

*Curriculum vitae for*  
**Ann L. Miracle**

**Institution:**

Environmental Assessment Group  
Earth Systems Science Division  
Energy and Environment Directorate  
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**Education:**

Ph.D., Molecular Immunology, University of South Florida, 2001

M.S., Molecular Genetics, University of Florida, 1993

B.A., Biology, University of Virginia, 1988

**Scientific Experience:**

- Scientist IV, Pacific Northwest National Laboratory, Richland, Washington. Program manager for Ecosystems Research in the Environmental Biomarkers Initiative, development of molecular tools for biomonitoring of impacted aquatic sites, application of molecular methods for risk assessment, biotic interactions of remediation technologies, preparation of aquatic ecology sections for environmental impact statements, biological assessments, and essential fish habitat assessments for new nuclear combined operating license permits (VC Summer, Levy, Harris), preparation of essential fish habitat assessments for relicensing and power uprate for existing nuclear licenses (St. Lucie). 2005 – present.
- Research Biologist, USEPA, NERL Cincinnati, Ohio. Scientific Lead for EPA's Computational Toxicology initiative using molecular profiles (transcriptomics, proteomics, and metabolomics) to investigate different chemical modes of action in small fish, Development of fathead minnow microarrays, Technology transfer of EDC bioindicator technology, development of stressor-specific bioindicators in vertebrate and invertebrate species. 2002 – 2005.
- Federal post-doctoral fellowship, USEPA, NERL Cincinnati, Ohio. Development of microarray technology for use in screening estrogenic exposures in the fathead minnow, *Pimphales promelas*, and EDC indicator development. 2001-2002.
- Graduate student fellowship, University of South Florida, Characterization of the development of the adaptive immune system in a phylogenetically primitive vertebrate, the clearnose skate, *Raja eglanteria*. 1997-2001.

- Biological Scientist, University of South Florida, Study of cardiotoxic effects of a chemotherapeutic agent on cardiac muscle in a rabbit model, Endocrine study of growth hormones in a murine model. 1996-1997.
- Marine Biologist, Florida Department of Environmental Protection, Population analyses of stone crabs, blue crabs, deep-sea lobsterettes, redfish, and snook. 1994-1996.
- Graduate student fellowship, University of Florida, Examination of diversity in natural populations of mullet, catfish, and sturgeon. 1992-1993.
- Research Assistant, Georgetown University, Characterization of SIV envelope glycoproteins in a simian model. 1990-1992.
- Biologist, National Institutes of Health, Human gene therapy development and testing. 1988-1990.

### **Publications:**

Preparation of aquatic ecology environmental impact statement for the V.C. Summer Nuclear Station (Fairfield County, SC) combined construction and operation license, Biological Assessment to FWS, Essential Fish Habitat Assessment to NMFS, Final EIS published in April 2011, NUREG-1939.

Preparation of aquatic ecology environmental impact statement for the Levy Nuclear Plant (Levy County, FL) combined construction and operation license, Biological Assessment to FWS, Biological Assessment to NMFS, Essential Fish Habitat Assessment to NMFS, Draft EIS published in August 2010, NUREG-1941.

**Miracle, A.L.,** ND Denslow, KJ Kroll, MC Liu, and KK Wang. 2009. Spillway-induced salmon head injury triggers proteolytic degradation of brain  $\alpha$ II-spectrin similar to mammalian traumatic brain injury: Development of a biomarker assay. PLoS: ONE 4(2):e4491. Epub 2009 Feb 13.

**Miracle, A.L.,** J Duncan, C. Jonason, and T. Carlson. 2008. Head Injury Biomarker Expression for Assessing Subacute Injury and Use of a Sensor Fish Device to Characterize Passage Conditions for Juvenile Chinook Salmon Passing Through the Removable Spillway Weir at Lower Monumental Dam, 2008. U.S. Army Corps of Engineers Final Report, Walla Walla District.

**Miracle, A.L.,** Bunn, A.L., Brandenberger, J., and D Gaspar. 2008. Fate and transport of titanium dioxide nanoparticles in freshwater mesocosms. Proceedings from International Environmental Nanotechnology Conference, Chicago, IL.

**Miracle, A.L.** 2008. Head Injury Biomarker Expression Comparison Between Brain Tissue and Blood Samples in Juvenile Chinook Salmon at McNary Dam, 2007. U.S. Army Corps of Engineers Technical Memorandum, Walla Walla District.

**Miracle, A.** 2008. Head Injury Assessment of Juvenile Chinook Salmon Spill Passage Routes at McNary Dam, 2007. U.S. Army Corps of Engineers Technical Report, Walla Walla District.

Mesa MG, MH Averbeck, AG Maule, D Elliott, and **AL Miracle**. 2008. Mechanisms of Delayed Mortality in Juvenile Salmonids Outmigrating in the Columbia River Basin. U.S. Army Corps of Engineers Technical Report, Walla Walla District.

**Miracle, A.L.**, Bailey, V.L., Baker, S.E., Bunn, A.L., Magnuson, J, Webb-Robertson, B.J. 2008. Integration of ‘omics technologies for characterization of complex microbial ecosystems in freshwater mesocosms. Proceedings from Waste Management 2008 Conference, Phoenix, AZ.

**Miracle, A.L.**, Evans, C.W., Ferguson, E.A., Greenberg, B., Kille, P., Schaeffner, A.R., Sprenger, M., van Aerle, R., Versteeg, D.J. “Applications of genomic technologies to ecological risk assessments at remediation / restoration sites”, in Toxicogenomics in Regulatory Ecotoxicology (Ankley, G.A., **Miracle, A.L.**, Perkins, E., eds.), SETAC Publishing, 2008.

Villeneuve, D., Knoebl, I., Larkin, P., **Miracle, A.**, Carter, B., Denslow, N., and Ankley, G. 2008. Altered gene expression in the brain and liver of female fathead minnows exposed to fadrozole: discovery-driven analysis using a 2000 gene microarray. J Fish Biol. 72(9):2281-2340.

Small, J.A. Bunn, A.L., McKinsty, C., Peacock, A. and **Miracle, A.L.** 2008. Investigating freshwater periphyton community response to uranium with phospholipid fatty acid and denaturing gradient gel electrophoresis analyses. J Environ Radioact, 99(4):730-738.

Villeneuve, D.L., Blake, L.S., Brodin, J.D., Greene, K.J., Knoebl, I., **Miracle, A.L.**, Martinovic, D., and Ankley, G.T. 2007. Transcription of key genes regulating gonadal steroidogenesis in control and ketoconazole- or vinclozolin-exposed fathead minnows. Toxicol Sci 98(2):395-407.

Larkin, P., Villeneuve, D., Knoebl, I., **Miracle, A.**, Carter, B., Liu, L., Denslow, N., and Ankley, G. 2007. Development and validation of a 2,000 gene microarray in the fathead minnow, *Pimephales promelas*. Environ Toxicol Chem. 26(7):1497-1506.

Villeneuve, D.L., **Miracle, A.L.**, Jensen, K.M., Degitz, S.J., Kahl, M.D., Korte, J.J., Greene, K.J., Blake, L.S., Linnum, A., and Ankley, G.T. 2007. Development of quantitative real-time PCR assays for fathead minnow (*Pimephales promelas*) gonadotropin beta subunit mRNAs to support endocrine disruptor research. Comp.Biochem Physiol C: Toxicol Pharmacol 145(2):171-183.

Cook, J.C., Denslow, N.D., Iguchi, T., Linney, E.A., **Miracle, A.L.**, Shaw, J.R., Viant, M.R. and Zacharewski, T.R. ““Omics” approaches in the context of environmental toxicology”, in Genomic Approaches for Cross-Species Extrapolation in Toxicology (Benson, W.H. and DiGiulio, R.T., eds), SETAC Publishing, 2007.

Villeneuve, D.L., Larkin, P., Knoebl, I., **Miracle, A.L.**, Kahl, M.D., Jensen, K.M., Makynen, E.A., Durhan, E.J., Denslow, N.D., and Ankley G.T. 2007. A graphical systems model to

facilitate hypothesis-based ecotoxicogenomics research on the teleost brain-pituitary-gonadal axis. *Environ Sci and Technol.* 41(1):321-330.

Ankley, G. T., Daston, G., Degitz, S., Denslow, N., Hoke, R., Kennedy, S., **Miracle, A.**, Perkins, E., Snape, J., Tillitt, D., Tyler, C., Versteeg, D. Toxicogenomics in regulatory ecotoxicology: Potential applications and practical challenges. 2006. *Environ. Sci. Toxicol.* 40(13):4055-65.

**Miracle, A.L.**, Ankley, G.T. and Lattier, D.L. Expression of two vitellogenin genes (*vg1* and *vg3*) in fathead minnow (*Pimephales promelas*) liver in response to exposure to steroidal estrogens and androgens. 2006. *Ecotoxicol. Environ. Saf.* 63:337-342

**Miracle, A.L.**, and Ankley, G.T. Ecotoxicogenomics: Linkages between exposure, effects, and risk assessment. 2005, *Reprod Toxicol*, 19(3):321-326.

Ankley, G. T., DeFoe, D. L., Kahl, M. D., Jensen, K.M., Makynen, E.A., **Miracle, A.L.**, Hartig, P., Wilson, V., Gray, L.E., and Cardon, M. Evaluation of the model anti-androgen flutamide for assessing the mechanistic basis of responses to an androgen in the fathead minnow (*Pimephales promelas*) 2004 *Environ. Safety Toxicol.*38(23):6322-7.

Anderson MK, Pant R, **Miracle AL**, Sun X, Luer CA, Walsh CJ, Telfer JC, Litman GW, Rothenberg EV. Evolutionary origins of lymphocytes: ensembles of T cell and B cell transcriptional regulators in a cartilaginous fish. 2004. *J Immunol.* 172(10):5851-60.

**Miracle, A.L.**, Toth, G., and Lattier, D.L. The Path from Molecular Indicators of Exposure to Describing Dynamic Biological Systems in an Aquatic Organism: Microarrays and the Fathead Minnow. 2003 *Ecotoxicology.* 12(6):457-462.

Bartl, S., **Miracle, A.L.**, Rumfelt, L., Kepler, T.B., Mochon, E., Litman, G.W., and Flajnik, M. Terminal deoxynucleotidyl transferases (TdT) from elasmobranchs reveal structural conservation within vertebrates. 2003 *Immunogenetics* 55(9): 594-604.

Boucek, R., Steele, A., **Miracle, A.L.**, and Atkinson, J. Effects of angiotensin converting enzyme inhibitor on delayed-onset doxorubicin-induced cardiotoxicity. 2003 *Cardiovasc Toxicol.* 3(4):319-329.

Lattier, D.L., Reddy, T.V., Gordon, D. Lazorchak, J.M., Smith, M.E., Williams, D.E., Wiechman, B., Flick, R.W., **Miracle, A.L.** and Toth, G. 17 $\alpha$ -ethynylestradiol-induced vitellogenin gene transcription quantified in livers of adult males, larvae, and gills of fathead minnows (*Pimephales promelas*). 2002 *Environ. Tox. Chem.* 21(11):2385-2393.

Hawke, N.A., Yoder, J.A., Haire, R.N., Mueller, M.G., Litman, R.T., **Miracle, A.L.**, Stugei, T., Sheni, L., Miller, N., and Litman, G.W. Extraordinary variation in a diversified family of immune-type receptor genes. *Proc. Nat. Acad. Sci.* 2001 Nov 98(24):13832-13837.

**Miracle, A.L.**, Anderson, M.K., Litman, R.T., Walsh, C.J., Luer, C.A., Rothenberg, E.V., and Litman G.W. Complex expression patterns of lymphocyte-specific genes during the development of cartilaginous fish implicate unique lymphoid tissues in generating an immune repertoire. *Int Immunol.* 2001 Apr;13(4):567-580.

Anderson, M.K., Sun, X., **Miracle, A.L.**, Litman, G.W., and Rothenberg, E.V. Evolution of hematopoiesis: Three members of the PU.1 transcription factor family in a cartilaginous fish, *Raja eglanteria*. *Proc Natl Acad Sci U S A.* 2001 Jan 16;98(2):553-8.

**Miracle, A.L.**, Hawke, N.A., Anderson, M.K., and Litman, G.W. The phylogenetic development of the cells that express, and the mechanisms that diversify, immunoglobulins and T cell antigen receptors. In: Zon L, ed. *Hematopoiesis: A Developmental Approach*. Oxford University Press, 2001; 565-573.

Haire, R.N., **Miracle, A.L.**, Rast, J.P., and Litman, G.W. Members of the Ikaros gene family are present in early representative vertebrates. *2000 J Immunol* Jul 1;165(1):306-312

Boucek, R.J., **Miracle, A.L.**, Anderson, M.K., Engelman, R.W., Atkinson, J. and Dodd, D.A. Persistent effects of doxorubicin on cardiac gene expression. *J. Mol. Cell. Cardiol.*, 1999, 31(8):1435-1446

Strong, S.J., Mueller, M.G., Litman, R.T., Hawke, N.A., Haire, R.N., **Miracle, A.L.**, Rast, J.P., Amemiya, C.T., and Litman, G.W. An extensively diversified family of novel immune-type genes that encodes variable and joining regions and is distinct from immunoglobulin and T cell antigen receptors. *Proc. Nat. Acad. Sci.* 1999, 96(26):15080-15085

**Miracle, A.L.** and Campton, D.E. Tandem repeat sequence variation and length heteroplasmy in the mitochondrial DNA D-loop of the threatened Gulf of Mexico sturgeon (*Acipenser oxyrinchus desotoi*), *J. Hered.* 1995, 86:22-27.

Chapman, F.A., Bardi, R.W., O'Keefe, S.F., Chen, I.C., **Miracle, A.L.**, and Campton, D.E. Establishment of parameters critical for the culture and commercialization of Gulf of Mexico sturgeon, *Acipenser oxyrinchus desotoi*, NOAA project No. NA27FD0066-01 final report, 1993.

### **Invited Presentations**

- National Nanotechnology Initiative; Nanomaterials and the Environment Workshop, “Transformation in the Organism and in the Environment”, “How Environmental Exposures Occur and Change Under Different Environmental Conditions”, Rosslyn, VA, October 6-7, 2010.
- Anadromous Fish Evaluation Program, “Head Injury Biomarker Expression and Use of a Sensor Fish Device to Characterize Passage Conditions for Juvenile Chinook Salmon

Passing Through the Removable Spillway Weir at Lower Monumental Dam, 2008”, Portland, OR, December 3, 2008.

- The Thrill of the Hunt: Engineering Solutions for Specialty Crop, “Environmental Biomarkers.” Kennewick, WA, July 28, 2008.
- Waste Management 2008, "Integration of ‘omics technologies for characterization of complex microbial ecosystems." Phoenix, AZ, February 2008.
- Anadromous Fish Evaluation Program, “Pilot study to evaluate juvenile salmon passage conditions at temporary spillway weirs at McNary Dam: Measuring the potential for injury with a head trauma biomarker” Walla Walla, WA December 3, 2007.
- Environment Canada ‘Omics Technologies Workshop, “Integrated ‘Omics Technologies for Environmental Monitoring and Remediation”, Canada Centre for Inland Waters, Burlington, Ontario, October 26, 2007.
- Community Science and Technology Seminar Series, “If Mother Nature Could Talk”, Columbia Basin College, Pasco, WA, April 17, 2007.
- SETAC North America Annual Meeting, “Assessment and prediction of ecosystem change and damage: A molecular systems approach using different ‘omics technologies”, Montreal, Canada, November 7, 2006.
- Department Seminar, “Environment and Biomolecular Systems”, Oregon Health and Sciences University, Portland, OR. October 20, 2006.
- USEPA Region 10 Environmental Assessment Office, “Trends in Molecular Tools for Ecosystems Research”, February 15, 2006.
- Anadromous Fish Evaluation Program, “Comparison of Delayed Mortality Impacts in Transported and In-River Migrating Juvenile Salmon Using Total Biological Systems Assessment “, Portland, OR, September 27, 2005.
- SETAC North America Annual Meeting, “Assessing the use of oligonucleotide microarrays for fathead minnow (*Pimephales promelas*) to examine exposure variables”, Portland, OR, November 18, 2004.
- Department Seminar, “Ecotoxicogenomics: The Use of ‘Omics Technologies in Aquatic Toxicology”, Wayne State University, Detroit, MI. September 22, 2004.
- BioNorth Technology Symposium, “Genomics and Environmental Research”, Ottawa, Canada, November 18, 2003.
- SETAC North America Annual Meeting, “Using genomics to examine multiple exposure variables in bioindicators research”, November 13, 2003.
- National Groundwater Association Annual Meeting, “Adapting Microarray Technology for Use in Ecotoxicogenomics”, Minneapolis, MN, March 17, 2003.

#### **Editorial Positions:**

- Editorial board, Environmental Toxicology and Chemistry, 2006 to 2009
- Editorial board, Ecotoxicology and Environmental Safety, 2004 to present
- Guest Editor, Vadose Zone Journal, 2011

**Academic Positions:**

1997: guest lecturer, University of South Florida (USF), Tampa, FL

1995 - 1999: Adjunct Faculty at St. Petersburg Junior College (SPJC), Gibbs Campus, St. Petersburg, FL

1993 - Graduate Teaching Assistant, University of Florida (UF), Gainesville, FL

**Awards and Honors:**

Outstanding Performance Award, PNNL, 2006, 2008, 2009, 2011

ORD Science Communications Award, USEPA, 2005

Bronze Medal Recipient, USEPA, 2003

Superior Accomplishment Recognition Award, USEPA, 2002 & 2004

Recipient, Medical Sciences Scholarship, University of South Florida, 1999

Recipient, Herberta Ann Leonardy Scholarship, Florida State Association of Parliamentarians, 1998

Recipient, Edith Wright Hartley Medical Sciences Scholarship, 1998

Graduate Student of the Year, 1993, Department of Fisheries and Aquatic Sciences, University of Florida