

Curriculum Vitae – Linda D. Rhodes

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Education

Ph.D. University of Washington	Molecular & Cellular Biology	1993
B.A. University of Texas at Austin	Biology (<i>cum laude</i>)	1974

Professional Experience:

Position/Title	Organization & Location	Dates
Research Microbiologist	NWFSC, Seattle WA	2/07 – present
Microbiologist	NWFSC, Seattle WA	5/99 – 2/07
Postdoctoral Fellow (National Research Council)	NWFSC, Seattle WA	5/97 – 4/99
Contract Scientist	NWFSC, Seattle WA	11/96 – 4/97
Postdoctoral Fellow (National Institutes of Health)	Zoology Department, University of Maine, Orono ME	12/93 – 8/96
Research Scientist (National Institutes of Health)	Department of Genetics, University of Washington, Seattle, WA	8/92 – 11/93
Doctoral Trainee (National Institutes of Health)	Cellular & Molecular Biology Training Program, University of Washington, Seattle WA	8/89 – 7/92
Doctoral Teaching Assistant (National Institutes of Health)	Department of Biological Structure, University of Washington, Seattle WA	6/88 – 7/89
Doctoral Research Scientist (National Institutes of Health)	Interdisciplinary Molecular & Cellular Biology Program, University of Washington, Seattle WA	9/87 – 6/88
Zoologist	NWFSC, Seattle WA	12/84 – 9/87
Microbiological Technician	NWFSC, Seattle WA	10/76 – 12/84

Expertise:

I have worked in the areas of aquatic toxicology, molecular immunology, and microbial pathogenesis. I acquired over 8 years of experience in marine fish histopathology and statistical analysis in studies examining the relationship between anthropogenic contaminants in marine sediments and pathogenesis in marine fish. I have 3 years of experience in assaying gene expression and genetic mutation effects of toxicants such as dioxin in aquatic organisms including soft-shell clam and medaka, and over 5 years of experience in the analysis of transcriptional regulation of mammalian gene expression.

Since 1996, I have studied multiple aspects of the microbial pathogen that causes bacterial kidney disease in salmonid fish. This research has included the molecular genetics of *Renibacterium salmoninarum*, the molecular basis of the host response, the efficacy and consequences of prophylactic and therapeutic studies of vaccine and antibiotic treatments against *R. salmoninarum*, and the epidemiology of *R. salmoninarum* in free-living populations of salmon. The molecular genetic research of the bacterium and the host response is directed at characterizing virulence determinants, characterizing an effective immune response, and developing vaccine candidates. The treatment studies are applied research efforts in early detection and mitigation of the disease caused by *R. salmoninarum* and assessing the risks of treatments. The field research in the epidemiology of *R. salmoninarum* examines the potential for disease interaction between wild and hatchery-reared salmon and evaluates changes in infection prevalence at different life history stages.

Recently, I have undertaken a line of research within the field of environmental microbiology. This work assesses microbial community ecology at sewage treatment plant outfalls, and includes an evaluation of the breadth of antibiotic resistance in microbial communities. A second research effort performed in collaboration with fisheries biologists and ecologists will integrate microbial community ecology into multiple trophic level assessment of pelagic food web in Puget Sound. The results of this avenue of research can inform both food web models and integrated ecosystem assessments.

Professional Society Memberships:

American Association for the Advancement of Science (1988 – present)

American Fisheries Society (1997 – present)

American Geophysical Union (2012 - present)

American Society for Microbiology (1997 – present)

Coastal and Estuarine Research Federation (2010 - present)

International Society of Developmental and Comparative Immunology (2009 - present)

Service Positions:

Mentoring:

Undergraduate Research Program mentor, University of Washington (2001-present; total of 12 students)

Howard Hughes Medical Institute Research mentor, University of Washington (2007; 1 student)

Undergraduate career volunteer, Western Washington University (2010; 1 student)

Program on the Environment capstone mentor, University of Washington (2012; 2 students)

Master's supervisory committee, University of Washington (2010-present; 2 students)

Peer reviewer - grants:

Agriculture & Food Research Initiative (USDA)

Environmental Marine Biotechnology Program (National Sea Grant)

Ecological & Evolutionary Physiology Program (National Science Foundation)

Great Lakes Fish & Wildlife Restoration Act Grants Program (US Fish & Wildlife Service)

Hudson River Foundation

Maine Agricultural & Forest Experiment Station Research Program (University of Maine)

Protected Species Authorizations & Permits (NOAA)

NWFSC Internal Grants Program (NOAA)

Oregon Agricultural Experimental Station Program Project (Oregon State University)

Oregon Coast Community College Research Internship Program
Saltonstall-Kennedy Program (NOAA)
Small Business Innovation Research (Dept. of Commerce/NOAA)
Washington State Board of Community & Technical Colleges Intern Program

Peer reviewer - journals:

Journal of Aquatic Animal Health (Associate Editor)
Applied & Environmental Microbiology; Diseases of Aquatic Organisms; Ecotoxicology;
Veterinary Microbiology; Aquaculture; Journal of Fish Diseases; Acta Veterinaria
Scandinavica; African Journal of Aquatic Science, African Journal of Microbiology Research

Committees:

Institutional Biosafety Committee, chair, Northwest Fisheries Science Center, NOAA
Fisheries (2000-present)
Safety Committee, Division representative, Northwest Fisheries Science Center, NOAA
Fisheries (2005-present)
Pacific Northwest Fish Health Protection Committee, NOAA Technical Representative (2012
- present)
American Fisheries Society Fish Health Section Blue Book Committee, NOAA
Representative (2013 - present)
Institutional Biosafety Committee, extra-institutional member, Western Fisheries Research
Center, USGS (2006-2011)
Institutional Animal Care & Use Committee, extra-institutional member, Western Fisheries
Research Center, USGS (2007-2010)
Marine Resources Committee of Island County (2010-present)
Environmental Health Assessment Team, Island County Health Department (2003-2007)

Publications (peer-reviewed only):

Scholz, NL, Myers MS, McCarthy SG, Labenia JS, McIntyre JK, Ylitalo GM, Rhodes LD, Laetz
CA, Stehr CM, French BL, McMillan B, Wilson D, Reed L, Lynch KD, Damm S, Davis
JW and Collier TK (2011). Recurrent die-offs of adult coho salmon returning to spawn in
Puget Sound lowland urban streams. PLoS One 6(12): e28013
Rhodes LD, Rice CA, Greene CM, Teel DJ, Nance SL, Moran P, Durkin CA, Gezhegne SB
(2011) Nearshore ecosystem predictors of a bacterial infection in juvenile Chinook
salmon. Marine Ecology Progress Series 432:161-172
Nance SL, Riederer M, Zubowski T, Trudel M, Rhodes LD (2010) Interpreting dual ELISA and
qPCR data for bacterial kidney disease of salmonids. Diseases of Aquatic Organisms
91:113-119
Rhodes LD, Wallis S, Demlow SE (2009) Genes associated with an effective host response by
Chinook salmon to *Renibacterium salmoninarum*. Dev Comp Immunol 33:176-186
Rhodes LD, Nguyen OT, Deinhard RK, White TM, Harrell LW, Roberts MC (2008)
Characterization of *Renibacterium salmoninarum* with reduced susceptibility to
macrolide antibiotics by a standardized antibiotic susceptibility test. Dis Aquat Organ
80:173-180
Wiens GD, Rockey DD, Wu Z, Chang J, Levy R, Crane S, Chen DS, Capri GR, Burnett JR,
Sudheesh PS, Schipma MJ, Burd H, Bhattacharyya A, Rhodes LD, Kaul R, Strom MS
(2008) The genome sequence of the fish pathogen *Renibacterium salmoninarum* suggests
reductive evolution away from an environmental *Arthrobacter* ancestor. J Bacteriol
190:6970-6982

- Coady AM, Murray AL, Elliott DG, Rhodes LD (2006) Both *msa* genes in *Renibacterium salmoninarum* are needed for full virulence in bacterial kidney disease. *Appl Environ Microbiol* 72:2672-2678
- Rhodes LD, Durkin C, Nance SL, Rice CA (2006) Prevalence and analysis of *Renibacterium salmoninarum* infection among juvenile Chinook salmon in north Puget Sound. *Diseases of Aquatic Organisms* 71:179-190
- Rhodes LD, Coady AM, Deinhard RK (2004) Identification of a third *msa* gene in *Renibacterium salmoninarum* and the associated virulence phenotype. *Appl Environ Microbiol* 70:6488-6494
- Rhodes LD, Rathbone CK, Corbett SC, Harrell LW, Strom MS (2004) Efficacy of cellular vaccines and genetic adjuvants against bacterial kidney disease in Chinook salmon (*Oncorhynchus tshawytscha*). *Fish Shell Immunol* 16:461-474
- Rhodes LD, Coady AM, Strom MS (2002) Expression of duplicate *msa* genes in the salmonid pathogen *Renibacterium salmoninarum*. *Appl Environ Microbiol* 68:5480-5487
- Rhodes LD, Grayson TH, Alexander SM, Strom MS (2000) Description and characterization of IS994, a putative IS3 family insertion sequence from the salmon pathogen, *Renibacterium salmoninarum*. *Gene* 244:97-107
- Van Beneden RJ, Rhodes LD, Gardner GR (1999) Potential alterations in gene expression associated with carcinogen exposure in *Mya arenaria*. *Biomarkers* 4:485-491
- Rhodes LD, Nilsson WB, Strom MS (1998) Sensitive detection of *Renibacterium salmoninarum* in whole fry, blood, and other tissues of pacific salmon by reverse transcription-polymerase chain reaction. *Mol Mar Biol Biotechnol* 7:270-279
- Van Beneden RJ, Rhodes LD, Gardner GR (1998) Studies of the molecular basis of gonadal tumors in the marine bivalve, *Mya arenaria*. *Mar Environ Res* 46:209-213
- Krause MK, Rhodes LD, Van Beneden RJ (1997) Cloning of the p53 tumor suppressor gene from the Japanese medaka (*Oryzias latipes*) and evaluation of mutational hotspots in MNNG-exposed fish. *Gene* 189:101-106
- Rhodes LD, Gardner GR, Van Beneden RJ (1997) Short-term disposition and effects of [³H]TCDD exposure in soft-shell clams (*Mya arenaria*). *Environ Toxicol Chem* 16:1888-1894
- Rhodes LD, Van Beneden RJ (1997) Isolation of the cDNA and characterization of mRNA expression of ribosomal protein S19 from the soft-shell clam, *Mya arenaria*. *Gene* 197:295-304
- Rhodes LD, Van Beneden RJ (1996a) Application of differential display polymerase chain reaction to the study of neoplasms of feral marine bivalves. *Mar Environ Res* 42:81-85
- Rhodes LD, Van Beneden RJ (1996b) Gene expression analysis in aquatic animals using differential display polymerase chain reaction. In: Ostrander GK (ed) *Techniques in Aquatic Toxicology*. Lewis Publishers, CRC Press, Boca Raton, FL, p 161-183
- Rhodes LD, Paull AT, Sibley CH (1994) Two different IFN-gamma nonresponsive variants derived from the B-cell lymphoma 70Z/3. *Immunogenetics* 40:199-209
- Casillas E, Misitano D, Johnson LL, Rhodes LD, Collier TK, Stein JE, McCain BB, Varanasi U (1991) Inducibility of spawning and reproductive success of female English sole (*Parophrys vetulus*) from urban and nonurban areas of Puget Sound, Washington. *Mar Environ Res* 31:99-122
- Johnson LL, Casillas E, Myers MS, Rhodes LD, Olson OP (1991) Patterns of oocyte development and related changes in plasma 17- beta estradiol, vitellogenin, and plasma chemistry in English sole *Parophrys vetulus* Girard. *J Exp Mar Biol Ecol* 152:161-185

- Miller CL, Feldhaus AL, Rooney JW, Rhodes LD, Sibley CH, Singh H (1991) Regulation and a possible stage-specific function of Oct-2 during pre-B-cell differentiation. *Mol Cell Biol* 11:4885-4894
- Landahl JT, McCain BB, Myers MS, Rhodes LD, Brown DW (1990) Consistent associations between hepatic lesions in English sole (*Parophrys vetulus*) and polycyclic aromatic hydrocarbons in bottom sediment. *Environ Health Perspect* 89:195-203
- Nameroff M, Rhodes LD (1989) Differential response among cells in the chick embryo myogenic lineage to photosensitization by Merocyanine 540. *J Cell Physiol* 141:475-482
- Myers MS, Rhodes LD (1988) Morphologic similarities and parallels in geographic distribution of suspected toxicopathic liver lesions in rock sole (*Lepidopsetta bilineata*) starry flounder (*Platichthys stellatus*), Pacific staghorn sculpin (*Leptocottus armatus*), and dover sole (*Microstomus pacificus*) as compared to English sole (*Parophrys vetulus*) from urban and non-urban embayments in Puget Sound, Washington. *Aquat Toxicol* 11:410-411
- Quinn LS, Rhodes LD, Nameroff M (1988) Characterization of sequential myogenic cell lineage compartments. In: Stockdale F, Kedes L (eds) *Cellular and Molecular Biology of Muscle Development*, Vol 93, p 37-46
- Stehr CM, Rhodes LD, Myers MS (1988) The ultrastructure and histology of hepatocellular carcinomas of English sole (*Parophrys vetulus*) from Puget Sound, Washington. *Toxicol Pathol* 16:418-431
- Myers MS, Rhodes LD, McCain BB (1987) Pathologic anatomy and patterns of occurrence of hepatic neoplasms, putative preneoplastic lesions, and other idiopathic hepatic conditions in English sole (*Parophrys vetulus*) from Puget Sound, Washington. *J Natl Cancer Inst* 78:333-363
- Rhodes LD, Myers MS, Gronlund WD, McCain BB (1987) Epizootic characteristics of hepatic and renal lesion in English sole (*Parophrys vetulus*) from Puget Sound. *J Fish Biol* 31:395-407
- Krahn MM, Rhodes LD, Myers MS, Moore LK, MacLeod WD, Jr., Malins DC (1986) Associations between metabolites of aromatic compounds in bile and the occurrence of hepatic lesions in English sole (*Parophrys vetulus*) from Puget Sound, Washington. *Arch Environ Contam Toxicol* 15:61-67
- Casillas E, Myers MS, Rhodes LD, McCain BB (1985) Serum chemistry of diseased English sole, *Parophrys vetulus* Girard, from polluted areas of Puget Sound, Washington. *J Fish Dis* 8:437-449
- Malins DC, Krahn MM, Brown DW, Rhodes LD, Myers MS, McCain BB, Chan SL (1985) Toxic chemicals in marine sediment and biota from Mukilteo, Washington: relationships with hepatic neoplasms and other hepatic lesions in English sole (*Parophrys vetulus*). *J Natl Cancer Inst* 74:487-494
- Malins DC, Krahn MM, Myers MS, Rhodes LD, Brown DW, Krone CA, McCain BB, Chan SL (1985) Toxic chemicals in sediments and biota from a creosote-polluted harbor: relationships with hepatic neoplasms and other hepatic lesions in English sole (*Parophrys vetulus*). *Carcinogenesis* 6:1463-1469
- Rhodes L, Casillas E, McKnight B, Gronlund W, Myers M, Olson OP, McCain B (1985) Interactive effects of cadmium, polychlorinated biphenyls, and fuel oil on experimentally exposed English sole (*Parophrys vetulus*). *Can J Fish Aquat Sci* 42:1870-1880
- Malins DC, McCain BB, Brown DW, Chan SL, Myers MS, Landahl JT, Prohaska PG, Friedman AJ, Rhodes LD, Burrows DG, Gronlund WD (1984) Chemical pollutants in sediments

and diseases in bottom-dwelling fish in Puget Sound, Washington. Environ Sci Technol
18:705-713

Technical Memorandum

Harvey CJ, Bartz KK, Davies J, Francis TB, Good TP, Guerry AD, Hanson B, Holsman KK, Miller J, Plummer ML, Reum JCP, Rhodes LD, Rice CA, Samhoury JF, Williams GD, Yoder N, Levin PS, Ruckelshaus MH (2010) A mass-balance model for evaluating food web structure and community-scale indicators in the central basin of Puget Sound U.S. Department of Commerce