000 Visiting Fellow, Pacific Biological Station, Nanaimo, British Columbia

HONORS, PRIZES AND AWARDS

2015 Chair, ICES Working Group on Pathology and Diseases of Marine Organisms (2015-18)

2014 Visiting Scientist, Canada Excellence Research Chair Program in Aquatic Epidemiology, Atlantic Veterinary College, University of Prince Edward Island

- 2013** Designated the US representative for invertebrates to the ICES Working Group on Pathology and Diseases of Marine Organisms
- 2011** Designated World Organisation for Animal Health (OIE, Paris, France) Reference Expert for Perkinsosis and Haplosporidiosis, diseases of molluscs
- 2001** National Shellfisheries Association Thurlow C. Nelson Award
- 1997** Award for Best Student Presentation, Maine Aquaculture Conference
- 1996** Lucien Cuprak Best Student Paper Award, Maine Biological and Medical Sciences Symposium

CONTRIBUTIONS TO THE EDUCATIONAL PROGRAM

Courses taught (VIMS)

- 2015** MSCI 565 “Principles of Pathobiology” (with A. Wargo and W. Vogelbein), 3.0 cr, Spring, 5 students
- 2014** MSCI 698 “Ecology and Evolution of Infectious Disease” (with A. Wargo and J. Shields), 2.0 cr, Fall, 6 students
- 2013** MSCI 698 “Aquatic Environments and Human Health” (with A. Wargo and K. Reece), 2.0 cr, Fall, 6 students
- 2013** MSCI 565 “Principles of Pathobiology” (with S. Kaattari and W. Vogelbein), 2.0 cr., Spring, 4 students
- 2010** MSCI 565 “Principles of Pathobiology” (with S. Kaattari and W. Vogelbein), 2.0 cr., Spring, 2 students
- 2009** MSCI 698 “Diseases of Molluscs” (with E.M. Burreson and K.S. Reece), 3.0 cr., Fall, 3 students
- 2006** MSCI 698 “Diseases of Molluscs” (with E.M. Burreson and K.S. Reece), 3.0 cr., Fall, 3 students

Courses taught (outside VIMS)

- 2010** Ecología Parasitaria de Moluscos Bivalvos de Importancia Comercial (with E. Delgado, M. Kroeck, M. Campalans). Univ. de la Republica, Montevideo, Uruguay, ~ 15 students

2006 Oyster Diseases and Diagnostics, University of Hawaii Pauley Summer Program (with K.S. Reece), ~ 10 students

**Students Mentored
Major Advisor**

Lauren Huey M.S. 2015-

Thesis topic: Evolutionary ecology of oyster disease caused by *Perkinsus marinus*

Lydia Bienlien M.S. 2013-

Thesis topic: Influence of *Perkinsus marinus* parasitism and oyster health on levels of contamination by human-pathogenic *Vibrios*

Student awards: First Place and People's Choice Award, inaugural VIMS Three Minute Thesis® competition (2014); National Shellfisheries Association Michael Castagna Student Research Grant (2014); TOGA Fellowship (2015)

Lúcia Safi Ph.D. 2013-

Dissertation topic: Diversity and ecological significance of peritrich ciliates in Chesapeake Bay

Sikai Peng M.S. 2011-2013 (co-advised with Kam Tang)

Thesis title: Investigations of the life cycle of the peritrich ciliate *Zoothamnium intermedium* in Chesapeake Bay

Erica Oehrens Ph.D. 2010- (Universidad Nacional del Comahue, Bariloche, Argentina; co-advised with Dr. Marina Kroeck)

Dissertation topic: Ecology of *Bonamia exitiosa* in Argentine oyster populations

Jamie Underdown B.S. 2006-2007 (William & Mary Department of Biology)

Honors thesis topic: Molecular characterization of a fungus infecting the hydrothermal vent mussel *Bathymodiolus brevior*

Student Committee Service

Joseph Matt (present), VIMS MS
Darbi Jones (present), VIMS MS
Ann Arfken (present), VIMS PhD
Sarah Pease (present), VIMS MS

Patricia O’Leary (present), VIMS PhD
Andrew Keppel, University of Maryland MS 2014
Brian Callam, VIMS MS 2013
Kristina Hill, VIMS MS 2011
Kelli Milleville, VIMS MS 2007
Delonna White, VIMS MS 2007
Carol Logan, W&M Dept. of Biology Honors Thesis Committee, BS 2006
Megan Evans, W&M Dept. of Biology Honors Thesis Committee, BS 2005

External Examiner, Doctoral Dissertations:

2009 Cécile Dang, University of Bordeaux, France (rapporteur at defense)
2008 Douglas Bearham, Murdoch University, Australia

Visiting Scientists Hosted for Laboratory Training:

2014 Cem Giray, Kennebec River Biosciences, Richmond, Maine (1 week)
2014 Fabiola Salcedo Moran, CICESE, Ensenada, Mexico (3 weeks)
2012 Mi Young Cho, Natl. Fisheries Research & Development Institute, Busan, Korea (1 year)
2012 Maite Letamendía, Universidad de la Republica, Montevideo, Uruguay (2 weeks)
2011 Kim Ju Heon and Lim Sang Uk, Animal, Plant and Fisheries Quarantine and Inspection Agency, Korea (2 weeks)
2011 Mary Stephenson, Gulf Fisheries Centre, Fisheries & Oceans Canada, Moncton, New Brunswick, Canada (1 week)
2010 Gary Meyer, Pacific Biological Station, Fisheries & Oceans Canada, Nanaimo, British Columbia, Canada (1 week)
2010 Ki Won Shin and Su-Yeong Park, Natl. Fisheries Research & Development Institute, Busan, Korea (2 weeks)
2009 Estela Delgado, Universidad de la Republica, Uruguay (2 weeks)
2008 Refka El Gharssalli, Institut National Agronomique de Tunisie, Tunis, Tunisia (2 weeks)
2007 Marina Kroeck, Inst. de Biología Marina y Pesquera “Alte. Storni”, Rio Negro, Argentina (2 weeks)
2007 Stephen Webb, Cawthron Institute, Nelson, New Zealand (1 week)

NSF Research Experiences for Undergraduates (REU) Students:

2013 Marc Hammond, University of Massachusetts
2012 Lydia Bienlien, Morningside College (Sioux City, Iowa)

FELLOWSHIPS AND GRANTS

- 2015** Sea Grant Aquaculture Extension 2015: VA Shellfish Aquaculture Industry Support (Co-PI). \$261,530. With K. Hudson, T.J. Murray, S.K. Allen, Jr., K.S. Reece, J.L. Smith, D.D. Kuhn, and M.H. Schwartz. Virginia Sea Grant. September 2015-August 2017
- 2015** Profiling the microbiome composition of hatchery-reared oyster larvae (Co-PI). \$10,000. With B. Song, S.K. Allen, Jr. Virginia Sea Grant. May-December 2015
- 2014** Streamlining biosecurity management in the context of regional molluscan shellfish transfers (**Principal Investigator**). \$266,989. With D. Bushek, L. Calvo, M. Nelson, R. Rheault and D. Bouchard. NOAA Sea Grant Aquaculture Research Program 2014. September 2014-August 2016
- 2014** Evaluation of potential larval oyster mortality from exposure to residue associated with Gwynns Island Bridge repainting (Co-PI). \$103,379. With K. Reece, W. Vogelbein, A. Beck, J. Shen, and S. Allen, Jr. VA Department of Transportation. September 2014-September 2015
- 2014** Investigation of potential correlation between oyster health and contamination with human pathogenic vibrios (**Principal Investigator**). \$6,900. With C. Audemard and K. Reece. Virginia Sea Grant. September 2014-August 2015
- 2014** The impact of Mid-Atlantic emerging harmful algal bloom (HAB) species on *Crassostrea virginica* larvae and spat (Co-PI). \$41,802. With K. Reece and W. Vogelbein. Virginia Sea Grant. May 2014-April 2015
- 2012** Determining the relationship between *Vibrio* spp. and *Perkinsus marinus* levels in oysters from Chesapeake Bay (**Principal Investigator**). \$5,000. With C. Audemard, H. Kator, and K. Reece. Virginia Sea Grant. July 2012-April 2013
- 2011** A bay-wide approach to oyster stock assessment, estimates of vital rates and disease status (Co-P.I.). VIMS portion \$336,192. With R. Mann and colleagues. NOAA Chesapeake Bay Office. July 2011-June 2013
- 2011** Influence of Oyster Reef Elevation on the Health of *Crassostrea virginica* (**Principal Investigator**). \$45,825. NOAA Chesapeake Bay Office. July 2011-June 2012
- 2011** Assessing the impacts of emerging harmful algal bloom species on shellfish restoration and aquaculture in Chesapeake Bay (Co-P.I.). \$39,980. With K. Reece and colleagues. Virginia Sea Grant. February 2011-January 2012
- 2010** Pathological analysis of Maryland Department of Natural Resources fall survey oyster samples, 2010 (**Principal Investigator**). \$5,000. Maryland Department of Natural Resources. November 2010-February 2011

- 2010** Determining the disease contribution to natural mortality of oysters in Chesapeake Bay (**Principal Investigator**). \$35,442. National Oceanic and Atmospheric Administration. June 2010-May 2011
- 2009** Pathological analysis of Maryland Department of Natural Resources fall survey oyster samples, 2009 (**Principal Investigator**). \$26,009. Maryland Department of Natural Resources. November 2009-April 2010
- 2008** Shellfish Diseases/Pathogens (A Southeastern Regional Aquaculture Center Publication) (**Principal Investigator**). \$2,000. Southeastern Regional Aquaculture Center. May 2008-April 2009
- 2008** A fast protocol for source tracking of contaminating protists in microalgal culture systems: development and application (**Principal Investigator**). Virginia Sea Grant. \$6,615. With E.M. Burreson, M. Peirson, and T. Riley. May 2008
- 2007** Native oyster restoration in the Virginia portion of the Chesapeake Bay (Co-P.I.). NOAA Chesapeake Bay Office. Disease portion \$183,848. With E.M. Burreson, R. Mann, M. Luckenbach, S. Allen, K. Reece, J. Carlsson, J. Harding, R. Lipcius, and the VMRC. July 2007-December 2009
- 2007** Evaluation of the health and reproductive status of older, post-market size *Crassostrea virginica* as a key to *Perkinsus marinus* resistance in natural oyster populations (**Principal Investigator**). Sea Grant Oyster Disease Research Program. \$90,010. With E.M. Burreson. July 2007-April 2009
- 2007** Identification of a novel haplosporidian parasite in Virginia hard clams, *Mercenaria mercenaria*, and design and distribution of a PCR assay for its detection (**Principal Investigator**). Virginia Sea Grant. \$2,846. With E.M. Burreson. October 2007-December 2007
- 2006** *Crassostrea ariakensis*-pathogenic *Bonamia*: The source of *Bonamia*, the role of *Crassostrea virginica* in epizootics, and the prepatent period (**Principal Investigator**). NOAA Chesapeake Bay Office. \$164,938. With E.M. Burreson, C. Audemard, and C.H. Peterson. October 2006-September 2007
- 2005** *Crassostrea ariakensis*-pathogenic *Bonamia* sp. from North Carolina: Determination of salinity and size susceptibility thresholds (**Principal Investigator**). NOAA Chesapeake Bay Office. \$175,000. With E.M. Burreson, C. Audemard, M.J. Bishop, and C.H. Peterson. October 2005-September 2006
- 2005** Infectivity and transmissibility to *Crassostrea ariakensis* of pathogenic *Bonamia* sp. from *Ostrea equestris*: Evaluation of crested oysters as a parasite reservoir (**Principal Investigator**). Virginia Sea Grant. \$132,191. With E.M. Burreson and C. Audemard. June 2005-May 2007

- 2005** Examination of the Potential for Vertical and Horizontal Transmission of the Oyster Herpes Virus from *Crassostrea ariakensis* Broodstock (Co-P.I.). Virginia Sea Grant. \$130,474. With K.S. Reece. June 2005-May 2007
- 2004** Pathogenic *Bonamia* sp. from North Carolina: Field and laboratory trials to characterize potential risks to *C. ariakensis* in the mid-Atlantic region (Co-P.I.). NOAA Chesapeake Bay Office. \$187,100. With E.M. Burrenson, C. Audemard, C. Peterson, and M. Bishop. October 2004-September 2005
- 2004** Potential for *Crassostrea ariakensis* to serve as a vector for exotic pathogens in Chesapeake Bay: Assessing the risk of *Perkinsus* spp. and oyster herpes virus to *C. ariakensis* and native bivalves (Co-P.I.). NOAA Chesapeake Bay Office. \$188,396. With K.S. Reece, E.M. Burrenson, and C. Dungan. October 2004-March 2006
- 2004** Determination of the natural host for *Bonamia* sp. in North Carolina, and evaluation of the potential for infection of *Crassostrea ariakensis* in Virginia (**Principal Investigator**). NOAA/VA Sea Grant. \$10,080. With E.M. Burrenson. January-April 2004
- 2004** Susceptibility of *Crassostrea ariakensis* to the oyster pathogen *Bonamia ostreae* and to *Bonamia* sp. recently discovered in *C. ariakensis* in North Carolina (Co-P.I.). Maryland Department of Natural Resources. \$39,963. With E.M. Burrenson and C. Audemard. 2004-2005
- 2001** Model application of a DNA probe: fine resolution of the seasonal infection cycle of the enigmatic oyster pathogen *Mikrocytos mackini* (**Principal investigator**). Science Branch of Fisheries and Oceans Canada. \$36,000. With G.R. Meyer and S.M. Bower. 2001-2002

RESEARCH

Scholarly activity: Refereed publications, book chapters, and conference proceedings (52 total published or in press)

- 2016** **Carnegie, R.B.**, I. Arzul, and D. Bushek. Managing Marine Diseases in the Context of Regional and International Commerce: Policy Issues and Emerging Concerns. Philosophical Transactions of the Royal Society B 371: 20150215 (doi:dx.doi.org/10.1098/rstb.2015.0215)
- 2016** Groner, M.L., J. Maynard, R. Breyta, **R.B. Carnegie**, A. Dobson, C.S. Friedman, B. Froelich, M. Garren, F.M.D. Gulland, S.F. Heron, R. Noble, J.D. Shields, C.W. Revie, R. Vanderstichel, E. Weil, S. Wyllie-Echeverria, and C.D. Harvell. Managing marine disease emergencies in an era of rapid change. Philosophical Transactions of the Royal Society B 371: 20150364 (doi:dx.doi.org/10.1098/rstb.2015.0364)

- 2016** Ribeiro, F., E.J. Hilton, and **R.B. Carnegie**. High prevalence and potential impacts of crustacean ectoparasites on larval Atlantic croaker (*Micropogonias undulatus*) in the Chesapeake Bay. *Estuaries and Coasts* 39: 583-588 (doi:10.1007/s12237-015-0010-z)
- 2015** Sanchez, J., **R.B. Carnegie**, P. Warris, J. Hill, J. Davidson, and S. St-Hilaire. Risk characterization for introduction and spread of Multinucleate Sphere X (MSX) in Prince Edward Island, Canada. *Journal of Shellfish Research* 34: 995-1005 (doi:10.2983/035.034.0326)
- 2015** Arzul, I., and **R.B. Carnegie**. New perspective on the haplosporidian parasites of molluscs. *Journal of Invertebrate Pathology* 131: 32-42 (doi:10.1016/j.jip.2015.07.014)
- 2015** Rodgers, C.J., **R.B. Carnegie**, M.C. Chávez-Sánchez, C.C. Martínez-Chávez, M.D. Furones Nozal, and P.M. Hine. Legislative and regulatory aspects of molluscan health management. *Journal of Invertebrate Pathology* 131: 242-255 (doi:10.1016/j.jip.2015.06.008)
- 2015** Hill, K.M., J.R. McDowell, N.A. Stokes, K.S. Reece, E.M. Bureson, and **R.B. Carnegie**. Phylogeographic perspective on the distribution and dispersal of a marine pathogen, oyster parasite *Bonamia exitiosa*. *Marine Ecology Progress Series* 536: 65-76 (doi:10.3354/meps11425)
- 2015** Breitburg, D.L., D. Hondorp, C. Audemard, **R.B. Carnegie**, R.B. Burrell, M. Trice, and V. Clark. Landscape-level variation in disease susceptibility related to shallow-water hypoxia. *PLOS ONE* e0116223
- 2014** Hine, P.M., **R.B. Carnegie**, M.A. Kroeck, A. Villalba, M.Y. Engelsma, and E.M. Bureson. Ultrastructural comparison of *Bonamia* spp. (Haplosporidia) infecting ostreid oysters. *Diseases of Aquatic Organisms* 110 (1-2): 55-64
- 2014** Engelsma, M.Y., S.C. Culloty, S.A. Lynch, I. Arzul, and **R.B. Carnegie**. *Bonamia* parasites: a rapidly changing perspective on a genus of important mollusc pathogens. *Diseases of Aquatic Organisms* 110 (1-2): 5-23
- 2014** Hill, K.M., N.A. Stokes, S.C. Webb, P.M. Hine, M.A. Kroeck, J.D. Moore, M.S. Morley, K.S. Reece, E.M. Bureson, and **R.B. Carnegie**. Phylogenetics of *Bonamia* parasites based on small subunit and internal transcribed spacer region ribosomal DNA sequence data. *Diseases of Aquatic Organisms* 110 (1-2): 33-54
- 2014** **Carnegie, R.B.**, and M.Y. Engelsma. Microcell parasites of molluscs: Introduction to DAO Special 7. *Diseases of Aquatic Organisms* 110 (1-2): 1-4

- 2014** Spiers, Z.B., M. Gabor, S.A. Fell, **R.B. Carnegie**, M. Dove, W. O'Connor, J. Frances, J. Go, I.B. Marsh, and C. Jenkins. A longitudinal study of winter mortality disease in *Saccostrea glomerata* (Sydney rock oysters). *Diseases of Aquatic Organisms* 110 (1-2): 151-164
- 2014** Audemard, C., **R.B. Carnegie**, K.M. Hill, C.H. Peterson, and E.M. Burreson. *Bonamia exitiosa* transmission among, and incidence in, Asian oyster *Crassostrea ariakensis* under warm conditions. *Diseases of Aquatic Organisms* 110 (1-2): 143-150
- 2014** Mann, R., M. Southworth, **R.B. Carnegie**, and R.K. Crockett. Temporal variation in fecundity and spawning in *Crassostrea virginica* in the Piankatank River, Virginia. *Journal of Shellfish Research* 33 (1): 167-176
- 2014** **Carnegie, R.B.**, K.M. Hill, N.A. Stokes, and E.M. Burreson. The haplosporidian *Bonamia exitiosa* is present in Australia, but the identity of the parasite described as *Bonamia roughleyi* is uncertain. *Journal of Invertebrate Pathology* 115: 33-40
- 2013** Stentiford, G.D., K.S. Bateman, N.A. Stokes, and **R.B. Carnegie**. *Haplosporidium littoralis* sp. nov.: a crustacean pathogen within the Haplosporidia (Cercozoa, Ascetospora). *Diseases of Aquatic Organisms* 105: 243-252
- 2012** **Carnegie, R.B.** Contemporary issues in molluscan health: challenges and opportunities. *Proceedings of the OIE Global Conference on Aquatic Animal Health Programmes: Their Benefits for Global Food Security* (Panama, June 2011), pp. 89-96
- 2012** Dungan, C.F., **R.B. Carnegie**, K.M. Hill, C.B. McCollough, S.E. Laramore, C.J. Kelly, N.A. Stokes, and J. Scarpa. Diseases of *Crassostrea ariakensis* and *C. virginica* oysters reared in ambient waters from the Choptank River, Maryland and the Indian River Lagoon, Florida. *Diseases of Aquatic Organisms* 101: 173-183
- 2012** Cáceres-Martínez, J., M. García Ortega, R. Vásquez-Yeomans, T. de Jesús Pineda García, N.A. Stokes, and **R.B. Carnegie**. Natural and cultured populations of the mangrove oyster *Saccostrea palmula* from Sinaloa, Mexico, infected by *Perkinsus marinus*. *Journal of Invertebrate Pathology* 110: 321-325
- 2012** **Carnegie, R.B.**, and E.M. Burreson. *Perkinsus marinus* and *Haplosporidium nelsoni*. Pages 92-108 in: *Fish Parasites: Pathobiology and Protection* (P.T.K. Woo and K. Buchmann, eds.). CABI Publishing, Oxfordshire, UK
- 2011** **Carnegie, R.B.**, and E.M. Burreson. Declining impact of an introduced pathogen: *Haplosporidium nelsoni* in the oyster *Crassostrea virginica* in Chesapeake Bay. *Marine Ecology Progress Series* 432: 1-15 (**Feature Article**)

- 2010** Hill, K.M., **R.B. Carnegie**, N. Aloui-Bejaoui, R. El Gharsalli, D. White, N.A. Stokes, and E.M. Burreson. Observation of a *Bonamia* sp. infecting the oyster *Ostrea stentina* in Tunisia, and a consideration of its phylogenetic affinities. *Journal of Invertebrate Pathology* 103: 179-185
- 2009** Ford, S.E., N.A. Stokes, E.M. Burreson, E. Scarpa, **R.B. Carnegie**, J.N. Kraeuter, and D. Bushek. *Minchinia mercenariae* n. sp. (Haplosporidia) in the hard clam *Mercenaria mercenaria*: implications of a rare parasite in a commercially important host. *Journal of Eukaryotic Microbiology* 56: 542-551
- 2009** Hine, P.M., **R.B. Carnegie**, E.M. Burreson, and M.Y. Engelsma. Inter-relationships of haplosporidians deduced from ultrastructural studies. *Diseases of Aquatic Organisms* 83: 247-256
- 2009** Robalino, J., **R.B. Carnegie**, N. O'Leary, S.A. Ouvry-Patat, E. de la Vega, S. Prior, P.S. Gross, C.L. Browdy, R.W. Chapman, K.L. Schey, and G. Warr. Contributions of functional genomics and proteomics to the study of immune responses in the Pacific White Leg shrimp *Litopenaeus vannamei*. *Veterinary Immunology and Immunopathology* 128: 110-118
- 2008** Carlsson, J., **R.B. Carnegie**, J.F. Cordes, M.P. Hare, A.T. Leggett, and K.S. Reece. Evaluating recruitment contribution of a selectively bred *Crassostrea virginica* oyster aquaculture line used in restoration efforts. *Journal of Shellfish Research* 27: 1117-1124
- 2008** Audemard, C., **R.B. Carnegie**, and E.M. Burreson. Shellfish tissue evaluated for *Perkinsus* spp. using the Ray's fluid thioglycollate medium culture assay can be used for downstream molecular assays. *Diseases of Aquatic Organisms* 80: 235-239
- 2008** Audemard, C., **R.B. Carnegie**, M.J. Bishop, C.H. Peterson, and E.M. Burreson. Interacting effects of temperature and salinity on *Bonamia* sp. parasitism in the Asian oyster *Crassostrea ariakensis*. *Journal of Invertebrate Pathology* 98 (3): 344-350
- 2008** **Carnegie, R.B.**, N.A. Stokes, C. Audemard, M.J. Bishop, A.E. Wilbur, T.D. Alphin, M.H. Posey, C.H. Peterson, and E.M. Burreson. Strong seasonality of *Bonamia* sp. infection and induced *Crassostrea ariakensis* mortality in Bogue and Masonboro Sounds, North Carolina, USA. *Journal of Invertebrate Pathology* 98 (3): 335-343
- 2008** Audemard, C., **R.B. Carnegie**, N.A. Stokes, M.J. Bishop, C.H. Peterson, and E.M. Burreson. Effects of salinity on *Bonamia* sp. survival in the Asian oyster *Crassostrea ariakensis*. *Journal of Shellfish Research* 27 (3): 535-540
- 2008** Logan, C.R., M.B. Evans, M. Ward, J.L. Scott, **R.B. Carnegie**, and C.L. Van Dover. Comparative ultrastructure of digestive diverticulae in bathymodiolin mussels: discovery of an unknown spherical inclusion (SIX) in digestive cells of a seep mussel. *Journal of Shellfish Research* 27: 97-105

- 2007** Van Dover, C.L., M.E. Ward, J. Underdown, M.A. Whalen, C.A. Gustafson, B. Anderson, J. Scott, and **R.B. Carnegie**. A fungal epizootic in mussels at a deep-sea hydrothermal vent. *Marine Ecology* 28: 54-62
- 2006** Bishop, M.J., **R.B. Carnegie**, N.A. Stokes, C.H. Peterson, and E.M. Bureson. Predicting the outcome of a non-native oyster introduction: facilitation of an enzootic parasite. *Marine Ecology Progress Series* 325: 145-152
- 2006** Hare, M.P., S.K. Allen, Jr., P. Bloomer, M.D. Camara, **R.B. Carnegie**, J. Murfree, M. Luckenbach, D. Meritt, C. Morrison, K. Paynter, K.S. Reece, and C. Rose. A genetic test for recruitment enhancement in Chesapeake Bay oysters, *Crassostrea virginica*, after population supplementation with a disease tolerant strain. *Conservation Genetics* 7: 717-734
- 2006** Camara, M.D., S.K. Allen, Jr., **R.B. Carnegie**, and K.S. Reece. Out-crossing among commercial strains of the northern quahog, *Mercenaria mercenaria*: Survival, growth, and implications for selective breeding. *Journal of Shellfish Research* 25(2): 403-416
- 2006** **Carnegie, R.B.**, E.M. Bureson, P.M. Hine, N.A. Stokes, C. Audemard, M.J. Bishop, and C.H. Peterson. *Bonamia perspora* n. sp. (Haplosporidia), a parasite of the oyster *Ostrea equestris*, is the first *Bonamia* species known to produce spores. *Journal of Eukaryotic Microbiology* 53(4): 232-245
- 2006** Azevedo, C., P Balseiro, G. Casal, C. Gestal, R. Aranguren, N.A. Stokes, **R.B. Carnegie**, B. Novoa, E.M. Bureson, and A. Figueras. Ultrastructural and molecular characterization of *Haplosporidium montforti* n. sp., parasite of the European abalone *Haliotis tuberculata*. *Journal of Invertebrate Pathology* 92: 23-32
- 2006** Johnson, P.T.J., J.E. Longcore, D.E. Stanton, **R.B. Carnegie**, J.D. Shields, and E.R. Preu. Chytrid fungal infections of *Daphnia pulex*: development, ecology, pathology and phylogeny of *Polycaryum laeve*. *Freshwater Biology* 51: 634-648
- 2005** **Carnegie, R.B.** Effects in mollusc culture. In K. Rohde (ed.). *Marine Parasitology*, pp 391-398. CSIRO Publishing, Australia
- 2005** Bower, S.M., G.R. Meyer, B. Goh, **R.B. Carnegie**, and A. Gee. Epizootiology and detection of nocardiosis in oysters. In P. Walker, R. Lester, and M.G. Bondad-Renteaso (eds). *Diseases in Asian Aquaculture V*, pp. 249-263. Fish Health Section, Asian Fisheries Society, Manila
- 2005** Meyer, G.R., S.M. Bower, and **R.B. Carnegie**. Sensitivity of a digoxigenin-labelled DNA probe in detecting *Mikrocytos mackini*, causative agent of Denman Island Disease (mikrocytosis) in oysters. *Journal of Invertebrate Pathology* 88: 89-94

- 2004** Patat, S.A., **R.B. Carnegie**, C. Kingsbury, P.S. Gross, R. Chapman, and K.L. Schey. Antimicrobial activity of histones from hemocytes of Pacific white shrimp. *European Journal of Biochemistry* 271: 4825-4833
- 2004** **Carnegie, R.B.**, and N. Cochenne-Laureau. Microcell parasites of oysters: Recent insights and future trends. *Aquatic Living Resources* 17: 519-528
- 2004** Burrenson, E.M., N.A. Stokes, **R.B. Carnegie**, and M.J. Bishop. *Bonamia* sp. (Haplosporidia) found in non-native oysters, *Crassostrea ariakensis*, in Bogue Sound, North Carolina. *Journal of Aquatic Animal Health* 16 (1): 1-9
- 2004** Reece, K.S., W.L. Ribeiro, P.M. Gaffney, **R.B. Carnegie**, and S.K. Allen Jr. Microsatellite marker development and analysis in the eastern oyster, *Crassostrea virginica*: Confirmation of null alleles and non-Mendelian segregation ratios. *Journal of Heredity* 95 (4): 346-352
- 2004** Bower, S.M., **R.B. Carnegie**, B. Goh, S.R.M. Jones, G.J. Lowe, and M.W.S. Mak. Preferential PCR amplification of parasitic protistan SSU rDNA from metazoan tissues. *Journal of Eukaryotic Microbiology* 51 (3): 325-332
- 2003** **Carnegie, R.B.**, B.J. Barber, and D.L. Distel. Detection of the oyster parasite *Bonamia ostreae* by fluorescent *in situ* hybridization. *Diseases of Aquatic Organisms* 55 (3): 247-252
- 2003** **Carnegie, R.B.**, G.R. Meyer, J. Blackburn, N. Cochenne-Laureau, F.C.J. Berthe, and S.M. Bower. Molecular detection of the oyster parasite *Mikrocytos mackini*, and a preliminary phylogenetic analysis. *Diseases of Aquatic Organisms* 54 (3): 219-227
- 2001** **Carnegie, R.B.**, and B.J. Barber. Growth and mortality of *Ostrea edulis* at two sites on the Damariscotta River estuary, Maine USA. *Journal of the World Aquaculture Society* 32 (2): 75-81
- 2000** **Carnegie, R.B.**, B.J. Barber, S.C. Culloty, A.J. Figueras, and D.L. Distel. Development of a PCR assay for detection of the oyster pathogen *Bonamia ostreae* (Pichot *et al.* 1980), and support for its inclusion in the Haplosporidia. *Diseases of Aquatic Organisms* 42 (3): 199-206
- 1996** Barber, B.J., **R.B. Carnegie**, C.V. Davis, and W. Mook. Effect of timing of seed deployment on growth and mortality of oysters, *Crassostrea virginica*, affected by Juvenile Oyster Disease (JOD). *Journal of the World Aquaculture Society* 27 (4): 443-448

Scholarly activity: Invited papers and talks (Student presentations underlined)(43 total)

- 2015** Carnegie, R.B. Rise of a marine superbug: understanding the origins of *Perkinsus marinus* as the East Coast's most significant oyster pathogen. Center for Physical Oceanography and Mitigation and Adaptation Research Institute, Old Dominion University, Norfolk, Virginia
- 2015** Carnegie, R.B. Long term evolution of virulence in marine diseases. Marine Disease Modeling and Transmission, a Workshop of the NSF Research Coordination Network on *Evaluating the impacts of a changing ocean on management and ecology of infectious marine disease*. Norfolk, Virginia (**Plenary presentation**)
- 2015** Carnegie, R.B., and D. Bushek. Rethinking molluscan health management in eastern North America. Interstate Seafood Seminar, Ocean City, Maryland
- 2015** Carnegie, R.B. Detection of bivalve mollusc pathogens: Are we headed in the right direction? Northeast Aquaculture Conference and Exposition, Portland, Maine
- 2014** Carnegie, R.B. New insights into the evolutionary ecology of oyster diseases in the eastern USA. University of Prince Edward Island, Charlottetown, Prince Edward Island
- 2014** Carnegie, R.B. Changing perspective on *Perkinsus marinus* parasitism of the oyster *Crassostrea virginica*. Haskin Shellfish Research Laboratory, Rutgers University
- 2014** Carnegie, R.B. Changing perspective on *Perkinsus marinus* parasitism of the oyster *Crassostrea virginica*. Interstate Seafood Seminar, Virginia Beach
- 2013** Carnegie, R.B. Contemporary disease issues of relevance to molluscan aquaculture and fisheries. International Symposium on Aquatic Animal Health and Food Safety, Ensenada, Mexico
- 2013** Carnegie, R.B., and D. Bushek. An initiative to improve interstate shellfish seed transport regulations. Maryland Division of Natural Resources for the Maryland Oyster Advisory Commission, Annapolis, Maryland
- 2013** Carnegie, R.B. A report on a new *Bonamia exitiosa* observation in North Carolina, and an initiative to improve interstate shellfish seed transport regulations. Maryland Watermans Association Annual Meeting, Ocean City
- 2013** Bienlien, L.M., and R.B. Carnegie. Molecular analysis of *Perkinsus marinus* infection acquisition in *Crassostrea virginica*. Association for the Sciences of Limnology and Oceanography Annual Meeting, New Orleans
- 2013** Carnegie, R.B. Activities and Responsibilities of an OIE Reference Laboratory. Gulf Fisheries Centre, Fisheries and Oceans Canada, Moncton, New Brunswick

- 2013** Carnegie, R.B. Living with *Haplosporidium nelsoni* (MSX) in the United States. Workshop “Developing a Coordinated Response Plan to MSX on Prince Edward Island”, Charlottetown, Prince Edward Island
- 2012** Carnegie, R.B. Evolutionary ecology of oyster disease: New insight into disease intensification in the 1980s, and a dynamic view of oyster-parasite relationships. South Carolina Department of Natural Resources, Charleston, South Carolina
- 2011** Carnegie, R.B. Evolutionary ecology of oyster disease in Chesapeake Bay. Webinar for the New South Wales (Australia) Department of Primary Industries
- 2011** Carnegie, R.B. Responsibilities and activities of a World Organisation for Animal Health (OIE) Reference Laboratory. International Symposium for Aquaculture Food Safety and Sanitation, Ensenada, Mexico
- 2011** Carnegie, R.B. Contemporary issues in molluscan health: challenges and opportunities. OIE Global Conference on Aquatic Animal Health Programmes, Panama City, Panama
- 2011** Carnegie, R.B., and E.M. Bureson. Evolutionary ecology of eastern oyster *Crassostrea virginica* and its parasites. National Shellfisheries Association Annual Meeting. Baltimore, Maryland
- 2011** Carnegie, R.B. Histological observation of *Perkinsus marinus*. Annual Meeting and Technical Workshop of the National Reference Laboratories for Mollusc Diseases, La Tremblade, France
- 2011** Carnegie, R.B. Situation on the East Coast of the USA: structure of the industry and its management of disease. Annual Meeting and Technical Workshop of the National Reference Laboratories for Mollusc Diseases, La Rochelle, France
- 2011** Carnegie, R.B. Evolutionary ecology of *Crassostrea virginica* and its parasites. Centro de Investigaciones Mariñas, Vilanova de Arousa, Spain
- 2011** Carnegie, R.B. Update on emerging disease outbreaks in Europe, New Zealand, and Australia, and relevance to US East Coast shellfish interests. Milford Aquaculture Seminar, Milford, Connecticut
- 2010** Carnegie, R.B. *Perkinsus marinus* parasitism of *Crassostrea virginica*: impacts on oyster health and related industries. 2nd International Symposium for Aquaculture Food Safety and Sanitation, Ensenada, Mexico
- 2009** Carnegie, R.B. La bataille des huîtres: native *Crassostrea virginica* vs. Asian *Crassostrea ariakensis* in a struggle for the future of the Chesapeake Bay (USA) oyster resource. La Station Marine d’Arcachon, University of Bordeaux, France

- 2008** Carnegie, R.B. Does disease limit the aquaculture potential of *Ostrea edulis* in the Northeast? Northeastern Aquaculture Conference and Exposition, Portland, Maine
- 2008** Carnegie, R.B. Insights and uncertainties concerning *Bonamia* phylogenetics. 4th Meeting of the Microcell Working Group, La Tremblade, France
- 2007** Carnegie, R.B., M. Alavi, T.D. Alphin, C. Audemard, M.J. Bishop, G. Brown, E.M. Burrenson, D. Bushek, C. Dungan, R. Fisher, S.E. Ford, X. Guo, K.M. Hill, B.J. Landau, S. Laramore, J.A. Moss, K. Paynter, C.H. Peterson, M. Posey, K.S. Reece, J. Robledo, K. Saito, E. Scarpa, J. Scarpa, E. Schott, J. Shields, N.A. Stokes, A.E. Wilbur, and G. Vasta. Disease considerations relative to the proposed introduction of exotic Suminoe oysters to the mid-Atlantic. Annual Meeting of the Estuarine Research Federation, Providence, Rhode Island
- 2007** Carnegie, R.B. Evolution and dispersal of *Bonamia* species, parasites of oysters from cool temperate waters (And what does Hawaii have to do with it?). Hawaii Institute of Marine Biology, Kane'ohe
- 2007** Carnegie, R.B., and E.M Burrenson. Disease resistance in native oysters, *Crassostrea virginica*. 59th Annual Mid-Atlantic Interstate Seafood Seminar, Rehoboth Beach, Delaware
- 2007** Carnegie, R.B., and E.M Burrenson. Resistance to *Perkinsus marinus* among natural *Crassostrea virginica* populations from Virginia, USA. European Association of Fish Pathologists Biannual Meeting, Grado, Italy
- 2007** Carnegie, R.B., and E.M Burrenson. Resistance to *Perkinsus marinus* among natural *Crassostrea virginica* populations from Virginia waters. National Shellfisheries Association Annual Meeting, San Antonio, Texas
- 2007** Carnegie, R.B., and E.M Burrenson. Increasing tolerance for *Perkinsus marinus* among natural *Crassostrea virginica* populations from Virginia waters. Delaware Estuary Science Conference, Cape May, New Jersey
- 2006** Carnegie, R.B., N.A. Stokes, C. Audemard, E.M. Burrenson, M.J. Bishop, C.H. Peterson, A.E. Wilbur, T.D. Alphin, and M.H. Posey. Potential impact of a new *Bonamia* parasite on the oyster *Crassostrea ariakensis* cultured in Virginia and Maryland, USA. AQUA 2006, Florence, Italy
- 2006** Carnegie, R.B., N.A. Stokes, C. Audemard, E.M. Burrenson, M.J. Bishop, C.H. Peterson, A.E. Wilbur, T.D. Alphin, and M.H. Posey. Potential impact of *Bonamia* sp. on *Crassostrea ariakensis* in Chesapeake Bay and North Carolina. National Shellfisheries Association Annual Meeting, Monterey, California

- 2005** Carnegie, R.B., and E.M. Burreson. *Polydora*-associated shell disease: Recent distribution in native and non-native oysters, and implications for a *Crassostrea ariakensis* introduction. Eastern Fish Health Workshop, Shepherdstown, West Virginia
- 2005** Carnegie, R.B., C. Audemard, N.A. Stokes, E.M. Burreson, M.J. Bishop, and C.H. Peterson. Epizootiology of *Bonamia* sp. in *Crassostrea ariakensis* in North Carolina, and implications for aquaculture. Eastern Fish Health Workshop, Shepherdstown, West Virginia
- 2005** Carnegie, R.B., C. Audemard, N.A. Stokes, E.M. Burreson, M.J. Bishop, and C.H. Peterson. *Bonamia*-related oyster mortality in North Carolina, and potential for infection of *Crassostrea ariakensis* in Chesapeake Bay. Annual Meeting of the Maryland Watermans Association, Ocean City, Maryland
- 2004** Carnegie, R.B. Research on *Bonamia* in mid-Atlantic *Crassostrea ariakensis*. Haskin Shellfish Research Laboratory, Rutgers University
- 2002** Carnegie, R.B., G.R. Meyer, J. Blackbourn, N. Cochenne-Laureau, and S.M. Bower. Development and application of a PCR for *Mikrocytos mackini*, the causative agent of Denman Island disease in oysters. 94th Annual Meeting of the National Shellfisheries Association, Mystic, Connecticut
- 2001** Carnegie, R.B., B.J. Barber, and D.L. Distel. Detection of the flat oyster *Ostrea edulis* parasite *Bonamia ostreae* by fluorescent *in situ* hybridization. 93rd Annual Meeting of the National Shellfisheries Association, Orlando, Florida
- 2000** Carnegie, R.B. Molecular Diagnosis of *Bonamia ostreae*. IFREMER, La Tremblade and La Trinite, France
- 2000** Carnegie, R.B., B.J. Barber, D.L. Distel, and S.C. Culloty. Development of a PCR assay for detection of *Bonamia ostreae* in flat oysters, *Ostrea edulis*. 92nd Annual Meeting of the National Shellfisheries Association, Seattle, Washington
- 1999** Carnegie, R.B., and B.J. Barber. Impact of *Bonamia ostreae* on cultured *Ostrea edulis* at two sites on the Damariscotta River, Maine. 91st Annual Meeting of the National Shellfisheries Association, Halifax, Nova Scotia

Scholarly activity: Contributed papers and talks (Student presentations)(48 total)

- 2016** Carnegie, R.B., S.E. Ford, R.K. Crockett, and P.R. Kingsley-Smith. A rapid increase in *Perkinsus marinus* virulence caused the historically significant 1980s epizootic. Aquaculture 2016, Las Vegas
- 2016** Huey, L.I., R. Mann, and R.B. Carnegie. Is improved reproductive capacity a tolerance adaptation to *Perkinsus marinus* in the oyster *Crassostrea virginica*? Aquaculture 2016, Las Vegas

- 2016** Bienlien, L.M., C. Audemard, K.S. Reece, and R.B. Carnegie. Influence of *Perkinsus marinus* infection on levels of human-pathogenic vibrios in the oyster *Crassostrea virginica*. Aquaculture 2016, Las Vegas
- 2015** Carnegie, R.B. Shellfish health. Biannual Virginia Aquaculture Conference, Newport News, Virginia
- 2015** Bushek, D., R.B. Carnegie, L. Calvo, R. Rheault, D. Bouchard, M. Nelson, and K. Hudson. Streamlining biosecurity management for regional molluscan shellfish transfers. National Shellfisheries Association Annual Meeting, Monterey, California
- 2014** Hudson, J.M., D.B. Rudders, W.D. DuPaul, and R.B. Carnegie. A histopathological and spatial analysis of *Placopecten magellanicus* from the Mid-Atlantic following observations of reduced meat quality and elevated mortality. National Shellfisheries Association Annual Meeting, Jacksonville, Florida
- 2014** Carnegie, R.B. Changing perspective on *Perkinsus marinus* parasitism of the oyster *Crassostrea virginica*. Eastern Fish Health Workshop, Shepherdstown, West Virginia
- 2014** Carnegie, R.B. Insight into the intensification of perkinsosis in the eastern USA. ICES Working Group on Pathology and Diseases of Marine Organisms, Copenhagen
- 2013** Bushek, D., and R.B. Carnegie. Regulation of molluscan transfers: defining new alternative models for biosecurity regulation. World Aquaculture Society, Nashville
- 2012** Carnegie, R.B., and D. Bushek. Interstate shellfish seed transport: Improving regulations to facilitate commerce while enhancing biosecurity. Northeastern Aquaculture Conference and Exposition, Mystic, Connecticut
- 2012** Carnegie, R.B., and E.M. Bureson. A phenotypic change in *Perkinsus marinus* was associated with intensification of disease in oyster *Crassostrea virginica*. American Society of Parasitologists Annual Meeting, Richmond, Virginia
- 2012** Carnegie, R.B., and K.S. Reece. Oyster population connectivity in Chesapeake Bay: Possible impacts of disease selection in structuring populations. Benthic Ecology Meeting, Norfolk, Virginia
- 2012** Carnegie, R.B., and K.S. Reece. Oyster population connectivity in Chesapeake Bay: Possible impacts of disease selection in structuring populations (presented by Reece). Annual meeting of the National Shellfisheries Association, Seattle
- 2012** Carnegie, R.B. Evolutionary ecology of oyster disease in Chesapeake Bay. Meeting of the Microcell Working Group, Lelystad, the Netherlands

- 2012** Carnegie, R.B. Phylogenetics of *Bonamia* spp. and phylogeography of *Bonamia exitiosa*. Meeting of the Microcell Working Group, Lelystad, the Netherlands
- 2011** Carnegie, R.B. Confronting disease in oyster restoration: the case of *Crassostrea virginica* in Chesapeake Bay, USA. International Conference on Shellfish Restoration, Stirling, United Kingdom
- 2010** Carnegie, R.B., and E.M. Burreson. Evolutionary ecology of *Crassostrea virginica* and its parasites. 6th International Symposium on Aquatic Animal Health, Tampa, Florida
- 2010** Carnegie, R.B., and E.M. Burreson. Changing role of *Haplosporidium nelsoni*, agent of MSX disease in the oyster *Crassostrea virginica*, in Chesapeake Bay, Virginia, USA. Annual Meeting of the National Shellfisheries Association, San Diego, California
- 2009** Carnegie, R.B., and E.M. Burreson. Problems with using PCR diagnostics as a basis for management: *Mercenaria mercenaria* as a case study. Annual Meeting of the National Shellfisheries Association, Savannah, Georgia
- 2008** Carnegie, R.B., and E.M. Burreson. Gametogenesis and spawning in *Crassostrea virginica* from disease-intense Virginia waters. International Conference on Shellfish Restoration, Charleston, South Carolina
- 2008** Carnegie, R.B., E.M. Burreson, J.D. Shields, and W.K. Vogelbein. Potential impact of climate change on marine diseases in the Mid-Atlantic region. VIMS Initiative for Coastal Climate Change Center Mini-Symposium, Gloucester Point, Virginia
- 2008** Carnegie, R.B., and E.M. Burreson. Factors contribution to the persistence of *Crassostrea virginica* populations in disease-intense Virginia waters. Annual Meeting of the National Shellfisheries Association, Providence, Rhode Island
- 2007** Carnegie, R.B., and E.M. Burreson. Mitigating the *Perkinsus marinus* impact on *Crassostrea virginica* populations and industries in Chesapeake Bay, USA. Workshop for the Analysis of the Impact of Perkinsosis to the European Shellfish Industry, Vigo, Spain
- 2007** Carnegie, R.B. Conservation and restoration of *Crassostrea virginica* in Virginia. Mid-Atlantic Malacologists Annual Meeting, Wilmington, Delaware
- 2006** Carnegie, R.B., and E.M. Burreson. Increasing tolerance for *Perkinsus marinus* among natural *Crassostrea virginica* populations from Virginia waters. International Conference on Shellfish Restoration, Charleston, South Carolina
- 2006** Carnegie, R.B., N.A. Stokes, C. Audemard, and E.M. Burreson. Newly discovered species change our view of *Bonamia*, a genus of haplosporidian oyster parasites. International Symposium on Aquatic Animal Health, San Francisco

- 2006** Carnegie, R.B., N.A. Stokes, C. Audemard, E.M. Bureson, M.J. Bishop, C.H. Peterson, A.E. Wilbur, T.D. Alphin, and M.H. Posey. Potential impact of *Bonamia* sp. on *Crassostrea ariakensis* in Chesapeake Bay and North Carolina. Annual Meeting of the National Shellfisheries Association, Monterey, California
- 2005** Carnegie, R.B., J. Carlsson, J.F. Cordes, E.M. Bureson, and K.S. Reece. Foolproof or foolhardy? Use of selected aquaculture stocks for large scale restoration of natural oyster populations. International Conference on Shellfish Restoration, Brest, France
- 2005** Carnegie, R.B., N.A. Stokes, C. Audemard, and E.M. Bureson. Bonamiasis in the crested oyster, *Ostreola equestris*, in North Carolina, USA. Third Meeting of the Microcell Working Group, Virginia Institute of Marine Science, Gloucester Point
- 2005** Carnegie, R.B., N.A. Stokes, C. Audemard, and E.M. Bureson. Bonamiasis in the crested oyster, *Ostreola equestris*, in North Carolina, USA. Annual Meeting of the National Shellfisheries Association, Philadelphia
- 2004** Carnegie, R.B., N.A. Stokes, C. Audemard, E.M. Bureson, M.J. Bishop, and C.H. Peterson. Recent developments in *Bonamia* research in Virginia and North Carolina. International Conference on Shellfish Restoration, Charleston, South Carolina
- 2004** Carnegie, R.B., E.M. Bureson, N.A. Stokes, and K.S. Reece. Asian oyster *Crassostrea ariakensis* mortality in North Carolina reveals a previously unappreciated diversity of haplosporidian parasites. American Society of Parasitologists Annual Meeting, Philadelphia
- 2004** Carnegie, R.B., G.P. Scott, L.M. Ragone Calvo, M.D. Camara, and K.S. Reece. Development of a microsatellite marker set for the hard clam, *Mercenaria mercenaria*. World Aquaculture Society Annual Meeting, Honolulu, Hawaii
- 2003** Carnegie, R.B., M.D. Camara, L.M. Ragone Calvo, K.S. Reece, and P.M. Gaffney. Development of single nucleotide polymorphism (SNP) and microsatellite marker sets for the hard clam, *Mercenaria mercenaria*. Eighth International Symposium on Genetics in Aquaculture, Puerto Varas, Chile
- 2003** Carnegie, R.B., B.J. Barber, and S.M. Bower. Molecular phylogenetics of the microcell oyster parasites: new perspectives on a “closely related” group of species. Hennig XXII, New York
- 2003** Carnegie, R.B., M.D. Camara, G. Scott, K.S. Reece, and P.M. Gaffney. Development of a single nucleotide polymorphism (SNP) marker set for the hard clam, *Mercenaria mercenaria*. 95th Annual Meeting of the National Shellfisheries Association, New Orleans, Louisiana

- 2002** Carnegie, R.B., S.A. Patat, and K.L. Schey. Proteomic analysis of gill tissue from White Spot Syndrome-challenged *Litopenaeus vannamei*. International Conference on Shellfish Restoration, Charleston, South Carolina
- 2002** Carnegie, R.B., S.A. Patat, and K.L. Schey. The low molecular weight gill proteome of WSSV-challenged *Litopenaeus vannamei*. 4th International Symposium on Aquatic Animal Health, New Orleans, Louisiana
- 2000** Carnegie, R.B., B.J. Barber, D.L. Distel, A.J. Figueras, and S.C. Culloty. Evaluation of a PCR assay for detection of *Bonamia ostreae* in the flat oyster, *Ostrea edulis*. Aquaculture Canada 2000, Moncton, New Brunswick
- 1999** Carnegie, R.B., B.J. Barber, D.L. Distel, and S.C. Culloty. Development of PCR and *in situ* hybridization assays for detection of *Bonamia ostreae* in flat oysters, *Ostrea edulis*. 3rd International Conference on Shellfish Restoration, Cork, Ireland
- 1998** Carnegie, R.B., and B.J. Barber. Growth, mortality, and *Bonamia ostreae* prevalence of cultured *Ostrea edulis* at two sites in the Damariscotta River, Maine. Northeast Aquaculture Conference and Expo, Rockland, Maine
- 1998** Carnegie, R.B., B.J. Barber, and D.L. Distel. *Bonamia* research in Maine: an update. 18th Milford Aquaculture Seminar, New Haven, Connecticut
- 1997** Carnegie, R.B., D.L. Distel, and B.J. Barber. Amplification and sequencing of the *Bonamia ostreae* 18S rDNA gene: phylogenetic considerations and applications for management of bonamiasis in European oysters, *Ostrea edulis*. Maine Biological and Medical Sciences Symposium, Waterville, Maine
- 1997** Carnegie, R.B., D.L. Distel, and B.J. Barber. Amplification and sequencing of the *Bonamia ostreae* 18S rDNA gene: phylogenetic considerations and applications. 89th Annual Meeting of the National Shellfisheries Association, Fort Walton Beach, Florida
- 1997** Carnegie, R.B., D.L. Distel, and B.J. Barber. *Bonamia ostreae* investigations at the University of Maine: assessment of the distribution of *Bonamia*, and progress towards the development of a molecular diagnostic tool. Maine Aquaculture Conference, Rockport, Maine
- 1996** Carnegie, R.B., B.J. Barber, and C.V. Davis. Growth and timing of juvenile oyster disease (JOD) induced mortality of *Crassostrea virginica* in the Damariscotta River, Maine, USA. Maine Biological and Medical Sciences Symposium, Orono, Maine
- 1996** Carnegie, R.B., B.J. Barber, and C.V. Davis. Growth and timing of juvenile oyster disease (JOD) induced mortality of *Crassostrea virginica* in the Damariscotta River, Maine, USA. 88th Annual Meeting of the National Shellfisheries Association, Baltimore, Maryland

- 1995** Carnegie, R.B. and W.D. DuPaul. Size-specific fecundity of the sea scallop *Placopecten magellanicus* during one spawning period in the mid-Atlantic resource area. 87th Annual Meeting of the National Shellfisheries Association, San Diego, California

Scholarly activity: Unrefereed publications not listed above

- 2014** Carnegie, R.B., D. Bushek, L.R. Calvo, K.L. Hudson, L.L. Gustafson, and L.H. Creekmore. East Coast Regional Molluscan Aquaculture Health Management Workshop: Meeting Summary. Co-published by the Virginia Institute of Marine Science, Gloucester Point, and the Rutgers University New Jersey Agricultural Experiment Station. 2 pp.
- 2014** Carnegie, R.B. On the transport of wild *Crassostrea virginica* seed from low salinity waters of Chesapeake Bay: an advisory. Virginia Institute of Marine Science, Gloucester Point. 1 p.
- 2013** Carnegie, R.B., and D. Bushek. *Bonamia exitiosa* and its infection of *Crassostrea virginica* in the eastern USA: an advisory. Co-published by the Virginia Institute of Marine Science, Gloucester Point, and the Rutgers University New Jersey Agricultural Experiment Station. 2 pp.
- 2013** Carnegie, R.B. Status of the major oyster diseases in Virginia, 2009-2012—a summary of the annual oyster disease monitoring program. Virginia Institute of Marine Science, Gloucester Point. 26 pp.
- 2009** Carnegie, R.B., and E.M. Bureson. Status of the major oyster diseases in Virginia, 2006-2008—a summary of the annual oyster disease monitoring program. Virginia Institute of Marine Science, Gloucester Point. 21 pp.
- 2009** Carnegie, R.B. Diseases of concern in molluscan aquaculture. Southern Regional Aquaculture Center Publication No. 4704. 4 pp.
- 2008** Vogelbein, W., E. Bureson, R. Carnegie, and J. Shields. Climate change and aquatic animal health in Virginia: effects and responses. Virginia Institute of Marine Science, Gloucester Point, Virginia. 4 pp.
- 2007** Wicks, C., R.B. Carnegie, B. Longstaff, J. King, and M. O'Herron. 2007. Asian oysters: Implications for oyster disease. Chesapeake EcoCheck and the NOAA Chesapeake Bay Office. 2 pp.
- 2007** Carnegie, R.B. Sizing up an oyster adversary: The Asian oyster parasite *Bonamia*. Virginia Marine Resource Bulletin Vol. 39 No. 3, Fall/Winter 2007
- 2007** Bureson, E.M., C. Audemard, R.B. Carnegie, C.F. Dungan, S.E. Ford, and K.T. Paynter. Report to the US EPA Chesapeake Bay Program on oyster disease issues for

revision of the Chesapeake Bay Oyster Management Plan. Virginia Institute of Marine Science, Gloucester Point

- 2007** Hare, M., C. Rose, D. Meritt, S. Allen, A. Frank-Lawale, J. Cordes, J. Carlsson, R. Carnegie, and J. Wesson. "Revisiting genetic considerations for hatchery-based restoration of oyster reefs", a report to the US EPA Chesapeake Bay Program on oyster disease issues for revision of the Chesapeake Bay Oyster Management Plan. University of Maryland, College Park
- 2006** Carnegie, R.B., and E.M. Burreson. Status of the major oyster diseases in Virginia, 2005-- a summary of the annual oyster disease monitoring program. Virginia Institute of Marine Science, Gloucester Point
- 2005** Carnegie, R.B., and E.M. Burreson. Status of the major oyster diseases in Virginia, 2004-- a summary of the annual oyster disease monitoring program. Virginia Institute of Marine Science, Gloucester Point
- 2003** Carnegie, R.B., E.M. Burreson, and L.R. Calvo. 2004. Status of the major oyster diseases in Virginia, 2003-- a summary of the annual oyster disease monitoring program. Virginia Institute of Marine Science, Gloucester Point

Scholarly activity: Manuscript reviews and editorial:

Manuscript reviews for *Aquaculture*, *Ecology*, *Marine Ecology Progress Series*, *Microbial Ecology*, *International Journal for Parasitology*, *Parasitology*, *Diseases of Aquatic Organisms*, *Journal of Invertebrate Pathology*, *Estuarine, Coastal and Shelf Science*, *Fish and Shellfish Immunology*, *PLOS One*, and others (**171 manuscript reviews** since 2000)

- 2015** Guest editor, *Philosophical Transactions B* special, "Marine Diseases"
- 2014** Co-editor, *Diseases of Aquatic Organisms* special, "Microcell Parasites of Molluscs"

Grant proposal/report reviews:

Proposal reviews for the US National Science Foundation; Texas, Rhode Island, Louisiana, Washington, California, New York, Hawaii Sea Grant; USDA NIFA; L'Agence Nationale de la Recherche, France; US Fish and Wildlife Service; Fisheries and Oceans Canada; US Environmental Protection Agency; and others (**38 proposal reviews** since 2004)

PROFESSIONAL SERVICE

College-wide committee service

- 2015-** Chair, William & Mary Institutional Biosafety Committee
- 2014-2015** William & Mary Institutional Biosafety Committee

SMS/VIMS Governance

2015-	Search Committee for faculty position in Marine Physiological Ecology
2010-	Member, Library Advisory Committee
2007-	Chair, VIMS Best Student Paper Committee
2015	Designated Coach, VIMS Three Minute Thesis® competition
2014	Designated Coach, VIMS Three Minute Thesis® competition
2013-2014	Search Committee for faculty positions in Global Change Marine Biology
2005-2006	VIMS Best Student Paper Award Committee

Editorial Board Services, review panels, program reviews, national or international research programs

2015-	Associate Editor, <i>Aquatic Living Resources</i>
2012-	Member, NSF Research Coordination Network “Evaluating the impacts of a changing ocean on management and ecology of infectious marine disease (D. Harvell, Cornell University, P.I.)
2013	New Jersey Sea Grant proposal review panel
2011	EPA STAR Program, Aquatic Ecology panel member
2009-2010	Editorial Board, Journal of Shellfish Research
2005	Organizer, Third Meeting of the Microcell Working Group, Virginia Institute of Marine Science, Gloucester Point, Virginia

Service to professional societies

Memberships:

American Association for the Advancement of Science
American Society of Parasitologists
National Shellfisheries Association
East Coast Shellfish Growers Association

Positions held:

2007-2010	Member at Large, National Shellfisheries Association
2005-2009	Co-Chair, Endowment / Student Awards, National Shellfisheries Association
1998-1999	Representative, Student Recruits, National Shellfisheries Association

ADVISORY SERVICE ACTIVITY

Advisory service relative to VIMS state mandates: Service to state agencies

2003-	Principal advisor to the Virginia Marine Resources Commission on health management for the oyster fishery and aquaculture industries
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2003- Coordinator of the annual VIMS Oyster Disease Monitoring Program

Advisory service relative to VIMS state mandates: Service to industry

2013- Member, VIMS ABC Industry Advisory Council
2003- Health evaluations of submitted shellfish samples (**369 total, 86 in 2015**)
2014 Organizer and co-host (with D. Bushek, Rutgers), East Coast Molluscan Aquaculture Health Management Workshop, Virginia Institute of Marine Science (25 attendees)
2014 Presentation “Pathology in spring mortality samples, 2012-2014”, Triploid Oyster Mortality Forum, VIMS Eastern Shore Laboratory, Wachapreague
2006-2011 Presentations on the status of major shellfish diseases in Virginia, annual Shellfish Aquaculture Forum, VIMS Eastern Shore Laboratory, Wachapreague
2004 Presentation on the emergence of *Bonamia* in *Crassostrea ariakensis*, Virginia Seafood Council annual meeting
2004 Presentation on the status of major shellfish diseases in Virginia, Shellfish Aquaculture Forum, VIMS Eastern Shore Laboratory, Wachapreague
2004 Organizer, session on oyster diseases, Master Oyster Gardner/Teacher Oyster Institute, Virginia Institute of Marine Science

Advisory Service: Regional, national or international management commissions or programs

2013- Member, ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO)
2011- Coordinator of the World Organisation for Animal Health (OIE, Paris, France) Reference Laboratory for Perkinsosis and Haplosporidiosis
2010- Advisor to USDA APHIS Veterinary Services on molluscan diseases
2015 Participant in a Capitol Hill briefing on marine diseases
2015 Organizer and co-host (with D. Bushek, Rutgers), East Coast Molluscan Health Workshop, Portland, Maine (50 attendees)
2015 Invited participant, joint Maryland Department of Marine Resources-Virginia Marine Resources Commission-Potomac River Fisheries Commission meeting, Colonial Beach, Virginia
2014 Organizer and co-host (with D. Bushek, Rutgers, and Lori Gustafson and Lynn Creekmore, USDA APHIS Veterinary Services), East Coast Regional Molluscan Health Management Workshop, VIMS (25 attendees)
2014 Participant, ICES Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) annual meeting, Copenhagen
2014 Invited participant, 3rd Global Conference of OIE Reference Centres, Incheon, Korea
2013 Invited participant, workshop “Developing a coordinated response plan to MSX”, Charlottetown, Prince Edward Island, Canada

- 2012** Invited participant, workshop “Building a future for the oyster industry in Cape Breton”, Wagmatcook, Nova Scotia, Canada
- 2012** Invited presentation “New perspectives on oyster disease ecology in Chesapeake Bay, and relevance to oyster restoration”, Chesapeake Bay Program Sustainable Fisheries Goal Implementation Team Meeting, Annapolis, Maryland
- 2012** Webinar on molecular detection of *Bonamia* parasites, USDA APHIS Veterinary Services
- 2011** Invited presentation, “Disease resistance in *Crassostrea virginica*”, Chesapeake Bay Scientific and Technical Advisory Committee, Annapolis, Maryland
- 2011** Invited participant, Annual Meeting and Technical Workshop of the National (European) Reference Laboratories for Mollusc Diseases, La Tremblade, France
- 2010** Participated in the 2nd Global Conference of OIE Reference Laboratories and Collaborating Centres, Paris, France
- 2010** Invited participant, Segundo Simposio Internacional de Sanidad e Inocuidad Acuicola, Ensenada, Mexico
- 2009** Invited presentation “Disease risks in, and arising from, bivalve shellfish aquaculture: magnitude and mitigation”, National Academies’ Ocean Studies Board *Committee on Best Practices for Shellfish Mariculture and the Effects of Commercial Activities in Drake’s Estero, Pt. Reyes National Seashore, California*, Irvine, California
- 2009** Co-organizer and participant, “First International Workshop of Office International des Epizooties-listed Molluscan Diseases in Argentina”, Río Negro, Argentina
- 2008** Participant, Third Meeting of the Office International des Epizooties Inter-American Aquatic Animal Health Committee, Mazatlán, Mexico
- 2007** Member, steering committee for a bi-state workshop (La Plata, Maryland) on revising the US EPA Chesapeake Bay Program Oyster Management Plan
- 2005** Invited presentation, presentation, Agriculture Canada workshop on *Bonamia* parasites, Abbotsford, British Columbia

Public outreach (K – 12, private organizations, citizenry)

- 2016** Public lecture, “Rethinking shellfish pathology”, VIMS Eastern Shore Laboratory, Wachapreague
- 2015** Lecture on oyster diseases, Peninsula Catholic High School
- 2015** VIMS Marine Science Day, laboratory exhibit on shellfish health
- 2015** Lecture on oyster diseases, Tidewater Oyster Gardeners Association Master Oyster Gardener class
- 2015** Lecture on oyster diseases to the VIMS ABC Oyster Aquaculture trainees
- 2014** Lecture on oyster diseases to the VIMS ABC Oyster Aquaculture trainees
- 2014** Public lecture, “Coming to terms with MSX and dermo: the US experience with oyster diseases, and the bright future for oysters in eastern North America”, Summerside, Prince Edward Island, Canada
- 2014** Public lecture, “MSX and dermo diseases and the eastern oyster: a new perspective”, VIMS Eastern Shore Laboratory, Wachapreague
- 2013** Public lecture on pearls in oysters, VIMS Marine Science Day

2013	Public lecture on oyster diseases, York Ruritan Club, Newport News, Virginia
2013	Lecture on oyster diseases to the VIMS ABC Oyster Aquaculture trainees
2013	Webinar for the Northern Middle School (Kentucky) Career Day
2012	Public lecture, "Natural selection in Chesapeake Bay oysters: New insights into disease resistance, and application to oyster restoration", VIMS After Hours Lecture Series
2012	Public lecture, "Evolutionary ecology of oyster disease in Chesapeake Bay", Tidewater Oyster Gardeners Association meeting, Kilmarnock, Virginia
2012	Public lecture, "Disease resistance in <i>Crassostrea virginica</i> ", Tidewater Oyster Gardeners Association meeting, Saluda, Virginia
2011	Presentations on oyster biology to 5 th grade students at Petsworth Elementary School, Gloucester, Virginia
2009	Public lecture, "Oyster Restoration in Chesapeake Bay", Norfolk Cosmopolitan Club, Norfolk, Virginia
2009	Lecture on oyster diseases, Tidewater Oyster Gardeners Association Master Oyster Gardeners class, Virginia Institute of Marine Science
2008	VIMS Marine Science Day, laboratory exhibit on oyster diseases
2007	VIMS Marine Science Day, laboratory exhibit on oyster diseases
2006	Presentations on oyster diseases, Master Oyster Gardener/Teacher Oyster Institute, Virginia Institute of Marine Science
2005	VIMS Marine Science Day, laboratory exhibit on oyster diseases
2005	Lecture on oyster diseases, Tidewater Oyster Gardeners Association Master Oyster Gardener class
2004	Public lecture, "Out of the blue? The inevitable emergence of new oyster diseases and our understanding of <i>Bonamia</i> from previous outbreaks around the world", VIMS Eastern Shore Laboratory, Wachapreague
2004	VIMS Marine Science Day, laboratory exhibit on oyster diseases
2003-2004	Volunteer at Blue Crab Bowl competition