

CURRICULUM VITAE

MARTIN F. POLZ

Massachusetts Institute of Technology
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EDUCATION

Harvard University, Organismic and Evolutionary Biology	Ph. D.	1997
Harvard University, Organismic and Evolutionary Biology	A. M.	1995
University of Vienna, Zoology	Mag. rer. nat.	1991

THESIS WORK

Ph. D. thesis, Harvard University: "The Ecology of Epibiotic Associations in the Marine Environment"
Advisor: Prof. Colleen Cavanaugh

Mag. rer. nat. thesis, University of Vienna: "Characterization of Ectosymbiotic Bacteria on Marine, Free-Living Nematodes (Stilbonematinae)"
Advisor: Prof. Jörg Ott

PROFESSIONAL

Associate Professor, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology	July 2004-present
Assistant Professor, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology	January 1998-June 2004
Consultant, Ecosystems Center, Marine Biological Laboratory	July-December 1997
Postdoctoral Fellow, Harvard University	May-June 1997
Graduate Research Assistant, Harvard University	September 1991-May 1997

RESEARCH INTERESTS

Molecular Microbial Ecology with emphasis on structure function relationships in marine microbial communities.

Environmental genomics with emphasis on population structure and differentiation.
Ecology of symbionts and pathogens.

PUBLICATIONS

1) Papers in refereed Journals

- Ott, J.A., Novak, R., Schiemer, F., Hentschel, U., Nebelsick, M., **Polz, M.** (1991). Tackling the sulfide gradient: a novel strategy involving marine nematodes and chemoautotrophic ectosymbionts. *P.S.Z.N. I: Marine Ecology* **12**: 1-12.
- Polz, M.F.**, Felbeck, H., Novak, R., Nebelsick, M., Ott, J.A. (1992). Chemoautotrophic, sulfur-oxidizing symbiotic bacteria on marine nematodes: morphological and biochemical characterization. *Microb. Ecol.* **24**: 313-329.
- Polz, M.F.**, Distel, D.L., Zarda, B., Amann, R., Felbeck, H., Ott, J.A., Cavanaugh, C.M. (1994). Phylogenetic analysis of a highly specific association between ectosymbiotic, sulfur-oxidizing bacteria and a marine nematode. *Appl. Environ. Microbiol.* **60(12)**: 4461-4467.
- Polz, M.F.**, Cavanaugh, C.M. (1995). Dominance of one bacterial phylotype at a Mid Atlantic Ridge hydrothermal vent site. *Proc. Natl. Acad. Sci. USA* **92**: 7232-7236.
- Polz, M.F.**, Cavanaugh, C.M. (1996). Phylogenetic relationships of the filamentous sulfur-bacterium *Thiothrix ramosa* based on 16S rRNA sequence analysis. *Int. J. Syst. Bacteriol.* **46(1)**: 94-96.
- Polz, M. F.**, Cavanaugh, C.M. (1996). Ecology of ectosymbiosis at a Mid Atlantic Ridge hydrothermal vent site. *in* Ublein, F., Ott, J., Stachowitsch, M. (Eds): Deep-sea and extreme shallow water habitats: affinities and adaptations. *Biosystematics and Ecology Series No. 11*: 337-352.
- Polz, M.F.**, Cavanaugh, C.M. (1997). A simple method for the quantification of not-yet cultivated microorganisms in the environment based on *in vitro* transcription of 16S rRNA. *Appl. Environ. Microbiol.* **63(3)**: 1028-1033.
- Van Dover, C.L., **Polz, M.F.**, Robinson, J., Cavanaugh, C., Kadko, D, Hickey, J. P. (1997). Predatory anemones at TAG. *BRIDGE* **12**: 33-34.
- Tay, S.T.-L., Hemond, H.F., **Polz, M.F.**, Cavanaugh, C.M., Krumholz, L.R. (1998). Characterization of two Toluene degrading mycobacterial isolates from a contaminated freshwater stream. *Appl. Environ. Microbiol.* **64(5)**: 1715-1720.
- Polz, M.F.**, Cavanaugh, C.M. (1998). Bias in template-to-product ratios in multi-template PCR. *Appl. Environ. Microbiol.* **64(10)**: 3724-3730.
- Polz, M.F.**, Robinson, J., Cavanaugh, C.M, VanDover, C.L. (1998). Trophic ecology of the massive aggregations of the hydrothermal vent shrimp *Rimicaris exoculata*. *Limnol. Oceanogr.* **43**:1631-1638.
- Robinson, J.J., **Polz, M.F.**, Fiala-Medioni, A., Cavanaugh, C.M. (1998). Physiological and immunological evidence for two distinct C1-utilizing pathways in a dual endosymbiotic mussel (family Mytilidae) from the Mid-Atlantic Ridge. *Mar. Biol.* **132**:625-633.
- Tay, S.T.-L., Hemond, H.F., **Polz, M. F.**, Cavanaugh, C.M., Krumholz, L.R. (1999). Importance of *Xanthobacter autotrophicus* in toluene biodegradation within a contaminated stream. *Syst. Appl. Microbiol.* **22**: 113-118.
- Polz, M.F.**, Harbison, C., Cavanaugh, C.M. (1999). Diversity and heterogeneity of epibiotic bacterial communities on the marine nematode *Eubostricus diana*. *Appl Environ. Microbiol.* **65(9)**:4271-4275.
- Giribet, G., Distel, D. L., **Polz, M. F.**, Sterrer, W., Wheeler, W. C. (2000). Triploblastic relationships with emphasis on the position of Gnathostomulida, Cycliophora, Plathelminthes, and Chaetognatha; a combined approach of 18S rDNA sequences and morphology. *Syst. Biol.* **49(3)**:539-562.

- Tay, S.T.-L, Hemond, H.F., Cavanaugh, C.M., Krumholz, L.R., **Polz, M.F.** (2001). Population dynamics of toluene degrading bacterial species in a contaminated stream assessed by quantitative PCR. *Microb. Ecol.* **41**:124-131.
- Kuai, L., Nair, A., **Polz, M.F.** (2001). A rapid and simple MPN technique for the enumeration of dissimilatory arsenic reducing bacteria. *Appl Environ. Microbiol.* **67(7)**:3168-3173.
- Lim, E., Tomita, A., Thilly, W., **Polz, M.F.** (2001) Combination of competitive quantitative PCR and constant denaturant capillary electrophoresis for high resolution detection and enumeration of microbial cells. *Appl. Environ. Microbiol.* **67(9)**:3897-3903.
- Thompson, J., Marcelino, L., **Polz, M.F.** (2002) Heteroduplexes in mixed-template amplifications: formation, consequence and elimination by 'reconditioning PCR'. *Nucleic Acids Res.* **30(9)**:2083-2088.
- Bertilsson, S., Cavanaugh, C. M., **Polz, M.F.** (2002) Sequencing-independent method to generate oligonucleotide probes targeting a variable region in Bacterial 16S rRNA by PCR with detachable primers. *Appl. Environ. Microbiol.* **68(11)**:6077-6086.
- Oates, P.M., Shanahan, P. **Polz, M.F.** (2003) Solar disinfection (SODIS): simulation of solar radiation for global assessment and application for point-of-use water treatment in Haiti. *Water Res.* **37**:47-54.
- Acinas, S.G., Marcelino, L., Klepac-Ceraj, V., **Polz, M.F.** (2004) Divergence and redundancy of 16S rRNA sequences in genomes with multiple *rrn* operons. *J. Bacteriol.* **186(9)**:2629-2635.
- Sarma-Rupavtarm, R.B., Ge, Z., Schauer, D.B., Fox, J.G., **Polz, M.F.** (2004) Spatial distribution and stability of the eight microbial species of the Altered Schaedler Flora in the gastrointestinal tract of mice. *Appl. Environ. Microbiol.* **70(5)**:2791-2800.
- Klepac-Ceraj, V. Bahr, M., Crumb, B., Teske, A., Hobbie, J., **Polz, M.F.** (2004) High overall diversity and dominance of microdiverse relationships in salt marsh sulfate-reducing bacteria. *Environ. Microbiol.* **6(7)**:686-698.
- Thompson, J.R., Randa, M.A., Marcelino, L.A., Tomita, A., Lim, E., **Polz, M.F.** (2004) Diversity and dynamics of a North Atlantic coastal vibrio community. *Appl. Environ. Microbiol.* **70(7)**:4103-4110.
- Acinas, S.G., Klepac-Ceraj, V., Hunt, D.E., Pharino, C., Ceraj, I., Distel, D.L., **Polz, M.F.** (2004) Fine-scale phylogenetic architecture of a complex bacterial community. *Nature.* **430**:551-554.
- Randa, M.A., **Polz, M.F.**, Lim, E. (2004) Population dynamics of *Vibrio vulnificus* in a North Atlantic estuary. *Appl. Environ. Microbiol.* **70(9)**:5469-5476.
- Oates, P.M., Castenson, C., Harvey, C.F., **Polz, M.F.**, Culligan, P. (2005) Illuminating reactive microbial transport in saturated porous media: Demonstration of a visualization method and conceptual transport model. *J. Contam. Hydrol.* **77(4)**:233-245.
- Thompson, J.R., Pacocha, S., Pharino, C., Klepac-Ceraj, V., Hunt, D.E., Benoit, J., Sarma-Rupavtarm, R., Distel, D.L., **Polz, M.F.** (2005) Genotypic diversity within a natural coastal bacterioplankton community. *Science.* **307**:1311-1313.
- Perry, T.D., Klepac-Ceraj, V., Zhang, X.V., McNamara, C.J., **Polz, M.F.**, Martin, S.T., Berke, N., Mitchell, R. (2005) Bacterial exopolymer and humic acid binding to calcite. *Environ. Sci. Technol.* **39**:8770-8775.

- Acinas, S.G, Sarma-Rupavtarm, R., Klepac-Ceraj, V., **Polz, M.F.** (2005) PCR induced sequence artifacts and bias: insights from two 16S rRNA clone libraries constructed from the same sample. *Appl. Environ. Microbiol.* **71(12)**:8966-8969.
- Luyten, Y.A., Thompson, J.R., **Polz, M.F.**, Distel, D.L. (2006) Symbiont community composition varies among members of a single host population of the wood-boring bivalve *Lyrodus pedicellatus* (Bivalvia: Teredinidae). *Appl. Environ. Microbiol.* **72(1)**:412-417.
- Klepac-Ceraj, V., Ceraj, I., **Polz, M.F.** (2006) CLUSTERER: extendable java application for sequence grouping and cluster analyses. *Online J. Bioinf.* **7(1)**:15-21.
- Hunt, D.E., Klepac-Ceraj, V., Acinas, S.G., Gauthier, C., Bertilsson, S., **Polz, M.F.** (2006) Evaluation of 23S rRNA PCR Primers for use in Phylogenetic Studies of Bacterial Diversity. *Appl. Environ. Microbiol.* **72(3)**:2221-2225.
- Ge, Z., Feng, Y., Taylor, N., Ohtani, M., **Polz, M.F.**, Schauer, D.B., Fox, J.G. (2006) Colonization of Altered Schaedler Flora is influenced by gender, aging and *Helicobacter hepaticus* infection in the intestine of Swiss Webster mice. *Appl. Environ. Microbiol.* **72(7)**:5100-5103.
- Marcelino, L., Backman, V., Donaldson, A., Steadman, C., Thompson, J.R., Paccocha-Preheim, S., Lien, C., Lim, E., Veneziano, D., **Polz, M.F.** (2006) Accurate identification of low abundant targets amidst similar sequences by revealing hidden correlations in oligonucleotide microarray data. *Proc. Natl. Acad. Sci. USA* **103(37)**:13629-13634.
- Polz, M.F.**, Hunt, D.E., Preheim, S.P., Weinreich, D.M. (2006) Patterns and mechanisms of genetic and phenotypic differentiation in marine microbes. *Phil. Trans. R. Soc. Lond. B.* **361**:2009-2021.
- Sabehi, G. Kirkup, B. C., Rozenberg, M., Stambler, N., **Polz, M.F.**, Beja, O. (2007) Niche adaptation and spectral tuning in marine proteorhodopsins. **Submitted.**
- Veneziano, D., Klepac-Ceraj, V., **Polz, M.F.** (2006) Likelihood estimation of richness and species abundance distribution in microbial communities. **Submitted.**

2) Reviews

- Polz, M.F.**, Ott, J.A., Bright, M., Cavanaugh, C.M. (2000) When bacteria hitch a ride. *ASM News.* **66(9)**:531-539.
- Polz, M.F.**, Bertilsson, S., Acinas, S.G., Hunt, D. (2003) A(r)Ray of hope in analysis of function and diversity of microbial communities. *Biol. Bull.* **204**:196-199.

3) Book Chapters

- Polz, M.**, Bertilsson, S., Bärlocher, F., Nikolcheva L., Newell, S.Y. & Kuehn, K.A. Community structure and interactions of aquatic microorganisms associated with decomposing litter. In: Gessner, M.O. (ed.) *Plant litter decomposition. Methods in Ecology.* Blackwell Publishers, Oxford.
- Thompson, J.T., Marcelino, L., **Polz, M.F.** (2005) Diversity and sources of human bacterial pathogens and overview of methods of their detection and quantification. In: Shimshon Belkin and Rita Colwell (Eds.), *Ocean and Health: Pathogens in the Marine Environment.* Springer. pp. 29-68.
- Thompson, J.T., **Polz, M.F.** (2006) Dynamics of vibrio populations and their role in environmental nutrient cycling. In: F.L. Thompson, B. Austin, and J. Swings (Eds.), *The Biology of Vibrios.* ASM Press. pp. 190-203

PATENT

Uranium enrichment using microorganisms. K. Czerwinsky and **M. F. Polz**. Patent pending.
March 18, 2003.

AWARDS AND FELLOWSHIPS

- Gilbert Winslow Career Development Chair, 2003-2004
- Takeda Entrepreneurship Award, finalist, 2001
- Doherty Professorship in Ocean Utilization, 2000-2002
- Peter Wall Institute for Advanced Studies: Visiting Assistant Professor, Univ. British Columbia, Vancouver; Outstanding Young Investigator in Residence Program, Aug. 2000
- Gilbert Winslow Career Development Chair, 1999-2001
- ASM Sustaining Member Student Travel Grant, 1997
- Anna Vaughn Foundation Fellowship, 1994-96
- OEB Fellowship for field research, 1993
- BKU Fellowship, Summer 1990

GRANTS

Current

NSF Biological Oceanography OCE0526241: "Oceanography on the bacterial scale: integrating microfluidics with microbial ecology" \$459,880. 9/01/05-8/31/05.

NSF/NIH "The Woods Hole Center for Ocean and Human Health". \$6,250,000. With J. Stegeman and others. 2/1/04-1/31/09.

DOE Genomes to Life: "Microbial Ecology, Proteogenomics, and Computational Optima." \$15,000,000. With Chisholm, Church and others. 10/01/02-9/30/07.

Moore Foundation: "Microevolutionary Genomics of Ocean Bacteria." \$950,000. 11/1/06-10/31/09.

Past

NSF SGER: "Microbial pathogens in Lake Pontchartrain as a result of Hurricane Katrina floodwaters". \$33,000. 10/01/06-10/30/06.

NIH R01-AI509552: "Microecology of the murine gut". \$1,320,000. With J. Fox and D. Schauer. 4/1/02-3/31/06.

NSF Biological Oceanography OCE0221340: "Toward Environmental Genomics: Can We Estimate Bacterial Diversity in the Ocean?" \$380,000. 9/15/02-9/14/05.

NSF Biological Oceanography OCE 9820035: "Regulation of Population Dynamics of *Prochlorococcus* and *Synechococcus* ecotypes in Diverse Oceanic Ecosystems". \$400,000. With S. W. Chisholm (PI). 4/1/02-3/31/04.

NSF Biological Oceanography OCE 9820035: "Regulation of Population Dynamics of *Prochlorococcus* and *Synechococcus* ecotypes in Diverse Oceanic Ecosystems". \$580,000. with S. W. Chisholm. 4/1/99-3/31/02.

Seagrant: "Quantitative PCR combined with constant denaturant capillary electrophoresis for the analysis of naturally occurring pathogens in coastal environments". \$149,016. 3/1/00-2/28/02.

NOAA/Seagrant: "Environmental Marine Biotechnology: Development of DNA Microarrays as Sensors for Diverse Marine Pathogens in the Environment." \$273,000. 7/1/00-30/6/02.

Class of '51, '55, and '72 Fund: "Field Research Experience for Freshmen". \$19,790, with P. Gschwend, H. Nempf, and S. Frankel.

Edgerly Fund: "Isolation and Characterization of Uranium Bacteria". \$75,000, with K. Czerwinski. 3/1/99-9/1/00.

Class of '51, '55, and '72 Fund: "Proposal for Teaching and Education Enhancement". \$19,020, with Bettina Voelker and Heidi Nepf.

TEACHING AT MIT

Undergraduate teaching:

- 1.016 Introduction to Environmental Engineering, Fall 1999
- 1.107 Aquatic Chemistry Laboratory (OLD), Spring 1998, 1999
- 1.107 Environmental Chemistry and Biology Laboratory, Spring 2000-present
- 1.080 Environmental Chemistry and Biology, Spring 2000-present

Graduate teaching:

- 1.89 Environmental Microbiology, Fall 1998-present
- 1.82 Problems in Aquatic Biology and Chemistry, Spring 2000, 2001, 2004
- 1.962 Topic in Bioremediation, Spring 1999

INVITED SEMINARS

- | | |
|----------------|--|
| September 1990 | University of Bonn; host: Prof. Hans Trüper
"Tackling the Chemocline: A Chemoautotrophic Symbiosis Between Bacteria and Nematodes" |
| December 1995 | University of Guelph, Canada; host: Prof. George Reininger
"The Microbial Ecology of Hydrothermal Vents" |
| June 1995 | British Geological Survey, Nottingham, England; host: Prof. Don Cowan
"Overview of American Hydrothermal Vent Research" |
| May 1996 | Massachusetts Institute of Technology, Cambridge; host : Prof. Philip Gschwend
"What Determines Microbial Community Structure at Hydrothermal Vent Surfaces" |
| February 1998 | University of Massachusetts, Boston; host: Prof. Brian White
"Ecology of Ectosymbiotic Associations Between Marine Invertebrates and Sulfur-Oxidizing Bacteria" |
| April 1998 | Woods Hole Oceanographic Institution; host: Sci. Rebecka Gast
"Ecology of Ectosymbiotic Associations Between Marine Invertebrates and Sulfur-Oxidizing Bacteria" |
| November 1998 | Massachusetts Institute of Technology, Biology Department.
"Together we are Stronger: Symbiosis and Cooperation between Animals and Epibacteria in Sulfidic Habitats" |
| October 1999 | University of Maine, Bangor; host: Prof. Daniel Distel
"When Bacteria Hitch a Ride: Ectosymbiosis in Marine Sulfidic Habitats" |
| August 2000 | Peter Wall Institute for Advance Studies, Vancouver; host: Prof. Ken MacGrimmon
"When Bacteria Hitch a Ride" |
| August 2000 | University of British Columbia, Vancouver; host: Prof. Curtis Suttle
"Ecology of Ectosymbiotic Associations Between Sulfur-Oxidizing Bacteria and Marine Invertebrates" |
| December 2001 | Caltech, Pasadena; host: Prof. Dianne Newmann |

- April 2002 “Deciphering structure-function relationships in microbial communities using DNA microarrays”
Harvard University; host: Prof. Ralph Mitchel
- November 2003 “Towards understanding microbial diversity”
Uppsala University; host: Dr. Stefan Bertilsson
“When bacteria hitch a ride: symbioses between sulfur bacteria and invertebrates”
“Microbial diversity: Can we see the forest for the trees?”
- December, 2003 WHOI; host: Dr. Stefan Sievert
“Microbial diversity: Can we see the forest for the trees?”
- January, 2004 University of Toronto; host: Prof. Belinda Chang
“Microbial diversity: Can we see the forest for the trees?”
- May, 2004 Harvard University; host: Prof. Colleen Cavanaugh
“Microbial diversity: Can we see the forest for the (phylogenetic) trees?”
- May, 2004 Dalhousie University; host: Prof. Ford Doolittle
“Microbial diversity: Can we see the forest for the trees?”
- September, 2004 Michigan State University, Center for Microbial Ecology; host: Prof. James Tiedje
“Microbial diversity: Can we see the forest for the trees?”
- February, 2005 University of Massachusetts, Amherst; host: Prof. Jeff Blanchard
“Microbial diversity: Can we see the forest for the (phylogenetic) trees?”
- March, 2005 Montana State University, Bozeman; host: Prof. Timothy Ford
“Microbial diversity: Can we see the forest for the (phylogenetic) trees?”
- March, 2005 Marine Biological Laboratory, Woods Hole; host: Yuriko Yano
“Microbial diversity: Can we see the forest for the (phylogenetic) trees?”
- June, 2005 Bauer Center for Genomics Research; Harvard University; host: Dr. Laura Galwin
“Microbial diversity in the wild: genomes, populations and species”
- November, 2005 University of Illinois, Urbana-Champaign; host: Prof. Bruce Foulke
“Microbial diversity in the Ocean: clones, populations, species”
- November, 2005 Northwestern University, Chicago; host: Prof. Martina Hausner
“Microbial diversity: Can we see the forest for the (phylogenetic) trees?”
- December, 2005 Wesleyan University, Middletown; host: Prof. Fred Cohan
“Microbial diversity: Can we see the forest for the (phylogenetic) trees?”
- July, 2006 Harvard University, Cambridge; host: Prof. Martin Novak
“Microbial diversity in the wild: genomes, populations and species”
- December, 2006 Louisiana State University; host: Prof. Aixin Hu
“Microbial diversity in the wild: genomes, populations and species”

CONFERENCE CONTRIBUTIONS

Convenor for Symposia

- 2000 American Society for Microbiology, General Meeting, Los Angeles
Convenor of Symposium
“The Y2K Census: Molecular Tools for the Quantification of Microbial Populations”; organized a symposium with 6 national and international speakers

- 2000 Boston Bacterial Meeting
- 2005 American Society for Microbiology, General Meeting, Atlanta
Convener of Colloquium
“Learning to interpret microbial diversity: Can we see the forest for the phylogenetic trees?”
- 2005 International Congress on the Biology of Vibrios; Ghent, Belgium
Chair for ecology and applications

Talks

- 1995 Boston Bacterial Meeting, Boston
- 1995 International Deep Sea Symposium, Vienna; invited speaker
- 1997 Second International Congress on Symbiosis, Woods Hole; invited speaker
- 2001 American Society for Limnology and Oceanography, Albuquerque
- 2001 Gordon Conference: Applied and Environmental Microbiology; invited speaker
- 2001 Outcomes of Genome-Genome Interactions; invited speaker
- 2004 CIAR Evolutionary Biology Meeting; invited speaker
- 2005 New Directions in Plant-Insect Interactions; Max Plank Institute for Chemical Ecology; invited speaker
- 2005 American Society for Microbiology General Meeting, Atlanta; invited speaker
- 2005 International Congress on the Biology of Vibrios; invited keynote speaker
- 2006 Discussion meeting on Species and speciation in microorganisms; The Royal Society; invited speaker;

Posters

- 1990 European Marine Microbiology Symposium, Kiel, Germany
- 1993 American Society for Microbiology Special Symposium, Woods Hole
- 1996 American Society for Microbiology General Meeting, New Orleans
- 1996 Symbiosis 96, Bar Harbor
- 1996 Boston Bacterial Meeting, Boston
- 1997 American Society for Microbiology General Meeting, Miami
- 1997 Gordon Conference on Applied and Environmental Microbiology, Newport
- 1998 American Society for Microbiology General Meeting, Atlanta
- 1999 Eighth International Symposium on Microbial Ecology, Halifax
- 1999 American Society for Microbiology General Meeting, Chicago
- 2000 American Society for Microbiology General Meeting, Los Angeles
- 2001 American Society for Microbiology General Meeting, Orlando
- 2001 ASLO, Albuquerque
- 2001 Gordon Conference, New London
- 2002 BAGECO, Bergen, Norway
- 2003 American Society for Microbiology General Meeting, Washington DC (7 Posters)
- 2004 American Society for Limnology and Oceanography, Honolulu
- 2004 American Society for Microbiology General Meeting, New Orleans (6 Posters)
- 2005 American Society for Microbiology General Meeting, Atlanta

Workshops

- 2004 American Academy for Microbiology: “Systems Microbiology: Beyond Microbial Genomics”; Portland, OR
- 2006 American Academy for Microbiology: “Genomics and Global Pathogens”; Washington, DC
- 2006 ICGEB: “Integrative Biology Workshop”; Patzcuaro, Mexico; invited speaker.
- 2007 American Academy for Microbiology: “The Uncharted Microbial World: Microbes and Their Activities in the Environment, Seattle, WA