

United States Environmental Protection Agency

- Office of Research and Development
- National Health and Environmental Effects Research Laboratory
- Mid-Continent Ecology Division, Duluth, Minnesota

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Research Events

DIVISION ECOLOGISTS CONTRIBUTE TO WORKSHOP ON LAKE SUPERIOR REGULATION REVIEW

In February, Division Ecologists Anett Trebitz, Michael Sierszen, Tom Hollenhorst, and Janet Keough were invited members of a workshop to refine indicators and approaches to investigating alternative outflow regulation plans for Lake Superior. The workshop, held in Windsor, Ontario, was sponsored by the International Joint Commission for the International Upper Great Lakes Study (http://www.iugls.org/en/home_accueil.htm). The workshop was organized by the Ecosystem Technical Workgroup for the Upper Great Lakes Study and brought together a group of Great Lakes coastal ecologists from the US and Canada. The workshop provided a review of a white paper that will serve as the strategy for the Ecosystem assessment of alternative regulation plans.
Contact: Janet Keough (218) 529-5025 (keough.janet@epa.gov)



ORD GREAT LAKES INVASIVE SPECIES INITIATIVE

On March 5, ORD scientists from the National Center for Environmental Assessment (NCEA), National Exposure Research Laboratory (NERL), and the National Health and Environmental Effects Research Laboratory (NHEERL) visited the Great Lakes National Program Office (GLNPO) and Region 5 in Chicago to present the findings of the ORD Great Lakes Invasive Species Initiative. GLNPO and Region 5 have been the primary clients of the Initiative, and the visit on March 5th was the third meeting focusing on progress, results, and outcomes.

The ORD Great Lakes Initiative included a wide array of topics but had three primary emphasis areas: 1) predict the spread of potential invasive species that are likely to become established and reach nuisance levels, 2) develop and implement monitoring protocols using customized and advanced techniques in high-risk areas, and 3) predict the potential ecosystem impacts of invasive species on the lower food web.

ORD speakers on the agenda were Russell Kreis (NHEERL-MED) and Michael Slimak (NCEA-HQ), who presented an introduction and overview of the Initiative and facilitated a discussion on next steps and future considerations; and Victor Serveiss (NCEA-HQ), who provided results of the GARP (Genetic Algorithm for Rule-set Prediction) invasive species modeling for potential invaders and geographical spread. Jack Kelly (NHEERL-MED) discussed findings and outcomes for early detection monitoring techniques. John Darling (NERL-Cincinnati) provided results of advanced molecular/DNA diagnosis detection methods. David Miller (NHEERL-MED) presented results of invasive species effects on lower food web productivity and abundance.



Zebra Mussel

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INVASIVE SPECIES INITIATIVE – CONTINUED

The research topics and results addressed by the Initiative are of great interest to GLNPO and Region 5. Research outcomes will be used to inform present and future issues under the Great Lakes Water Quality Agreement, Collaborative Science and Monitoring Initiative, and the Great Lakes Rapid Response Task Force. Research supports a range of legislation including Executive Order for Great Lakes Regional Cooperation, Clean Water Act, National Aquatic Invasive Species Act, US-Canada Great Lakes Water Quality Agreement, and Great Lakes Legacy Act. This was an opportunity for ORD to showcase multi-disciplinary research from one of its centers and two laboratories that demonstrates ORD support to address critical issues for program offices and regions.

Contact: Russell G. Kreis Jr. (734) 692-7615

ORD SCIENTISTS CONTRIBUTE TO SETAC WORKSHOP ON PREDICTIVE ECOTOXICOLOGY, APRIL 19-24

Approximately 40 experts with multidisciplinary backgrounds participated in a SETAC-sponsored Pellston workshop, “A Vision and Strategy for Predictive Ecotoxicology in the 21st Century: Defining Adverse Outcome Pathways Associated with Ecological Risk.” The workshop, held in Forest Grove, Oregon, focused on some of the key challenges related to implementing a predictive toxicity testing paradigm (i.e., greater use of in vitro assays, molecular and biochemical markers, and predictive models) in the field of ecological risk assessment. The workshop was supported by the US Army Engineering Research and Development Center (ERDC), the Procter and Gamble Company, the European Natural Environment Research Council (NERC), and the USEPA. MED toxicologist Dan Villeneuve co-chaired the workshop and MED researchers Gerald Ankley and John Nichols served as participants and ad hoc advisors to the organizing committee. Additional participating ORD scientists were Kevin Crofton (NTD), Stephen Edwards (NHEERL), and Matthew Etterson (MED).



This workshop was an opportunity for ORD scientists to provide leadership in developing concrete research strategies aimed at making more effective use of mode-of-action-based predictive tools to support ecological risk assessments. The recent US National Research Council (NRC) report, *A Vision and Strategy for Toxicity Testing in the 21st Century*, advocated greater use of in vitro bioassays and mode-of-action-based predictive models as a basis for future human health risk assessment. This workshop provided ORD scientists with an opportunity to discuss how the strategy and vision proposed by the NRC can be applied to ecological risk assessment, and develop research strategies that can provide the scientific foundation to support implementation of that vision in the field of ecotoxicology. Additionally, it provided a unique forum for ORD scientists to exchange ideas with internationally-recognized scientists from academia, government, and the private sector, and communicate those ideas to the scientific community via the workshop proceedings, which are to be published in a peer-reviewed scientific journal. **Contact:** Dan Villeneuve (218) 529-5217

MED SCIENTISTS ORGANIZE GREAT RIVERS SPECIAL SESSION AT NABS MEETING, MAY 17-22



Ecological research on great rivers has lagged behind research on smaller rivers and streams. For the mid-continent great rivers of the US – the Mississippi, Missouri, and Ohio – a recent EPA research effort, the Environmental Monitoring and Assessment Program for Great Rivers (EMAP-GRE) has increased our knowledge of the ecology of these rivers, and has motivated the development of new large river bioassessment tools. This special session, *Basic and applied ecological research on the US mid-continent great rivers*, will highlight the recent research on these rivers conducted by EMAP-GRE participants and by other scientists working in the mid-continent great rivers. The underlying theme of the session is how basic and applied ecological research findings are relevant for river monitoring, management, and restoration. The session, organized by Drs. Brian Hill and Ted Angradi of MED, will consist of 18 presentations by federal, basin commission, state, and university researchers.

This will be the 57th annual meeting of the North American Benthological Society, and will be held in Grand Rapids, Michigan. The NABS annual meeting has established a reputation for the high quality of its program and presentations. **Contact:** Brian Hill (218) 529-5224



The International Association for Great Lakes Research (IAGLR) will convene its 52nd Annual Conference at the University of Toledo. IAGLR is devoted to research on the St. Lawrence Great

Lakes and other large lakes of the world. The theme for IAGLR 2009 is "Bridging Ecosystems and Environmental Health" and the conference will feature 42 technical sessions and more than 500 oral and poster presentations, with an anticipated attendance of over 800. Conference information can be found at:

<http://www.iaglr.org/conference>

Scientists from NHEERL-MED Duluth, Minnesota, and Grosse Ile, Michigan, will be attending and are senior authors on four presentations and co-authors on three others, distributed over five technical sessions. Peder Yurista has co-convened the technical session entitled *Upper Great Lakes food webs, conditions, and assessments*, and will also present a platform presentation in the

session. Jack Kelly will also present in the same session. Russell Kreis will present an invited paper in the session entitled *Fish contaminant advisories in the Great Lakes: bridging contaminants and human health*. Ronald Rossmann will participate in *Causes of injury to ecosystems and environmental health across the Great Lakes*. Two presentations with MED co-authors will also be given in the *Physical limnology and physical-chemical-biological coupling in lakes* session, and one in the *Remote sensing, visualization, and spatial data applications for the Great Lakes* session.

This international event is the largest Great Lakes conference of the year, and an opportunity for MED staff to showcase research results over a broad range of topic areas and network with other Great Lakes scientists working in multi-disciplinary areas. The presentations support a range of legislation including Executive Order for Regional Cooperation, Clean Water Act, US-Canada Great Lakes Water Quality Agreement, and Great Lakes Legacy Act. **Contact:** Russell G. Kreis Jr. (734) 692-7615

Featured Research

AN INTEGRATED WATERSHED-NEARSHORE OBSERVING SYSTEM REVEALS LANDSCAPE PRESSURES ON THE GREAT LAKES

MED has an active research program that focuses on the nearshore/coastal zone of the Great Lakes. Shallow coastal waters have received little attention from the perspective of monitoring and research, although there is a widely-recognized need for a consistent and comprehensive set of information. MED's research and development efforts of the past 6-8 years have had two general thrusts: 1) to develop the means to adequately sample and report on coastal aquatic ecosystems and, moreover, to integrate such information into a larger whole lake assessment context; and 2) to examine the nature and expression of contributing watersheds upon coastal systems, to aid in protective and restorative strategies for the entire basin-lake system. Some recent progress and findings on the latter topic are highlighted in this briefing.

Coastal systems are dynamic and have notoriously wide ranges of environmental/ecological variability. As consequence, one issue has been a difficulty in resolving the "signal" of ecological effects due to terrestrial, landscape discharges from the "noise" of background spatial and temporal variability. To overcome this problem, MED has been developing a high resolution in situ water sampling system to provide information at appropriate scales for the nearshore, yet sample efficiently and cost-effectively. To date, we have used this system to survey much of Lake Superior, the entire US coast of Lake Huron, and a full circumnavigation of Lake Ontario. This summer, we will circumnavigate Lake Erie and in 2010 we expect to cover Lake Michigan.

In conjunction with the information on water quality and plankton biology from these surveys, we have been using detailed landscape data summarized spatially for all the US watersheds across the Great Lakes as part of the Great Lakes Environmental Indicators Project (see Danz et al. 2007; Niemi and Kelly, 2007). The combination of water and landscape quality data has proven very powerful. It has helped us resolve some of the driving pressures which exist on land that influence the ecology of the lake. Remarkably, in Lake Superior (See Figure) we have successfully used certain landscape information to predict the water quality, phytoplankton, and zooplankton

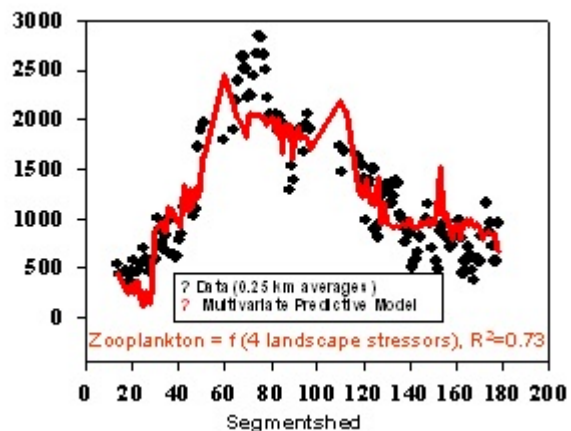


Figure. From Yurista and Kelly (In press). The black points show water-column integrated biomass of zooplankton measured by an in situ sensor oscillated from near-bottom to near-surface, and summarized as 0.25 km track lengths. Segmentsheds represent watersheds along this 537-km nearshore transect that followed the western Lake Superior shoreline. The red line shows a model prediction of biomass based on a spatially-explicit multivariate regression that uses four terrestrial landscape metrics summarized for adjacent watersheds as predictor variables.

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LANDSCAPE PRESSURES ON THE GREAT LAKES – CONTINUED

abundance and biomass with the shallow receiving nearshore waters. We know that discernible nearshore patterns are somewhat stable within seasons, as we see repeatable features over repeated surveys in the same lake. Subsequent similar summaries for the other lakes are being prepared and we will soon have a complete picture across the whole shoreline of the Great Lakes that begins to tie the terrestrial basin activities to the nearshore lake quality.

References:

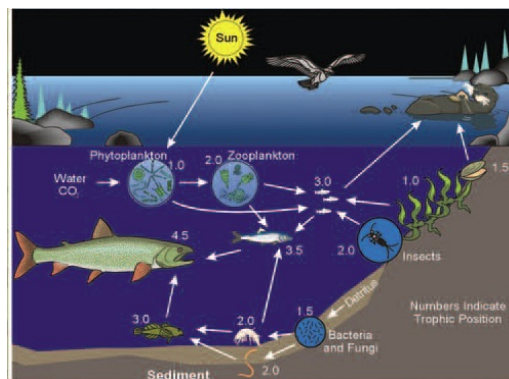
- Danz, N., G.J. Niemi, R.R. Regal, T. Hollenhorst, L. Johnson, J. Hanowski, R.P. Axler, J. Ciborowski, T. Hrabik, V.J. Brady, J.R. Kelly, J.A. Morrice, J.C. Brazner, R. Howe, C.A. Johnson, and G.E. Host. 2007. Integrated measures of anthropogenic stress in the US Great Lakes Basin. *Environmental Management* 39:631-647.
- Niemi, G. J. and J.R. Kelly (Guest Editors). 2007. Environmental indicators for the coastal region of the North American Great Lakes. *Special Issue of Journal of Great Lakes Research*. Volume 33(S13).
- Yurista, P.M. and J.R. Kelly. Spatial patterns of water quality and plankton from high-resolution continuous in situ sensing along a 537-km nearshore transect of western Lake Superior, 2004. *Special Lake Superior Issue, Aquatic Ecosystem Health and Management Society, In: Ecovision World Monograph Series, Backhuys Publishers, the Netherlands*. In press.

EXTRAPOLATING BIOACCUMULATION DATA

When performing assessments of risk at sites with contaminated sediments, risk assessors need to estimate residues in fish and other aquatic biota based upon the levels of contaminants in the sediments. Unfortunately, risk assessors are often challenged by data limitations, i.e., 1) contaminant data available for the sediments only (i.e., no contaminant data for biota), 2) incomplete data such that biota-sediment accumulation factors (BSAFs) can not be developed because of temporal and/or spatial differences between the sediment and tissue data, and 3) BSAF data limited to select locations and/or species. When adequate field data exist, residues in fish and other aquatic biota can be estimated mechanistically with food web models or empirically with field measured BSAFs. However, for cases with inadequate data, risk assessors must use some type of estimation or extrapolation technique where BSAFs are ultimately derived for the species and location of interest from existing BSAF data. Extrapolation techniques can range from direct application of existing BSAF data to the site of interest to the development of BSAFs from existing data after modification for condition differences. The need for extrapolation techniques is great given the number and diversity of Superfund sites across the nation.



In order to develop extrapolation techniques, a dataset of approximately 17,000 BSAFs was assembled from two sources: 1) an EPA data set consisting data from 20 sites, mostly Superfund sites, and includes data from 14 freshwater, 4 marine, and 2 tidal ecosystems; and 2) BSAF data from the field study of Wong et al. (2001) for chlorinated pesticides from 90 stream/river sites for mussel and fish species. With these data, BSAFs were predicted by simply applying a BSAF from one location/site/species combination to another. The predicted BSAF was then compared to the measured BSAF for the comparison of interest, and level of agreement was tabulated. Five different scenarios, commonly faced by Superfund risk assessors, were evaluated: 1) application of BSAFs from one species to other species at a sampling location, 2) application of BSAFs from one location to other locations within a site for the same species, 3) application of BSAFs from one species to other species at different locations within a site, 4) application of BSAFs from one site to other sites for the same species, and 5) application of BSAFs from one species to other species across sites.



Comparisons of estimated and measured BSAFs revealed median differences of <2 for within location, <3 for across locations, and <4 for across site extrapolations (by simply applying BSAFs) for fish, mussel, and decapod crustacean data groups. In general, median differences were relatively similar across chemical classes, i.e., PCBs, PCBs with TEFs, PCDD/Fs, chlorinated pesticides, and PAHs. These comparisons suggest that sediment to fish relationships can be estimated, with reasonable accuracy (i.e., <3), for most situations commonly faced by Superfund risk assessors. **Contact:** Lawrence Burkhard (218) 529-5164

Current Events

MED'S NEW AQUATIC CULTURE WASTEWATER SYSTEM

In mid-March, the Division began to send the water used to culture its aquatic animals to a new on-site wastewater treatment system. We previously disposed of this water by sending it to the Western Lake Superior Sanitary District's treatment plant in Duluth. The facility initially draws clean water from Lake Superior and uses it to husband fish, frogs, and invertebrates for research programs. Water from this culture operation contains only unused food and animal waste from healthy animals; this wastewater does not contain water used in toxicology research. This water is used to rear a diverse array of aquatic organisms at the Duluth EPA facility, including several species of small fish (i.e., fathead minnow, medaka, zebrafish, and sculpin), two amphibian (*Xenopus*) species, rainbow and brook trout, and various classes of aquatic invertebrates such as Lumbriculus, Hyallela, and Daphnia. Over 50,000 gallons per day of Lake Superior water are used for culturing, and had been discharged to the local sanitary district for treatment. This single pass water added a large volume of essentially clean water to the sanitary sewer system, and cost the Division over \$100,000/year for treatment. The new wastewater treatment process allows us to treat this water to remove bacteria and nutrients from the culture water and return it to Lake Superior as clean water. **Contact:** Carl Richards (218) 529-5010

UNIVERSITY FOR SENIORS, 2009

A group of scientists from MED presented a water quality course as part of the University of Minnesota Duluth's University for Seniors continuing education program. In this winter term course conducted during January and February, current research from a variety of ongoing research programs within the USEPA was presented and discussed with students. Speakers emphasized the relationship between the national environmental problems, the regulatory setting for these issues, and ongoing research that helps address fundamental science questions needed to resolve these difficult problems. Over 25 students enrolled in the course. Topics and instructors were:

- Water quality issues associated with Concentrated Animal Feedlot Operations (CAFOs), Gary Ankley
- Environmental monitoring and assessment of great rivers, Dave Bolgrien
- Nanomaterials: Is there a water quality problem? Steve Diamond
- Nitrogen and the Mississippi River, Brian Hill
- Overview of EPA regulatory and research challenges, Carl Richards
- Great Lakes coastal wetlands: Overview of their ecology and human impacts, Anett Trebitz
- The new world of predictive toxicology, Dan Villeneuve
- Great Lakes nearshore zones, Peder Yurista



DIVISION HOSTS EPA'S BOSC EXECUTIVE COMMITTEE

In early June, the Division will host a regular meeting of the Executive Committee of EPA's Board of Scientific Counselors (BOSC). The Executive Committee tries to hold at least one meeting a year at one ORD's laboratories. This will be a chance for the committee to visit our facilities and learn about our research programs. **Contact:** Carl Richards (218) 529-5010

New Publications since November 2008

Angradi, T.R., D.W. Bolgrien, T.M. Jicha, M.S. Pearson, D.L. Taylor, and B.H. Hill. 2009. Multispatial-scale variation in benthic and snag-surface macroinvertebrate assemblages in mid-continent US great rivers. *Journal of the North American Benthological Society* 28:122-141.

Angradi, T.R., D.L. Taylor, T.M. Jicha, D.W. Bolgrien, M.S. Pearson, and B.H. Hill. 2009. Littoral and shoreline wood in mid-continent great rivers (USA). *River Research and Applications* 24:1-18.

Ankley, G.T., D.C. Bencic, M.S. Breen, T.W. Collette, R.B. Conolly, N.D. Denslow, S.W. Edwards, D.R. Ekman, N. Garcia-Reyero, K.M. Jensen, J.M. Lazorchak, D. Martinovic, D.H. Miller, E.J. Perkins, E.F. Orlando, D.L. Villeneuve, and R.-L. Wang. 2009. Endocrine disrupting chemicals in fish: Developing exposure indicators and predictive models of effects based on mechanism of action. *Aquatic Toxicology* 92:168-178.

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- Bennett, R.S., J.B. French, R. Rossmann, and R. Haebler. 2009. Dietary toxicity and tissue accumulation of methylmercury in American kestrels. *Archives of Environmental Contamination and Toxicology* 56:149-156.
- Cormier, S.M., J.F. Paul, and R.L. Spehar. 2009. Chapter 1: Estimation of effect thresholds for the development of water quality criteria. In: *Real-Time and Deliberative Decision Making*, I. Linkov, E. Ferguson, V. Magar, Eds., Springer, the Netherlands, pp.159-178.
- Ekman, D.R., Q. Teng, D.L. Villeneuve, M.D. Kahl, K.M. Jensen, E.J. Durhan, G.T. Ankley, and T.W. Collette. 2009. Profiling lipid metabolites yields unique information on sex- and time-dependent responses of fathead minnows (*Pimephales promelas*) exposed to 17 α -ethynylestradiol. *Metabolomics* 5:22-32.
- Etterson, M.A., R.S. Bennett, E.L. Kershner, and J.W. Walk. 2009. Markov chain estimation of avian seasonal fecundity. *Ecological Applications* 19:622-630.
- Garcia-Reyero, N., D.L. Villeneuve, K.J. Kroll, L. Liu, E. Orlando, K. Watanabe, M. Sepúlveda, G.T. Ankley, and N.D. Denslow. 2009. Expression signatures for a model androgen and antiandrogen in the fathead minnow (*Pimephales promelas*) ovary. *Environmental Science & Technology* 43: 2614–2619.
- Jensen, O.P., P.M. Yurista, T.R. Hrabik, and J.D. Stockwell. 2009. Densities and diel vertical migration of *Mysis relicta* in Lake Superior: a comparison of optical plankton counter and net-based approaches. *Verh. Internat. Verein. Limnol.* 30:957-963.
- Johns, S., M. Kane, N. Denslow, K. Watanabe, E. Orlando, D.L. Villeneuve, G.T. Ankley, and M. Sepúlveda. 2009. Characterization of ontogenetic changes in gene expression in the fathead minnow (*Pimephales promelas*). *Environmental Toxicology and Chemistry* 28:873-880.
- Martinovic, D., D.L. Villeneuve, M.D. Kahl, L.S. Blake, J. Brodin, and G.T. Ankley. 2009. Hypoxia alters gene expression in the gonads of zebrafish (*Danio rerio*). *Aquatic Toxicology*. Published online: [doi:10.1016/j.aquatox.2008.08.021](https://doi.org/10.1016/j.aquatox.2008.08.021)
- Martyniuk, C.J., S. Alvarez, S. McClung, D.L. Villeneuve, G.T. Ankley, and N.D. Denslow. 2009. Quantitative proteomic profiles of androgen receptor signaling in the liver of fathead minnows (*Pimephales promelas*). *Proteome Research* 8:2186–2200.
- Melendez, W., M. Settles, J.J. Pauer, and K.R. Rygwelski. 2009. LM-3: A high-resolution Lake Michigan mass balance water quality model, USEPA/ORD/NHEERL/MED, Large Lakes and Rivers Forecasting Research Branch, *EPA/600/R-09/020*.
- Pauer, J.J. and M.T. Auer. 2009. Formulation and testing of a novel river nitrification model. *Ecological Modelling* 220:857-866.
- Weisbrod, A.V., J. Sahi, H. Segner, M.O. James, J. Nichols, I. Schultz, S. Erhardt, C. Cowan-Ellsberry, M. Bonnell, and B. Hoeger. 2009. The state of in vitro science for use in bioaccumulation assessments for fish. *Environmental Toxicology and Chemistry* 28:86-96.
- Zhang, X., K.R. Rygwelski, and R. Rossmann. 2009. The Lake Michigan contaminant transport and fate model, LM2-toxic: development, overview, and application. *Journal of Great Lakes Research* 35:128-136.

MED Seminars

RECENT AND UPCOMING SEMINARS

February 19

Dr. Julieta Werner, Lakehead University, Thunder Bay, ON

- Pulp and paper mill effluents induce distinct gene expression changes linked to androgenic and estrogenic responses in the fathead minnow (*Pimephales promelas*)

February 25

Dr. James Wheeler, Syngenta, Berkshire, UK

- Endocrine disruption: some European activities and regulatory impacts

March 11

Dr. Jake Beaulieu, USEPA, National Risk Management Research Laboratory, Cincinnati, OH

- Nitrous oxide emissions from streams and rivers

April 15

Dr. Sarah A. Spaulding, USGS Institute of Arctic and Alpine Research University of Colorado, Boulder

- Ecology and distribution of *Didymosphenia geminata* "Didymo": a Lake Superior diatom

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April 22

Dr. Robin Sternberg, NRC Associate, MED

- Regulation of thyroid-stimulating hormone release from the pituitary by thyroxine during metamorphosis in *Xenopus laevis*

April 29

Lake Superior Monitoring Conference

Host: MN SeaGrant

May 6

Dr. Euan Reavie, Center for Water and the Environment,
Natural Resources Research Institute, UMD, Ely, MN

- Phytoplankton from Great Lakes monitoring

May 12

Lindsey Blake, MS Candidate, Integrated Biological Sciences, UMD

- Characterization of the androgen-sensitive MDA-kb2 cell line for assessing complex environmental mixtures

May 13

Dr. Allen Olmstead, NRC Associate, MED

- *Xenopus tropicalis* reproductive toxicology

May 27

Dr. Jose Serrano, MED

- Biomarkers and proteomics

Awards

2008 EPA SCIENCE AND TECHNOLOGY ACHIEVEMENT AWARDS (“STAA”)

STAA awards are sponsored by EPA’s Office of Research & Development to recognize publications that demonstrate scientific excellence in support of the Agency’s mission. Publications are reviewed and selected annually by EPA’s Science Advisory Board, a panel of non-EPA experts. STAA winners represent some of our finest accomplishments and our best products.

Level 1

- Hornung, M.W., P.M. Cook, P.N. Fitzsimmons, D.W. Kuehl, and J.W. Nichols. 2007. Tissue distribution and metabolism of benzo[a]pyrene in embryonic and larval medaka (*Oryzias latipes*). *Toxicological Sciences* 100:393-405.

Level 2

- Degitz, S.J., G.W. Holcombe, K.M. Flynn, P.A. Kosian, J.J. Korte, and J.E. Tietge. 2005. Progress towards development of an amphibian-based thyroid screening assay using *Xenopus laevis*: Organismal and thyroidal responses to the model compounds 6-propylthiouracil, methimazole, and thyroxine. *Toxicological Sciences* 87:353-364.
- Ekman, D.R., Q. Teng, K.M. Jensen, D. Martinovic, D.L. Villeneuve, G.T. Ankley, and T.W. Collette. 2007. NMR analysis of male fathead minnow urinary metabolites: A potential approach for studying impacts of chemical exposures. *Analytical Toxicology* 85:104-112.
- Tietge, J.E., G.W. Holcombe, K.M. Flynn, P.A. Kosian, J.J. Korte, L.E. Anderson, D. Wolf, and S.J. Degitz. 2005. Metamorphic inhibition of *Xenopus laevis* by sodium perchlorate: Effects on development and thyroid histology. *Environmental Toxicology and Chemistry* 24:926-933.

Level 3

- Norberg-King, T.J., P.K. Sibley, G. Burton, C.G. Ingersoll, N. Kemble, S. Ireland, D.R. Mount, and C. Rowland. 2006. Interlaboratory evaluation of *Hyaella azteca* and *Chironomus tentans* short-term and long-term sediment toxicity tests. *Environmental Toxicology and Chemistry* 25:2662-2674.
- Sierszen, M.E., G.S. Peterson, and J.V. Scharold. 2006. Depth-specific patterns in benthic-planktonic food web relationships in Lake Superior. *Canadian Journal of Fisheries and Aquatic Sciences* 63:1496-1503.
- Trebitz, A.S. 2006. Characterizing seiche and tide-driven daily water level fluctuations affecting coastal ecosystems of the Great Lakes. *Journal of Great Lakes Research* 32:102-116.

Honorable Mention

- Bennett, R.S. and M.A. Etterson. 2007. Incorporating results of avian toxicity tests into a model of annual reproductive success. *Integrated Environmental Assessment and Management* 3:498-507.

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AWARDS – CONTINUED

Honorable Mention – continued

- Fitzsimmons, P.N., G.L. Lien, and J.W. Nichols. 2007. A compilation of in vitro rate and affinity values for xenobiotic biotransformation in fish measured under physiological conditions. *Comparative Biochemistry and Physiology, Part C* 145:485-506.
- Nichols, J.W., P.N. Fitzsimmons, and L.P. Burkhard. 2007. In vitro-in vivo extrapolation of quantitative hepatic biotransformation data for fish. II. Modeled effects on chemical bioaccumulation. *Environmental Toxicology and Chemistry* 26:1304-1319.
- Villeneuve, D.L., P. Larkin, I. Knoebl, A.L. Miracle, M.D. Kahl, K.M. Jensen, E.A. Makynen, E.J. Durhan, B.J. Carter, N.D. Denslow, and G.T. Ankley. 2007. A graphical systems model to facilitate hypothesis-driven ecotoxicogenomics research on the teleost brain-pituitary-gonadal axis. *Environmental Science & Technology* 41:321-330.
- Bennett, R.S. and M.A. Etterson. 2006. Estimating pesticide effects on fecundity rates of wild birds using current laboratory reproduction tests. *Human and Ecological Risk Assessment* 12:762-781.
- Etterson, M.A. and R.S. Bennett. 2006. On the use of published demographic data for population-level risk assessment in birds. *Human and Ecological Risk Assessment* 12:1074-1093.
- Nichols, J.W., I.R. Schultz, and P.N. Fitzsimmons. 2006. In vitro-in vivo extrapolation of quantitative hepatic biotransformation data for fish. I. A review of methods and strategies for incorporating intrinsic clearance estimates into chemical kinetic models. *Aquatic Toxicology* 78:74-90.
- Nacci, D., M. Pelletier, J. Lake, R. Bennett, J. Nichols, R. Haebler, J. Grear, A. Kuhn, J. Copeland, M. Nicholson, S. Walters, and W.R. Munns, Jr. 2005. An approach to predict risks to wildlife populations from mercury and other stressors. *Ecotoxicology* 14:283-293.

People

GARY HOLCOMBE RETIRES



In August of 1970, Gary began his career at the Division, when it was the "Water Lab." In late December, he finally hung up the lab coat for the last time. Gary has been a friend and colleague to many people at MED throughout the years. We will miss his even temperament, work ethic, scientific contributions, and ability to work well with people and take on new challenges.

Gary was great to work with in the lab. He is known for having the most organized, complete, and orderly lab books ever. Color coded hand drawn data sheets filled volumes of lab books with exposures on just about every species of fresh water organism imaginable. Over the course of his career he was known for his attention to detail and never left a data point unanswered. He liked to stick to test protocols and could always find that little bit of information you needed from some exposure he worked on long, long ago, which would answer your important question, "How did we do it?"

Just when you thought he was all science and serious he'd come over and say, "Seen that big buck again?" He always liked to mix his lab day with a little outdoor talk, then back to his test he would go. He is also a mean volleyball player – very sneaky! We miss him and wish him well.
