

CHARLES RAYMOND FISHER

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Education:

B.S.--1976--Biology, Michigan State University.
M.A.--1981--Biological Sciences, University of California, Santa Barbara.
Ph.D.-1985--Biological Sciences, University of California, Santa Barbara.

Current Research Interests:

Carbon/energy flux in autotrophic symbiotic associations and communities.
Ecology of hydrothermal vent, cold seep, and deep-sea coral communities.
Physiological ecology of chemoautotrophic symbioses.
Physiology of vent fauna and of chemoautotrophic symbionts.
Biogeography and biodiversity of seep fauna

Teaching Experience:

Symbiosis - Spring 1991, 1995, 1997, 1999, 2001, Fall 1992
Biology of Invertebrates - Spring 1992, 1993, Fall 1994 - 1999
Physiological Ecology - Spring 1994, 1996, 1998, 2000
Critical Evaluation of Biological Literature - Spring 1993, Fall 1993-1996
Research and current literature colloquium - Every semester since Fall 1993
Biology and Ecophysiology of deep-sea hot vents and cold seeps. Univ. of Vienna. Fall 2000

Professional Experience:

Chair, NSF RIDGE 2000 Steering Committee and Program office 10/01 - present
Professor, Penn State Univ. 7/99 - present.
Assistant Dept. Head for Graduate Education, Dept. of Biology, PSU. 6/98 – present
Associate Professor, Department of Biology, Pennsylvania State University, 7/95—7/99
Assistant Professor, Department of Biology, Pennsylvania State University, 8/90--7/95
Assistant Research Biologist, Univ. of Calif., Santa Barbara, 1/87--7/90.
Postdoctoral Research Biologist, Univ. of Calif., Santa Barbara, 3/84-12/86
Research Assistant, Univ. of Calif., Santa Barbara, 1/82-1/84
Teaching Assistant, Univ. of Calif., Santa Barbara, 8/79 – 12/81

Awards:

Presidential Young Investigator Award (National Science Foundation) 1991
Collaborative Instructional and Curricular Innovation Award (Pennsylvania State Univ.) 1996
Faculty Associates Award (Office of Student Affairs, Pennsylvania State Univ.) 1997
“The Years Best”, One of the top 100 discoveries in science and technology (Popular Science Magazine) 1997
C.I. Noll Award for Excellence in Teaching (College of Science Student Council and Alumni Society, Penn. State Univ.) 2001
Faculty Scholars Medal (Pennsylvania State University) 2004

Service to the University:

Assistant Department Head for Graduate Affairs 1998 - present
 Biology Graduate Affairs Committee 1990 – 1992, Chair 1998 – present
 Advisory/Long Term Planning Committee for Biology 1991-1993, 1996 – present
 Marine Science Minor Committee 1992 – present
 Chair Biology TA Allocation Committee 1998 – present
 Senate Committee on Research (SCOR) 2001 – present
 University Faculty Senate 2001 – present
 Member HUB Aquarium Advisory Committee (for class gift of 1999) 1999 – present
 Biology Promotion and Tenure Committee 1996 – 1999, Chair 2003 - present
 Faculty Search Committees 1992, 1993, 1994, 1995, 1998, 1999, 2000, 2001, 2002
 Admissions Committee of Intercollege Graduate Program in Ecology 1998 – 2001
 Biology Candidacy Committee 1993-1994, chair 1994-1997, Ad Hoc 1998-1999
 C. I. Noll Award Selection Committee 1998
 Judge Graduate Research Exhibition 1991-1994
 Chair, Seminar Committee for Intercollege Graduate Program in Ecology 1992-1993
 Student Awards Committee 1991- 1992

Service to the Scientific Community (in addition to manuscript and grant proposal review, grant review panels, and organization of workshops, meetings, and scientific sessions):

Editorial Board, Symbiosis, 1995 - present
 Chair NSF Ridge 2000 Program Steering Committee and office 2001 – present
 InterRidge Steering Committee 2001 – present
 UNOLS Committee on Shallow (<1,500m) submersible science 2001 – present
 NSF New Alvin Design and Review Committee 2002 – present
 Scientific Steering Committee for the Census of Marine Life ChEss program 2002-present
 Management Committee for the Endeavour hydrothermal Vents Marine Protected Area (MPA), Canada 2003 – present
 National Advisory Board for NSF Centers for Ocean Science Education Excellence 2004 - present
 RIDGE Steering Committee 1995 – 1997; 1999 – 2001
 NSF Ocean Observatories Initiative Steering Committee 2000 – 2002
 InterRidge Ad Hoc Committee on Biology 1994 - 2000
 NSF DEOS (Dynamics of Earth and Ocean Systems) Program Committee 1996 – 2000

Oceanographic Cruises:

Participant on 50 oceanographic cruises over the past 22 years (RV Atlantis, RV Atlantis II, RV E.B. Scripps, RV Edwin Link, RV Gordan Sproul, RV Gyre, CSS John P. Tulley, RV Melville, Nadir, RV New Horizon, RV Point Sur, RV Seward Johnson I and II, RV Seaward Explorer, RV Thomas Thompson, RV Transquest, RV Velero IV, and RV Vickers) and Chief scientist on 22 cruises.. Sixteen of these cruises were major international expeditions to hydrothermal vent sites ("Oasis Expedition" in 1982 to 21°N on the East Pacific Rise, "Galapagos '85" to the Galapagos Rift, "Project Hydronaut" to 13°N on the East Pacific Rise in 1987, "Galapagos '88" to the Galapagos Rift, HERO I expedition to 13° on the East Pacific Rise in 1991, HERO II to the same site in 1992, Bio ROPOS I and II to the Juan de Fuca Ridge in 1994 and 1995, HERO III to 9 and 13°N on the EPR in 1994, Hot Rocks III and IV and V to 9°N on the EPR in 1995, 1998, and 1999, HOT '96 to 9 and 13°N on the EPR in 1996, REVEL / ROPOS to the Juan de Fuca Ridge in 1996, Ediface Rex to the Juan de Fuca Ridge in 1997, and REVEL/Alvin to the Juan de Fuca Ridge in 1998 and 1999), and 21 others were also supported by a submersible. 113 dives on research submersibles and 54 days work with remote vehicles (Submersibles Alvin, Johnson Sea-Link I & II, Nautil, Pisces II, and Turtle, and ROVs ROPOS and Jason).

Publications:

- 1) Fisher, C.R. and R. K. Trench. 1980. In vitro carbon fixation by Prochloron sp. isolated from Diplosoma virens. Biol. Bull., 159: 639-648.
- 2) Trench, R. K. and C. R. Fisher. 1983. Carbon dioxide fixation in Symbiodinium microadriaticum: Problems with mechanisms and pathways. Pp. 659-673 in Endocytobiology, Vol. II, H. A. E. Schenk and W. Schwemmler, eds. Walter deGruyter & Co., Berlin · New York.
- 3) Arp, A. J., J. J. Childress, and C. R. Fisher. 1984. Metabolic and blood gas transport characteristics of the hydrothermal vent bivalve Calyptogena magnifica. Physiol. Zool., 57: 648-662.
- 4) Childress, J. J., A. J. Arp, and C. R. Fisher. 1984. Metabolic and blood characteristics of the hydrothermal vent tube-worm Riftia pachyptila. Mar. Biol., 83: 109-124.
- 5) Fisher, C. R. and J. J. Childress. 1984. Substrate oxidation by trophosome tissue from Riftia pachyptila Jones (Phylum Pogonophora). Mar. Biol. Lett., 5: 171-183.
- 6) Fitt, W. K., C. R. Fisher, and R. K. Trench. 1984. Larval biology of tridacnid clams. Aquaculture, 39: 181-195.
- 7) Arp, A. J., J. J. Childress, and C. R. Fisher. 1985. Blood gas transport in Riftia pachyptila. In The Hydrothermal Vents of the Eastern Pacific: An Overview. M. L. Jones, ed., Bull. Biol. Soc. Wash., 6: 289-300.
- 8) Fisher, C. R., 1985. Aspects of the Symbiosis Between some Marine Microbes and their Invertebrate Hosts. Ph.D. Dissertation. University of California at Santa Barbara. 84 pp.
- 9) Fisher, C. R., W. K. Fitt, and R. K. Trench. 1985. Photosynthesis and respiration in Tridacna gigas as a function of irradiance and size. Biol. Bull., 169: 230-245.
- 10) Childress, J. J., C. R. Fisher, J. M. Brooks, M. C. Kennicutt II, R. Bidigare, and A. E. Anderson. 1986. A methanotrophic marine molluscan symbiosis: Mussels fueled by gas. Science, 233: 1306-1308.
- 11) Fitt, W. K., C. R. Fisher, and R. K. Trench. 1986. Contribution of the symbiotic dinoflagellate Symbiodinium microadriaticum to the nutrition, growth, and survival of larval and juvenile tridacnid clams. Aquaculture, 55: 5-22.
- 12) Fisher, C. R. and J. J. Childress. 1986. Translocation of fixed carbon from the symbiotic bacteria to host tissues in the gutless bivalve, Solemya reidi. Mar. Biol., 93: 59-68.
- 13) Brooks, J. M., M. C. Kennicutt II, R. R. Bidigare, T. L. Wade, E. N. Powell G. J. Denoux, R. R. Fay, J. J. Childress, C. R. Fisher, I. Rossman and G. Boland. 1987. Hydrates, oil seepage, and chemosynthetic ecosystems on the Gulf of Mexico Slope: An update. Eos Trans. AGU, 68: 498-499.
- 14) Brooks, J. M., M. C. Kennicutt, C. R. Fisher, S. K. Mako, K. Cole, J. J. Childress, R. R. Bidigare and R. Vetter. 1987. Deep-Sea hydrocarbon seep communities; Evidence of energy and nutritional carbon sources. Science, 238: 1138-1142.
- 15) Fisher, C. R., J. J. Childress, R. S. Oremland and R. R. Bidigare. 1987. The importance of methane and thiosulfate in the metabolism of the symbionts of two deep-sea mussels. Mar. Biol., 96:59-71.
- 16) Cary, S. C., C. R. Fisher, and H. Felbeck. 1988. Mussel growth supported by methane as sole carbon and energy source. Science, 240: 78-80.
- 17) Childress, J. J. and C. R. Fisher. 1988. Energy and carbon sources for endosymbioses between bacteria and marine invertebrates. NOAA Symp. Series for Undersea Research, 6 (2).
- 18) Fisher, C. R., J. J. Childress, A. J. Arp, J. M. Brooks, D. Distil, J. A. Favuzzi, H. Felbeck, R. Hessler, K.S. Johnson, M.C. Kennicutt II, S. A. Macko, A. Newton, M. A. Powell, G. N. Somero, and T. Soto. 1988. Microhabitat variation in the hydrothermal-vent mussel, Bathymodiolus thermophilus at the Rose Garden vent on the Galapagos Rift. Deep-Sea Research, 35: 1769-1792.
- 19) Fisher, C. R., J. J. Childress, A. J. Arp, J. M. Brooks, D. Distil, J. A. Dugan, H. Felbeck, L. Fritz, R. Hessler, K.S. Johnson, M.C. Kennicutt II, R. Lutz, S. A. Macko, A. Newton, M. A. Powell, G. N. Somero, and T. Soto. 1988. Variation in the hydrothermal-vent clam, Calyptogena magnifica at the Rose Garden vent on the Galapagos spreading center. Deep-Sea Research, 35: 1745-1758.

- 20) Fisher, C. R., J. J. Childress, A. J. Arp, J. M. Brooks, D. Distil, J. A. Favuzzi, S. A. Macko, A. Newton, M. A. Powell, G. N. Somero, and T. Soto. 1988. Physiology, morphology, and composition of Riftia pachyptila at Rose Garden in 1985. Deep-Sea Research, 35: 1811-1832.
- 21) Fisher, C. R., J. J. Childress and N. K. Sanders. 1988. The role of vestimentiferan hemoglobin in providing an environment suitable for chemoautotrophic sulfide oxidizing endosymbionts. Symbiosis, 5: 229-246.
- 22) Fisher, C.R., J.J. Childress and E. Minnich. 1989. Autotrophic carbon assimilation by the chemoautotrophic symbionts of Riftia pachyptila. Bio. Bull. , 177: 372-385.
- 23) Page, H. M., C. R. Fisher, and J. J. Childress., 1989. Filter-feeding and the nutritional biology of a deep-sea mussel with methanotrophic symbionts. Mar. Biol. 104: 251-257.
- 24) Fiala-Medioni, A., H. Felbeck, J. J. Childress, C. R. Fisher, and R. Vetter. Lysosomal resorption of bacterial symbionts in deep-sea bivalves. Endocytobiology IV. 4th International Colloquium on Endocytobiology and Symbiosis. INSA. Villeurbanne (France), July 4-8, 1989. Eds. P Nardon et al., 334-338.
- 25) Fisher, C. R., M. C. Kennicutt II, and J. M. Brooks. 1990. Stable carbon isotopic evidence for carbon limitation in hydrothermal vent vestimentiferans. Science. 247: 1094-1096.
- 26) Fisher, C. R. 1990. Chemoautotrophic and methanotrophic symbioses in marine invertebrates. Reviews in Aquatic Science. 2: 399-436.
- 27) Brooks, J. M., D. A. Wiesenburg, H. Roberts, R. S. Carney, I. R. MacDonald, C. R. Fisher, N. L. Guinasso, W. W. Sager, S. J. McDonald, R. A. Burke, P. Aharon, and T. J. Bright. 1990. Salt, seeps and symbiosis in the Gulf of Mexico. EOS. 71: 1772-1773.
- 28) Childress, J. J., C. R. Fisher, J. A. Favuzzi, R. Kochevar, N. K. Sanders, and A. M. Alayse. 1991. Sulfide-driven autotrophic balance in the bacterial symbiont-containing hydrothermal vent tubeworm, Riftia pachyptila Jones. Biol. Bull. 180: 135-153.
- 29) Childress, J. J., C. R. Fisher, J. A. Favuzzi, and N. K. Sanders. 1991. Sulfide and carbon dioxide uptake by the hydrothermal vent clam, Calyptogena magnifica and its chemoautotrophic symbionts. Phys. Zoo. 64: 1444-1470.
- 30) Page, H. M., A. Fiala-Medioni, C. R. Fisher, and J. J. Childress. 1991. Experimental evidence for filter-feeding by the hydrothermal vent mussel, Bathymodiolus thermophilus. Deep Sea Res. 38: 1455-1461.
- 31) Kochevar, R. E., J. J. Childress, C. R. Fisher, and E. Minnich. 1992. The methane mussel: Roles of symbiont and host in the metabolic utilization of methane. Marine Biology. 112: 389-401.
- 32) Childress, J. J. and C. R. Fisher. 1992. The biology of hydrothermal vent animals: Physiology, biochemistry and autotrophic symbioses. Oceanogr. Mar. Biol. Annu. Rev. 30: 337-441.
- 33) Lee, R. W., E. V. Thuesen, J. J. Childress, and C. R. Fisher. 1992. Ammonium and free amino acid uptake by a deep-sea mussel containing methanotrophic bacterial symbionts. Marine Biology. 113: 99-106.
- 34) Fisher, C. R. and J. J. Childress. 1992. Organic carbon transfer from methanotrophic symbionts to the host hydrocarbon-seep mussel. Symbiosis. 12: 221-235.
- 35) Fisher, C. R. 1993. Oxidation of methane by deep sea mytilids in the Gulf of Mexico. In: Biogeochemistry of Global Change: Radiatively Active Trace Gases. R. S. Oremland ed., Chapman and Hall Inc., New York. 606-618.
- 36) Childress, J. J., C. R. Fisher, J. A. Favuzzi, A. J. Arp, and D. R. Oros. 1993. The role of a zinc-based, serum-borne sulfide-binding component in the uptake and transport of dissolved sulfide by the chemoautotrophic symbiont-containing clam Calyptogena elongata. J. Exp. Biol. 179: 131-158.
- 37) Fisher, C. R., J. M. Brooks, J. Vodenichar, J. Zande, J. J. Childress, and R. A. Burke Jr. 1993. The co-occurrence of methanotrophic and chemoautotrophic sulfur-oxidizing bacterial symbionts in a deep-sea mussel. Mar. Ecol. 14: 277 - 289.
- 38) Fisher, C. R., J. J. Childress, S. A. Macko, and J. M. Brooks. 1994. Nutritional interactions at Galapagos hydrothermal vents: Inferences from stable carbon and nitrogen isotopes. Mar. Ecol. Prog. Ser. 103: 45-55.

- 39) Scott, K. M., C. R. Fisher, J. S. Vodenichar, E. Nix and E. Minnich. 1994. Effects of inorganic carbon concentrations, pH, and temperature on autotrophic carbon fixation by the chemoautotrophic symbionts of *Riftia pachyptila*. Phys. Zool. 67: 617-638.
- 40) Scott, K. M., and C. R. Fisher. 1995. Physiological ecology of sulfide metabolism in hydrothermal vent and cold seep vesicomyid clams and vestimentiferan tube worms. Am. Zool. 35: 102-111.
- 41) Nelson, D. C., and C. R. Fisher. 1995. Chemoautotrophic and methanotrophic endosymbiotic bacteria at vents and seeps. In; *Microbiology of Deep-Sea Hydrothermal Vent Habitats*. D. M. Karl ed., CRC Press, Boca Raton. p. 125-167.
- 42) Nix, E., C. R. Fisher, K. M. Scott, and J. Vodenichar., 1995. Physiological ecology of a mussel with methanotrophic symbionts at three hydrocarbon seep sites in the Gulf of Mexico. Mar. Biol. 122: 605-617.
- 43) Fisher, C. R. 1995. Toward an appreciation of hydrothermal-vent animals: their environment, physiological ecology, and tissue stable isotope values. In; *Seafloor Hydrothermal Systems: Physical, Chemical, Biological, and Geochemical Interactions*, S. E. Humphris, R. A. Zierenberg, L. S. Mullineaux, and R. E. Thomson eds. *Geophysical Monographs Series 91*: 297-316.
- 44) Vacelet, J., N. Boury-Esnault, A. Fiala-Medioni, and C. R. Fisher. 1995. A methanotrophic carnivorous sponge. Nature. 377: 296.
- 45) Fisher, C. R. 1996. Ecophysiology of primary production at deep-sea vents and seeps. In: *Deep-sea and extreme shallow-water habitats: affinities and adaptations*. R. Uiblein, J. Ott, and M. Stachowtish (eds.) *Biosystematics and Ecology Series 11*: 311-334.
- 46) MacDonald, I. R. and C. R. Fisher. 1996. Life without light. Nat. Geo. Oct:313-323.
- 47) Vacelet, J., A. Fiala-Médioni, C. R. Fisher, and N. Boury-Esnault. 1996. Symbiosis between methane-oxidizing bacteria and a deep-sea carnivorous cladorhizid sponge. Mar. Ecol. Prog. Ser. 145: 77-85.
- 48) Fisher, C. R., I. Urcuyo, M. A. Simpkins, and E. Nix. 1997. Life in the slow lane: growth and longevity of cold-seep vestimentiferans. Mar. Ecol. 18: 83-94.
- 49) Streams, M. and C. R. Fisher. 1997. Incorporation of methane by methanotrophic symbionts and symbiont digestion by their host mussel. Mar. Biol. 129: 465-476.
- 50) Martineu, P., S. K. Juniper, C. R. Fisher, and G. J. Massoth. 1997. Sulfide-binding in the body fluids of hydrothermal vent alvinellid polychaetes. Phys. Zool. 70: 578-588.
- 51) Smith, E., Williams, F. M., and C. R. Fisher. 1997. Effects of intrapopulation variability on parameter estimates for the von Bertalanffy growth equation. Can. J. of Fish. Aqua. Sci. 54: 2025-2032.
- 52) Fisher, C. R. 1998. Temperature and sulfide tolerance of hydrothermal vent fauna. Cah. Biol. Mar. 39: 283-286.
- 53) Scott, K. M., M. Bright, and C. R. Fisher. 1998. The burden of independence: Inorganic carbon utilization strategies of the sulfur chemoautotrophic hydrothermal vent isolate *Thiomicrospira crunogena* and the symbionts of hydrothermal vent and cold seep vestimentiferans. Cah. Biol. Mar. 39: 379-382.
- 54) Urcuyo, I.A., G. Massoth, I.R. MacDonald and C.R. Fisher. 1998. In situ growth of the vestimentifera *Ridgeia piscesae* living in highly diffuse flow environments in the main Endeavour Segment of the Juan de Fuca Ridge. Cah. Biol. Mar. 39: 267-270.
- 55) Julian, D. F. Gaill, E. Wood, A. J. Arp, and C. R. Fisher. 1999. Roots as a site of hydrogen sulfide uptake in the hydrocarbon seep vestimentiferan *Lamellibrachia* sp. J. Exp. Biol. 202: 2245-2257.
- 56) Scott, K. M., M. Bright, S. A. Macko, and C. R. Fisher. 1999. Carbon dioxide use by chemoautotrophic endosymbionts of hydrothermal vent vestimentiferans: affinities for carbon dioxide, absence of carboxysomes, and $\delta^{13}\text{C}$ values. Mar. Biol. 135: 25-34.
- 57) Smith, E. B., K. M. Scott, E. R. Nix, C. Korte, and C. R. Fisher. 2000. Growth and condition of seep mussels (*Bathymodiolus childressi*) at a Gulf of Mexico Brine Pool. Ecology. 81; 2392-2403.
- 58) Pruski, A. M., A. Fiala-Médioni, C. R. Fisher, and J. C. Colomines. 2000. Free amino compound composition of symbiotic invertebrates from the Gulf of Mexico hydrocarbon seeps. Mar. Biol. 136: 411-420.

- 59) Bright, M., H. Keckeis, C. R. Fisher. 2000. An autoradiographic examination of carbon fixation, transfer and utilization in the *Riftia pachyptila* symbiosis. *Mar. Biol.* 136: 621-632.
- 60) Fisher, C. R., I. R. MacDonald, R. Sassen, C. M. Young, S. Macko, S. Hourdez, R. Carney, S. Joy, and E. McMullin. 2000. Methane ice worms: *Hesiocaeca methanicola* colonizing fossil fuel reserves. *Naturwissenschaften* 87 (4): 184-187.
- 61) Bergquist, D. C., F. M. Williams, and C. R. Fisher. 2000. Longevity record for deep-sea invertebrate. *Nature* 403: 499-500.
- 62) Mullineaux, L. S., C. R. Fisher, C. H. Peterson, and S. Schaeffer. 2000. Tubeworm succession at hydrothermal vents: possible use of biogenic cues to reduce habitat selection error. *Oecologia*. 123: 275-284.
- 63) Nelson, K. and C. R. Fisher. 2000. Speciation of the bacterial symbionts of deep-sea vestimentiferan tube worms. *Symbiosis* 28: 1-15.
- 64) Johnson, H. P., M. Hutnak, R. P. Dziak, C. G. Fox, I. Urcuyo, J. P. Cowen, J. Nabelek, and C. R. Fisher. 2000. Earthquake-induced changes in a hydrothermal system at the Endeavour Segment: Juan de Fuca Ridge. *Nature* 407; 174-177.
- 65) McMullin, E., D. C. Bergquist, and C. R. Fisher. 2000. Metazoans in extreme environments: adaptations of hydrothermal vent and hydrocarbon seep fauna. *Grav. Space Biol. Bull.* 13; 13-24.
- 66) Hourdez, S., J. Lamontagne, P. Peterson, R. E. Weber, and C. R. Fisher. 2000. Hemoglobin from a deep-sea hydrothermal vent copepod. *Biol. Bull.* 199: 95 –99.
- 67) Chevaldonné, P., C. R. Fisher, J. J. Childress, D. Desbruyères, D. Jollivet, F. Zal, and A. Toulmond. 2000. Thermotolerance and the “Pompeii worms”. *Mar. Ecol. Prog. Ser.* 208; 293 – 295.
- 68) Hourdez, S., Frederick, L. A., Scherneck, A., and C. R. Fisher. 2001. Functional respiratory anatomy of a deep sea orbiid polychaete from the Brine Pool NR-1 in the Gulf of Mexico. *Invert. Biol.* 120: 29-40.
- 69) Johnson, H. P., R. P. Dziak, C. R. Fisher, C. G. Fox, and M. J. Pruis. 2001. Earthquakes’ impact on hydrothermal systems may be far-reaching. *EOS*. 82; 233-236.
- 70) Freytag, J. K., P. Girguis, D. C. Bergquist, J. P. Andras, J. J. Childress, and C. R. Fisher. 2001. Sulfide acquisition by roots of seep tubeworms sustains net chemoautotrophy. *Proc. Nat. Acad. Sci.* 98; 13408-13413.
- 71) Gardiner, S. L., E. McMullin, and C. R. Fisher. 2001. *Seepiophila jonesi*, a new genus and species of vestimentiferan tube worm (Annelida: Pogonophora) from hydrocarbon seep communities in the Gulf of Mexico. *Proc. Bio. Soc. Wash.* 114; 694-707.
- 72) MacAvoy, S. E., R. S. Carney, C. R. Fisher and S. A. Macko. 2002. Use of chemosynthetic biomass by large, mobile, benthic predators in the Gulf of Mexico. *Mar. Ecol. Prog. Ser.* 225: 65-78.
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- 74) Bergquist, D. C., I. A. Urcuyo, and C. R. Fisher. 2002. Establishment and persistence of seep vestimentiferan aggregations from the upper Louisiana slope of the Gulf of Mexico. *Mar. Ecol. Prog. Ser.* 241: 89-98.
- 75) Hourdez, S., R. E. Weber, B. N. Green, J. M. Kenney, and C. R. Fisher. 2002. Respiratory adaptations in a deep-sea Orbiid polychaete from Gulf of Mexico Brine Pool NR-1: Metabolic rates and hemoglobin structure-function. *J. Exp. Biol.* 205: 1669-1681.
- 76) Govenar, B., D. C. Bergquist, I. A. Urcuyo, J. T. Eckner and C. R. Fisher. 2002. Epifaunal assemblages from a Juan de Fuca Ridge sulfide edifice: Structurally different and functionally similar. *Cah. Biol. Mar.* 43: 247-252.
- 77) Carney, S. L., J. R. Peoples, C. R. Fisher, and S. W. Schaeffer. 2002. AFLP analyses of genomic DNA reveal no differentiation between two phenotypes of the vestimentiferan tubeworm, *Ridgeia piscesae*. *Cah. Biol. Mar.* 43: 363-366.
- 78) McMullin, E.R., S. Hourdez, S. W. Schaeffer, and C. R. Fisher. 2003. Phylogenetics and biogeography of deep sea vestimentiferan tubeworms and their bacterial symbionts. *Symbiosis*. 34: 1-41.

- 79) Bergquist, D. C., T. Ward, E. E. Cordes, T. McNelis, R. Kosoff, S. Hourdez, R. Carney, and C. R. Fisher. 2003. Community structure of vestimentiferan-generated habitat islands from upper Louisiana slope cold seeps. J. Exp. Mar. Bio. Ecol. 289: 197-222.
- 80) Cordes, E. E., D. C. Bergquist, K. Shea, and C. R. Fisher. 2003. High hydrogen sulfide demand of long-lived vestimentiferan tube worm aggregations modifies the chemical environment at deep-sea hydrocarbon seeps. Ecology Letters 6: 212-219.
- 81) Urcuyo, I. A., G. Massoth, D. Julian, and C. R. Fisher. 2003. Habitat, growth and physiological ecology of a basaltic community of *Ridgeia piscesae* from the Juan de Fuca Ridge. Deep Sea Res. 50: 763-780.
- 82) Bergquist, D.C., J. Andras T. McNelis, S. Howlett, M.J. van Horn and C.R. Fisher Succession in upper Louisiana slope cold seep vestimentiferan aggregations: the importance of spatial variability. In Press, Mar. Ecol.
- 83) Childress, J. J., C. R. Fisher, H. Felbeck, and P. Girguis. 2004. On the edge of a deep biosphere: Real animals in extreme environments. In: Subseafloor Biosphere at Mid-Ocean Ridges. W. Wilcock, C. Cary, E. Delong, D. Kelley, and J. Baross eds. Geophysical Monographs Series 111: 41-49.
- 84) Bergquist, D.C., C. Fleckenstein, E. Smith, C.R. Fisher. Environment drives physiological variability in the cold seep mussel *Bathymodiolus childressi*. In Press. Limn. Ocean.
- 85) Urcuyo, I. A., D. C. Bergquist, R. MacDonald, M. VanHorn, and C. R. Fisher. The impact of environment on the growth and condition of the tubeworm *Ridgeia piscesae* in diffuse vent flow habitats of the Juan de Fuca Ridge. In Press. Mar. Eco. Prog. Ser.
- 86) Dattagupta, S., D. C. Bergquist, E. B. Smith, S. A. Macko, and C. R. Fisher. Tissue carbon, nitrogen and sulfur stable isotope turnover in transplanted hydrocarbon seep mussels: relation to growth and physiological condition. Accepted for publication, Limn. Ocean.
- 87) Kicklighter, C. E., C.R. Fisher, and M.E. Hay Chemical defense of hydrothermal vent and methane seep organisms: a preliminary assessment using shallow-water consumers. Accepted for publication, Limn. Ocean

Publications (submitted and in final preparation/internal review):

- Bergquist, D. C., Eckner, J. T., I. A. Urcuyo, S. Hourdez, S. Macko, and C. R. Fisher. A vestimentiferan tubeworm aggregation: associated fauna and trophic interactions. In prep for Limn. Ocean.
- Bergquist, D.C., C. Fleckenstein, J. Knisel, B. Begley, C.R. Fisher. Community structure of methanotrophic mussel beds at upper Louisiana slope cold seeps. In prep for Mar. Ecol. Prog. Ser.
- Govenar, B., M. Freeman, D. Bergquist, G. Johnson, and C. R. Fisher. Growth and composition of a one-year old aggregation of *Riftia pachyptila* from the East Pacific Rise. In Prep for Biol. Bull.
- MacAvoy, S. E., C R. Fisher, R. S. Carney, and S. A. Macko. Nutritional associations among fauna at hydrocarbon seep communities in the Gulf of Mexico. In prep for Mar. Ecol. Prog. Ser.
- Bright, M., A. Nussbaumer, and C. R. Fisher. Symbiont transmission in the hydrothermal vent tubeworms: Similar strategies in symbiotic and pathogen infections? In Prep for Science

Invited Talks and Seminars:

- Autotrophic bacterial symbionts in marine invertebrates. Univ. of Mich., Dept. of Biol., 2/17/87.
- A methanotrophic symbiosis in a mussel living near hydrocarbon seeps. Div. of Geochem., 193rd ACS National Meeting, Denver, 4/7/87.
- Chemoautotrophic symbioses in marine invertebrates. Univ. of S. Cal., Dept. of Biol., 4/88.
- Riftia pachyptila*; An autotrophic symbiosis. Laboratoire Arago, Université P. M. Curie, Banyuls-Sur-Mer, France, 6/24/88.
- Sulfide and carbon metabolism in the Vestimentifera. 2nd international congress of comparative physiology and biochemistry. Baton Rouge, LA, 8/1/88.

- Chemoautotrophic symbioses in hydrothermal vent and hydrocarbon seep animals. Louisiana State Univ., Depts. of Zoology and Marine Biology, 10/25/88.
- Structure and function of "chemosynthetic invertebrates". Ninth annual information transfer meeting of Mineral Management Service's Gulf of Mexico OCS Region. New Orleans, LA, 10/26/88.
- Chemoautotrophic and methanotrophic symbioses with marine invertebrates. Harbor Branch Oceanographic Institution, Fort Pierce, FL, 3/4/89.
- Stable carbon isotopes in the study of chemoautotrophic symbioses: Uses and abuses. Moss Landing Marine Station, Moss Landing, CA, 3/9/89.
- Chemoautotrophic and methanotrophic metazoans. Harvard Univ., Dept. of Organismic and Evolutionary Biology, 4/10/89.
- Vestimentiferans: Three approaches to the study of an elusive group. Univ. of N. Carolina, Chapel Hill, Biology Dept., 2/21/90.
- Ecological physiology of some chemoautotrophic symbioses. Florida State Univ., Ocean. Dept., 2/26/90.
- Ecological physiology of some chemoautotrophic symbioses. Arizona State Univ., Biology Dept., 3/1/90.
- Mussels fueled by gas: Recent findings and future directions. Office of Naval Research workshop on Marine Symbiosis. Maui, HI, 11/16/90.
- Physiology and ecology of methanotrophic symbioses. Univ. of Alabama, Biology Dept., 3/1/91.
- Autotrophy in the deep sea. Allegheny College, Biology Dept., 4/15/91.
- Oxidation of methane by deep-sea mussels with methanotrophic symbionts. 10th International Symposium on Environmental Biogeochemistry. San Francisco, CA, 8-21-91.
- Hydrothermal vent and cold seep communities. Penn State University, Geosciences Dept., 11/8/91.
- Primary production in the deep-sea. Bryn Mawr College, Biology Dept., 11/20/91.
- Symbiosis in the deep-sea. California State Collage of Pennsylvania., 12/10/91.
- Chemoautotrophy and hydrothermal-vent communities. Susquehanna University, Biology Dept., 2/26/92.
- Stable isotopes and chemoautotrophic symbioses. Pennsylvania State University, Geology Dept., 3/22/93.
- The eukaryotic connection: methanotrophy in marine mussels. 93rd. General meeting of the American Society for Microbiologists. Atlanta, GA 5/18/93.
- Microbial ecology of deep-sea chemoautotrophic metazoan communities. University of Georgia, co-sponsored by Zoology, Microbiology, Marine Biology, Histology, and Ecology Depts. 5/21/93.
- Physiological ecology and responses to changes in fluid flow by hydrothermal vent macrofauna. Third RIDGE Theoretical Institute. Big Sky, MT. 9/1/93.
- Physiology and nutritional relations in hydrothermal vent fauna: Inferences from stable carbon and nitrogen isotopes. University of Paris, 11/15/93.
- Stable isotopes and the study of hydrothermal vent fauna and communities. IDGP in Ecology, Pennsylvania State University, 11/18/93.
- In situ growth rates of mussels and tubeworms around hydrocarbon seeps. 14th annual information transfer meeting of Mineral Management Service's Gulf of Mexico OCS Region. New Orleans, LA, 12/15/93.
- Sulfide metabolism of hydrothermal-vent and cold-seep species of vestimentiferan tubeworms and vesicomyid clams. Annual meeting of the American Society of Zoologists. Los Angeles, CA, 12/27/93.
- Stable isotope studies of food webs at hydrocarbon seeps in the Gulf of Mexico. Université du Québec à Montréal, GEOTOP. 1/31/94.
- Stable isotopes and the physiological ecology of hydrothermal vent fauna. SCRIPPS Institution of Oceanography, UCSD. 2/24/94.
- Ecological physiology of hydrothermal vent and cold seep symbioses. University of Colorado, Dept. of Environmental, Population, and Organismic Biology. 9/13/94.
- The physiological ecology of chemoautotrophic symbioses. 4th International Congress of Comparative Physiology and Biochemistry. Birmingham, U. K. 8/10/95.

- Ecophysiology of symbiotic primary production in the deep-sea. Keynote address. Vienna Deep Sea Symposium. Vienna, Austria. 10/7/95.
- Alien life on Earth. Frontiers of Science Lecture Series, Penn. State Univ., College of Science. 3/16/96.
- High-productivity and long-life at cold seeps in the Gulf of Mexico. Bodega Bay Marine Lab, UCD. 3/28/96.
- Hydrothermal-vent and hydrocarbon-seep communities: Life in the deep sea. General Motors Research Division (AAAS Chapter), Detroit MI. 4/12/96.
- Alien Life Forms on Earth. 46th Annual Alumni Institute, Penn. State Univ., College of Science. 5/31/96.
- Hydrothermal vent and cold seep vestimentiferan tube worms: very similar symbiotic associations, very different physiological ecologies. Symbiosis '96. Bar Harbor, ME. 9/7/96.
- Studying the biology of deep-sea hydrothermal vent and cold seep communities. Annual Convention of the Pennsylvania Science Teachers Association. State College, PA. 12/5/96.
- Life without light. Pennsylvania Chapter of the American Association of Professional Engineers. Pittsburg, PA. 1/17/97.
- Chemoautotrophic symbioses: Adaptations to life at oxic-anoxic interfaces (with C. Cavanaugh) Second International Congress on Symbiosis. Woods Hole, MA. 4/16/97.
- Life without light. General Power and Utilities, AWESIM Kids program (with live Internet links). "Virtual" to Sommerset Park, NJ. 6/27/97.
- A stable isotope approach to ecological studies of vent and seep animals and communities. Three lectures to the EEC "MAST III" short course, "Communautés benthiques profondes à base chimiosynthétique". Paris, France. 9/18/97 - 9/19/97.
- Life without light: A research update. Eberly College of Science Alumni Board of Directors, Penn. State Univ. 10/4/97.
- Physiological ecology of hydrothermal vent and cold seep fauna. InterRidge First International Hydrothermal Vent Biology Symposium. Funchal, Madeira. 10/21/97.
- Physiology and ecology of chemoautotrophic symbiosis in the deep-sea. Shippensburg University. 11/6/97
- Extreme worms. Four lectures in the "Extreme Science" series at the Columbia Center of Marine Biotechnology Research and Education. One lecture each to graduate students, secondary school educators, general public, and inner-city middle-school students. Baltimore MD, 12/4 - 12/5/97.
- Sampling from extreme environments in the deep sea: Brine pools, hydrocarbon seeps and hydrothermal vents. Gordon Conference on Marine natural Products. Ventura CA 2/23/98.
- Deep sea cold seep and hydrothermal vent fauna: Similar symbioses with very different physiological ecologies. University of Maine. 4/24/98.
- Long life with deep roots in the Gulf of Mexico. Dauphin Island Sea Lab, Dauphin Island AL. 6/11/98.
- Physiological ecology of deep sea tubeworms from vents and seeps. Bucknell University, Department of Biology, 9/18/98
- Cutting edge discoveries in deep sea biology. 74th annual convention of the Pennsylvania Newspaper Publishers' Association, State College, PA 9/24/98.
- Lightless autotrophy: Deep roots and long life in the deep sea. The Pennsylvania State University, Department of Agronomy, 10/9/98
- Stable isotopes physiology, and ecology of cold seep communities. University of Virginia, Department of Environmental Science, 10/15/98
- Hydrothermal vent biology. The Pennsylvania State University, Department of Geology, 11/19/98.
- The next decade of RIDGE biological research. RIDGE Union Session, American Geophysical Union Annual Meeting, San Francisco, CA 12/8/98.
- Exploring temporal change in deep sea communities. DEOS Union Session, American Geophysical Union Annual Meeting, San Francisco, CA 12/9/98.
- Conducting research in the deep sea: Trials, tribulations, and fun. Keynote Address, 15th annual symposium of the Graduate Association of Biological Sciences (GABS), College

- Park, MD, 1/12/99.
- Hesiocaeca methanicola, a clathrate dwelling polychaete, American Society of Limnologists and Oceanographers, Santa Fe, NM 2/2/99
- Advances in hydrothermal vent biology of the Juan de Fuca Ridge. NSF RIDGE Juan de Fuca Results symposium. Seattle WA, 11/7/99
- Metazoan (real animal!) life styles in extreme environments of the deep sea: Brine pools, methane hydrates, hydrocarbon seeps, and hydrothermal vents. Special Symposium on Life in Extreme Environments, American Society for Gravitational and Space Biology annual meeting. Seattle, WA. 11/11/99
- Ecology of cold seep communities on the Louisiana Slope of the Gulf of Mexico. Mineral Management Service Information Transfer meeting, New Orleans, LA, 12/1/99
- On the edge of a deep biosphere: real animals in extreme environments. American Geophysical Union annual meeting, San Francisco, CA 12/16/99.
- Adaptations to life at hydrothermal vents and cold seeps. NASA Workshop: Life in Extreme Environments. Big Sky, MO, 3/7/00
- Biology of deep-sea hydrothermal-vent and cold-seep communities. Lock Haven University. Lock Haven, PA, 3/23/00
- Animal adaptations to life in extreme environments of the deep sea. Astrobiology Group at MBL, Woods Hole, MA, 4/14/00
- Biological studies at a RIDGE integrated studies site. NSF RIDGE Integrated Studies Workshop. De Kalb, IL, 5/18/00
- The cold seeps of the Gulf of Mexico. Station Biologique de Roscoff, Roscoff, France, 6/14/00.
- Extreme adaptations for life with sulfide. Society for Experimental Biology Joint International Meeting. Cambridge, England, 8/1/00
- Hydrothermal vent and cold seep fauna: similar animals with very different physiological ecologies. Univ. of Virginia. 9/12/00
- Stable isotopes and the biology of hydrothermal vents. Univ. of Vienna, Vienna, Austria. 10/12/00
- Hydrothermal vent and cold seep communities: Similar fauna with very different life styles. UCSB, Santa Barbara, CA. 11/6/00
- Long lives and Deep Roots: Tubeworms in Gulf of Mexico chemosynthetic communities. Mineral Management Service Information Transfer meeting, New Orleans, LA. 12/12/00
- Hydrothermal vent and cold seep communities: islands of autotrophy in the deep-sea.. International Conference on Ecology of Island Communities. Plenary public lecture. Wellington, New Zealand. 2/15/2001
- Chemosynthetic communities associated with gas hydrates in the Gulf of Mexico. Georgia Tech University, Atlanta, GA. 4/23/01
- Live hard and die young--or plant deep roots and live long: contrasting ecophysiological strategies of hydrothermal vent and cold seep tubeworms. Hopkins Marine Station. Carmel, CA. 5/11/2001
- The prospect of Ocean Exploration for research and discovery. Briefing for NOAA Ocean Exploration Initiative aboard the RV Seward Johnson in the Gulf of Mexico. 6/30/01
- Long lives and deep roots: Ecophysiology of cold seep vestimentiferans. International Conference of Comparative Physiology and Biochemistry: How Animals Work. Chobe National Park, Botswana. 8/22/01
- Long Lives and Deep Roots: Ecophysiology of cold seep vestimentiferans (unraveled with the help of submersibles, assorted toys, and persistence). Monterey Bay Aquarium Research institute (MBARI) 11/20/01
- From gas hydrates to tubeworms: microbial-macroalgal interactions. Univ. of Missouri. 2/2/02
- Using the Johnson-Sea-Links to Unravel the Biology of a Very Long Lived and Deeply Rooted Animal. American Society of Limnology and Oceanography, Ocean Sciences meeting. Honolulu, HI. 2/11/02
- The Ridge 2000 program and proposed Integrated Studies on the East Lau Basin Spreading Center. Annual meeting of the South Pacific Applied Geosciences Commission. Fiji. 9/22/02
- Extreme lifestyles in the deep sea. Penn State Altoona. 10/17/02
- Biology of cold seeps in the deep Gulf of Mexico. Georgia Tech., 4/15/03

- The necessity of a manned submersible for Ridge 2000 and deep sea biological research. National Academies' National Research Council New Alvin Review Committee public meeting. Woods Hole, MA 5/7/03
- Chemosynthetic Communities of the Gulf of Mexico. Oceanology International. New Orleans, LA 6/4/03
- Education, Outreach, and the Census of Marine Life ChEss Program. Joint R2k/ChEss workshop, Biogeography and Biodiversity of Chemosynthetic Ecosystems: Planning for the Future. Southampton, UK 6/18/03
- Biology of cold seeps in the deep Gulf of Mexico. JAMSTEK (Japan Marine Science and Technology Center), Yokosuka, Japan, 6/30/03
- Sulfide Acquisition by vestimentiferan tubeworms: From hydrothermal vents to cold seeps. Keynote address at the 4th international Symbiosis Society Congress, Halifax, Canada, 8/18/03.
- Plans for a Multi-Leg Ridge 2000 Expedition to the East Lau Spreading Center in 2004. Thirty-second Congress of the South Pacific Applied Geosciences Commission, Niue, 9/20/03
- The US Ridge 2000 Program. InterRidge Workshop "Opportunities and Contributions of Asian Countries to the InterRidge Next Decade Initiative" Beijing, China 10/27/03
- Biodiversity along mid-ocean ridges. InterRidge Workshop "Opportunities and Contributions of Asian Countries to the InterRidge Next Decade Initiative" Beijing, China 10/28/03
- Status of the US NSF Ridge 2000 program. Ridge 2000 Community Workshop. Boulder CO, 11/7/03
- Understanding the biology of very long-lived hydrocarbon seep tubeworms: Symbiosis, physiology, ecology, geomicrobiology and models. Duke Marine Laboratory Graduate Student Association. Beaufort, NC. 11/12/03