Recent advances in toxicity assessment across taxa

Ruth Sofield¹ · Tracy K. Collier²

Received: 21 July 2017 / Accepted: 8 November 2017 / Published online: 8 December 2017
© Springer-Verlag GmbH Germany, part of Springer Nature 2017

This special issue of ESPR is dedicated to the memory, and friendship, of Steve Klaine.

Stephen J. Klaine was a giant in the field of ecotoxicology, and any perusal of his CV shows that. But more than being an internationally respected and accomplished scientist, Steve was foremost a treasured colleague, a good friend to all, and always a joy to spend time with. Steve truly embodied the spirit of ISTA—good science, relevant science, and good friends. We all miss him, and his enthusiasm for the work we do.

Dr. Klaine, of Clemson University, had proposed to host the 17th International Symposium on Toxicity Assessment (ISTA17) in South Carolina, but his illness necessitated a move of ISTA17 to Washington State, where a successful conference was held.

Western Washington University in Bellingham, WA, hosted the conference from August 2–5, 2015. Bellingham is well positioned between Seattle and Vancouver, British Columbia, with numerous government agencies, academic institutions, and environmental consultants who focus on monitoring, toxicity, remediation, risk assessment, and environmental management. Seven federally recognized U.S. tribes are within a 50 km drive of Bellingham. Nearby Puget Sound has been the focus of cleanup efforts with a stated goal to restore the health of Puget Sound by 2020. Entire watersheds, from mountains to bays, are readily accessed from Bellingham. All of these features combined to create a conference with

local expertise and themes, but also included rich and extensive international contributions, as is a key feature of ISTA.

Over 60 presentations were given in nine sessions, two of which were special sessions that highlighted regional issues. The sessions included the following:

- Risk
- Stormwater—from people to fish to people (special session)
- Coastal contamination
- Emerging issues
- New testing approaches
- Multiple stressors and mixtures
- Monitoring
- Climate
- Impacts from transportation of fossil fuels in the Salish Sea (special session)

In this special issue, which highlights the work of conference attendees, a range of environments, toxicants, and test organisms are considered, and multiple techniques for the assessment of toxicity are utilized.

Rees et al. (2017) exposed *Vicia faba* to three soil types amended with biochar and compared micronuclei number, secondary root growth, metal accumulation, and changes to the soil environment when compared to unamended soils and to biochar only. The presence of biochar increased the soil pH, and reduced the uptake of metals and the genotoxicity associated with those metals. Similarly, Maki et al. (2016) assessed the changes in arsenic bioavailability to earthworms in the presence of hydrous ferric oxide (HFO) and to *Brassica juncea* in the presence of earthworms and HFO. The HFO amendments decreased metal accumulation in the earthworms, but not significantly so in the plants. Interestingly, the earthworms changed the soil environment by decreasing the pH, which corresponded to an increase in arsenic accumulation in the plants. A final manipulation of the

Responsible editor: Philippe Garrigues

✉ Tracy K. Collier
tkcoll@gmail.com

¹ Environmental Toxicology and Chemistry, Huxley College of the Environment, Western Washington University, Bellingham, USA

² Salish Sea Institute, Western Washington University, Bellingham, USA

environment is presented by Drobniewska et al. (2016). The authors irradiated sulfadimethoxine for 1 or 4 h and exposed *Lemna minor* to the solutions; they found less toxicity in the irradiated samples, indicating that the photoproducts did not contribute to the toxicity.

Manusadzianas et al. (2016) provide an example of emerging contaminant studies with their focus on the compartmentalization of nano-copper in *Nitellopsis obtusa* and relationship between that uptake and bioelectrical responses in the cells. Although the work does not distinguish whether the ions released by the nano-copper or the nano-copper itself is the primary cause of toxicity, it does contribute to this on-going discussion.

Blaise et al. (2016) presents the case for simple biomarkers that are readily measured in bivalve mollusks with minimal funding and without specialized equipment. Three biomarkers, condition index, growth index, and SOS (air-time survival), are identified as ones that can discriminate organism health, while achieving the goals of low cost and low technology. At the other end of the technological spectrum, Ye et al. (2016) and Kokushi et al. (2016) employ immune function detection and metabolomics approaches to assess toxic response. Ye et al. (2016) evaluated four in vivo immune function technologies at different levels of biological organization in *Oryzias melastigma*; a goal of this work was to develop a fish model that would allow for an evaluation of immunosuppression mechanisms in marine organisms. Kokushi et al. (2016) used principle component analysis to determine metabolic effects in *Oryzias latipes* larvae exposed to 2,4-dichlorophenol.

Kawano et al. (2016) and Uno et al. (2016) also focused on responses of *Oryzias latipes* to toxicants. In both cases, toxicity endpoints were survival, time to hatching, and developmental abnormalities. Kawano et al. (2016) exposed the embryos to four oxy-PAHs. Uno et al. (2016) similarly exposed embryos to sediments collected from seven sites in Tokyo Bay, measured PAHs and metal concentrations in the sediments, and hypothesized that PAHs might be associated with observed delays in hatching times associated with contaminated sediments.

Taken as a group, the papers in this special issue of ESPR demonstrate the breadth of toxicity assessments being conducted globally. From its somewhat humble beginnings, the International Symposia on Toxicity

Assessment have now grown in the diversity of organisms tested, the range of toxicants considered, and the increasing environmental relevance of the work being done. We envision a bright future for this international gathering of scientists devoted to better understanding the risks posed to ecosystem processes by toxic substances.

References

- Blaise C, Gagné F, Burgeot T (2016) Three simple biomarkers useful in conducting water quality assessments with bivalve mollusks. *Environ. Sci. Pollut. Res.* pp 1–8. <https://dx.doi.org/10.1007/s11356-016-6908-6>
- Drobniewska A, Wójcik D, Kaplan M, Adomas B, Nalecz-Jawecki G (2016) Recovery of *Lemna minor* after exposure to sulfadimethoxine irradiated and non-irradiated in a solar simulator. *Environ. Sci. Pollut. Res.* <https://dx.doi.org/10.1007/s11356-016-7174-3>
- Kawano M, Uno S, Koyama J, Kokushi E, McElroy A (2016) Effects of oxygenated polycyclic aromatic hydrocarbons on the early life stages of Japanese medaka. *Environ. Sci. Pollut. Res.* pp 1–8. <https://dx.doi.org/10.1007/s11356-016-6917-5>
- Kokushi E, Shintoyo A, Koyama J, Uno S (2016) Evaluation of 2,4-dichlorophenol exposure of Japanese medaka, *Oryzias latipes*, using a metabolomics approach. *Environ. Sci. Pollut. Res.* <https://dx.doi.org/10.1007/s11356-016-6425-7>
- Maki BC, Hodges KR, Ford SC, Sofield RM (2016) The influence of hydrous ferric oxide, earthworms, and a hypertolerant plant on arsenic and iron bioavailability, fate, and transport in soils. *Environ. Sci. Pollut. Res.* pp 1–14. <https://dx.doi.org/10.1007/s11356-016-7852-1>
- Manusadzianas L, Gylte B, Grigutyte R (2016) Accumulation of copper in the cell compartments of charophyte *Nitellopsis obtusa* after its exposure to copper oxide nanoparticle suspension. *Environ. Sci. Pollut. Res.* <https://dx.doi.org/10.1007/s11356-016-8023-0>
- Rees F, Dhyèvre A, Morel JL, Cotelle S (2017) Decrease in the genotoxicity of metal-contaminated soils with biochar amendments. *Environ. Sci. Pollut. Res.* pp 1–8. <https://dx.doi.org/10.1007/s11356-017-8386-x>
- Uno S, Kokushi E, Kawano M, McElroy AE, Koyama J (2016) Toxic evaluations of sediments in Tokyo Bay, Japan, using Japanese medaka embryos. *Environ. Sci. Pollut. Res.* pp 1–8. <https://dx.doi.org/10.1007/s11356-016-7581-5>
- Ye RR, Peterson DR, Seemann F, Kitamura S, Lee JS, Lau T. CK, Tsui S. KW, Au D. WT (2016) Immune competence assessment in marine medaka (*Oryzias melastigma*)—a holistic approach for immunotoxicology. *Environ. Sci. Pollut. Res.* pp 1–15. <https://dx.doi.org/10.1007/s11356-016-7208-x>

Ruth Sofield has been at Western Washington University since 2003 and is currently a Professor of Environmental Toxicology and Chemistry. She received her PhD in Environmental Science and Engineering from the Colorado School of Mines; this research was in collaboration with the Center for Coastal Environmental Health and Biomolecular Research, Marine Ecotoxicology Branch, National Ocean Service, NOAA, Charleston, SC. Dr. Sofield's current research program is focused on the effects of altered water chemistry and other environmental parameters on metal fate, transport, and aquatic toxicity. These studies range from laboratory bench scale to field scale investigations and include organism exposures combined with chemical modeling.

Tracy Collier worked for more than 30 years at NOAA's Northwest Fisheries Science Center, ending up as the Director of the Environmental Conservation Division, where his research portfolio included environmental toxicology and chemistry, assessing oil spill impacts, harmful algal blooms, seafood safety, and watershed processes. Following his "retirement" from that position, he has served as the science advisor for NOAA's Oceans and Human Health

Initiative from 2010 to 2014, and was a technical advisor to NOAA and other natural resource trustees charged with assessing injuries to marine mammals and sea turtles after the Deepwater Horizon oil spill, from 2010 to 2016. He accepted a role from 2012 to 2014 as the Science Director for the Puget Sound Partnership, a Washington State agency charged with protecting and recovering Puget Sound, protecting the ecosystem services that it provides, and with using science to inform management and policy. Tracy was also appointed to the Delta Independent Science Board in California in 2010, and recently finished serving for 2 years as the chair of that Board. Dr. Collier received his PhD from the University of Washington in 1988, and he plans to retire again someday.