# Learned Discourses: Timely Scientific Opinions

## Timely Scientific Opinions

**Intent.** The intent of Learned Discourses is to provide a forum for open discussion. These articles reflect the professional opinions of the authors regarding scientific issues. They do not represent SETAC positions or policies. And, although they are subject to editorial review for clarity, consistency, and brevity, these articles are not peer reviewed. The Learned Discourses date from 1996 in the North America *SETAC News* and, when that publication was replaced by the *SETAC Globe,* continued there through 2005. The continued success of Learned Discourses depends on our contributors. We encourage timely submissions that inform and stimulate discussion. We expect that many of the articles will address controversial topics and promise to give dissenting opinions a chance to be heard. This section is dedicated to the memory of Dr. Peter M. Chapman, who founded Learned Discourses and served as Editor until he passed away in 2017.

**Rules.** All submissions must be succinct: no longer than 1000 words, no more than 6 references, and at most 1 table or figure. Reference format must follow the journal requirement found at http://www.setacjournals.org. Topics must fall within *IEAM*'s sphere of interest.

**Submissions.** All manuscripts should be sent via email as Word attachments to the *IEAM* Editorial Office (learned_discourses@setac.org).

## In a Nutshell. . .

**ENDOCRINE DISRUPTION**

**Establishing the relevance of endocrine disrupting effects for nontarget vertebrate populations**, by Mark Crane, Nina Hallmark, Laurent Lagadic, Katharina Ott, Dan Pickford, Thomas Preuss, Helen Thompson, Pernille Thorbek, Lennart Weltje, and James Wheeler

*A critical evaluation of the European Commission's criteria to identify endocrine-disrupting properties of plant protection products.*

**ENVIRONMENTAL MONITORING**

**Use real-world data to inform the National Coastal/Great Lakes Condition**, by Robin Reash

*Ecological health assessments need historical perspectives and strong field population data in order to provide adequate context.*

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## ESTABLISHING THE RELEVANCE OF ENDOCRINE-DISRUPTING EFFECTS FOR NONTARGET VERTEBRATE POPULATIONS

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European Commission (EC) criteria to identify the endocrine-disrupting properties of plant protection products (PPPs) have been developed in a regulation for application across the European Union (EU) beginning 10 November 2018 (EC 2018), with implementation of this regulation supported by an accompanying guidance document (ECHA/EFSA 2018).

The endocrine assessment required for PPPs under this regulation is hazard based rather than risk based, but there are inherent challenges in such hazard-based regulations (Nordlander et al. 2010). For example, 1) safe products may be restricted (because humans or animals may never be exposed to doses that cause adverse effects), 2) beneficial products may be restricted with consequent loss of consumer benefits, 3) restrictions on the use of one product may lead to increased use of another product with equal or greater risks, and 4) product stigmatization and loss of incentives to innovate may occur.

Based on a review of the literature and interviews with regulators, academics, policymakers, politicians, and other stakeholders across the EU, Lofstedt (2011) concluded that political pressure to regulate on the basis of hazard or risk varied among EU Member States, and inconsistent positions were taken by Member States depending upon whether hazard assessment supported or threatened their respective national interests. Lofstedt (2011) found that Europe-wide

regulation based on weaker scientific approaches, such as hazard- instead of risk-based assessment, has been facilitated by several factors, including

- the rise of the "post-trust society,"
- a lack of interest in environmental regulatory issues on the political center right,
- an increase in vote-winning "game-playing" by politicians in policy areas that have only limited impacts on their own electorates,
- different cultural values in different Member States,
- a lack of effective communication and agreement among different national and European regulatory agencies,
- product stigmatization, and
- increasingly negative public perceptions of chemicals.

In addition to these general weaknesses of a hazard-based approach, further weaknesses are apparent in the ECHA/EFSA (2018) guidance for the identification of endocrine disruptors for PPPs due to inconsistencies between what the regulation requires and what the guidance recommends. Inconsistency is especially evident in guidance concerning vertebrate wildlife population relevance, as shown by the following 2 direct quotes:

1) "When assembling and assessing the line of evidence, any available epidemiological studies should be considered as supportive evidence for the evaluation of whether an [endocrine disruptor] ED is likely to have adverse effects for humans. However, they cannot be used to override or dismiss evidence of adversity found in laboratory studies, nor can they replace laboratory studies. Similarly, when assembling the lines of evidence for non-target organisms any field and monitoring studies and population modelling can be considered as supportive evidence" (ECHA/EFSA 2018, p 20).
2) "Effects on growth, development, [and] reproduction in single species are generally regarded relevant for the maintenance of the wild population. Therefore, the relevance of such effects at the population level should be assumed when determining the adversity in the absence of appropriate scientific data demonstrating non-relevance" (ECHA/EFSA 2018, p 22).

These statements contradict the PPP regulation clauses that a substance should be considered to have endocrine-disrupting properties "unless there is evidence demonstrating that the adverse effects identified are not relevant at the (sub)population level for non-target organisms," and that "adequate, reliable and representative field or monitoring data and/or results from population models shall as well be considered where available" [EC 2018].

This inconsistency between regulation and guidance threatens to make it difficult to disprove the relevance of endocrine effects on nontarget wildlife vertebrate populations because of an apparent reliance on a hazard assessment approach in which any indication of an endocrine-mediated individual adverse effect in any laboratory test is considered to indicate that a PPP is an endocrine disruptor with wildlife population relevance. This excludes any consideration of population relevance based on modeling or field data, which is clearly not the intention of the regulation.

Participants at a recent SETAC Pellston Workshop® on Endocrine-Active Substances (Matthiessen et al. 2017) suggested that regulation of endocrine-disrupting chemicals based on hazard alone may be partly driven by a perception that there is no toxic threshold for these substances. The workshop concluded that 1) it is impossible to prove that toxic thresholds do not exist, 2) a viable physiological basis for no thresholds has not been clearly identified, and 3) there is no evidence that no-threshold effects apply to populations. Workshop participants determined that thresholds of toxicity existed for all 6 data-rich case study substances examined, and that theoretical considerations suggested that endocrine systems could not actually function if such thresholds were absent.

Agreement on scientifically defensible methods to assess adverse population effects of PPPs in the context of endocrine-disrupting activity is urgently required. In an associated paper (Crane et al. this issue), we propose a practical and scientifically robust way to bridge the gap between the guidance and the legal requirements of the regulation. The approach maintains the hazard-based intent of the PPPs regulation and introduces the necessary steps between demonstration of individual adverse endocrine effects in laboratory organisms and demonstration of adverse effects on wildlife populations. We hope that this proposal initiates a debate among relevant stakeholders to establish scientifically sound regulatory solutions to resolve the inconsistency between the legally mandated regulation (EC 2018), the supporting guidance document (ECHA/EFSA 2018), and the intent of science-based regulation in the EU.

## REFERENCES

Crane M, Hallmark N, Lagadic L, Ott K, Pickford D, Preuss T, Thompson H, Thorbek P, Weltje L, Wheeler JR. 2019. Assessing the population relevance of endocrine disrupting effects for nontarget vertebrates. *Integr Environ Assess Manag* 15:278–291.

[EC] European Commission. 2018. Commission Regulation (EU) 2018/605 of 19 April 2018 amending Annex II to Regulation (EC) No 1107/2009 by setting out scientific criteria for the determination of endocrine disrupting properties. *OJ L* 101/33. 2018 Apr 20.

[ECHA/EFSA] European Chemicals Agency, European Food Safety Authority [with the technical support of the Joint Research Centre (JRC)]. 2018. Guidance for the identification of endocrine disruptors in the context of Regulations (EU) No 528/2012 and (EC) No 1107/2009. *EFSA J* 16(6):5311.

Lofstedt RA. 2011. Risk versus hazard – How to regulate in the 21st century. *Eur J Risk Regul* 2:149–168.

Matthiessen PG, Ankley R, Biever P, Bjerregaard C, Borgert K, Brugger A, Blankinship J, Chambers K, Coady L, Constantine Z et al. 2017. Recommended approaches to the scientific evaluation of ecotoxicological hazards and risks of endocrine-active substances. *Integr Environ Assess Manag* 13(2):267–269.

Nordlander K, Simon C-M, Pearson H. 2010. Hazard v. risk in EU chemicals regulation. *Eur J Risk Regul* 3:239–250.

## USE REAL-WORLD DATA TO INFORM THE NATIONAL COASTAL AND GREAT LAKES CONDITION

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In January 2016, the United States Environmental Protection Agency issued its "National Coastal Condition Assessment–2010" report (USEPA 2016). The purpose of the report was to provide a snapshot of ecological and water quality attributes for US coastal waters (i.e., Northeast Coast, Southeast Coast, Gulf of Mexico, Western Coast), in addition to fresh waters of the Great Lakes. The study is an extension of the agency's National Coastal Assessment (NCA) reports (2000–2006), which assessed the water quality and ecological health of lakes, rivers and streams, coastal waters, and wetlands. The most recent (2010) study evaluated a total of 35 400 $mi^2$, and the number of sample stations for each region ranged from 87 (Southeast Coast) to 405 (Great Lakes).

In the 2010 study, 5 attributes were evaluated: biological quality, water quality, sediment quality, ecological fish tissue (risks to wildlife) quality, and human health fish tissue (Great Lakes only) quality.

Biological quality (measured as benthic macroinvertebrate species richness at coastal stations, and oligochaete community structure for the Great Lakes) was rated as "good" at 56% of coastal waters or Great Lakes monitoring stations.

Water quality was assessed using an index that comprised the parameters total P, N compounds, water clarity, chlorophyll *a*, and dissolved O. The agency found that 36% of the stations sampled were rated as "good" for these parameters, while 48% of the monitoring stations were rated as "fair." For those stations rated as "poor," total P was identified as the key stressor.

Regarding sediment quality, the agency determined that about 55% of coastal and Great Lakes sample stations had a "good" quality rating, based on concentrations of pollutants in sediments and sediment toxicity test results. Gulf and Western Coast monitoring stations had the highest percentage of waters rated as "poor."

For ecological fish tissue quality, the agency assessed "the potential harm that fish tissue contaminants pose to predator fish, birds, and wildlife." Fish whole-body tissue samples were analyzed for 3 trace elements (i.e., As, Hg, Se) and 3 recalcitrant organic compounds (i.e., total PCBs and DDT, and hexachlorobenzene). For each receptor group (i.e., mammals, birds, fish), USEPA then evaluated laboratory-based toxicity data and selected the lowest observed adverse effect level (LOAEL), expressed as a body burden dose threshold (e.g., milligrams per kilogram). The agency then compared the conservative LOAEL values with measured concentrations in fish tissue samples. Ratings of "good," "fair," and "poor" were assigned to each comparison (e.g., a "poor" rating was indicated if LOAEL values were exceeded for 2 or 3 receptor groups).

For all water body segments assessed for ecological fish tissue quality, a "good" rating was determined for <1% of all study segments, a "fair" rating was assigned to between 26% and 38% of all study segments, and a "poor" rating was assigned to between 38% and 49% of all study segments. Selenium and Hg were the pollutants that resulted in the majority of LOAEL "exceedances"; however, for the Great Lakes, the report did not reference USEPA's 2016 updated water quality criteria for Se in fresh waters.

For human health fish tissue quality, for the Great Lakes stations sampled, 11% of these had total Hg concentrations in consumed fish that exceeded USEPA's methylmercury human health water quality criterion of 0.3 mg/kg wet weight.

Based on these results, the lay reader could conclude that concentrations of pollutants in fish tissue were likely the cause of pervasive adverse effects to piscivorous mammals, birds, and fish in US coastal waters and in the Great Lakes. Indeed, the report states that "…contaminants in fish may have long-term adverse effects on fish-eating wildlife." (USEPA 2016, p xi).

There are a number of concerns with the methodology used in the USEPA (2016) "snapshot" assessment. First, the lowest of all candidate LOAEL values was selected for each receptor group. This is akin to selecting the lowest observed LC50 value for a test organism instead of calculating and applying a species mean acute or chronic value (SMAV or SMCV) or genus mean acute or chronic value (GMAV or GMCV), as is applied for ambient water quality criteria development. Beckvar et al. (2005) discuss various approaches to linking whole-body fish tissue residues to potential biological effects (relative to Hg and DDT) and weigh the technical advantages of each. Fuchsman et al. (2016) reviewed the various proposed toxicity reference values for Hg (based on adverse effects to fish) and found that many of these represent ambient or "background" concentrations. Thus, selecting LOAEL values as toxicity benchmarks for environmental receptors involves uncertainty.

Moreover, the USEPA (2016) report ignores the voluminous studies that report on the health and condition of actual field populations exposed to bioaccumulative pollutants. For example, concentrations of Hg in piscivorous bird species, purported to cause adverse effects, have not resulted in adverse effects on species in the Great Lakes (e.g., Bowerman et al. 1994). Moreover, PCB and DDE concentrations have declined over time in bald eagles residing in the Great Lakes and in Michigan inland waters (Wierda et al. 2016). Similarly, concentrations of Hg in Great Lakes sediment samples have declined over time (Marvin et al. 2004). Although sublethal non-overt effects in fish-eating wildlife may occur in some highly exposed populations, the emphasis for resource agencies should be on long-term population trends using measures such as reproductive success and trends of tissue pollutant concentrations.

In summary, assessments of ecological health—especially on a regional scale—need historical perspective to provide context to the data. Laboratory-based thresholds are useful when assessing and mitigating ecological risk in the absence of long-term population data. However, where information exists on pollutant concentrations in field populations—and meaningful, associated population parameters—such data should take precedence over laboratory-based thresholds. The general public and other stakeholders will benefit from the presentation of "real world" data in environmental condition assessments.

## REFERENCES

Beckvar N, Dillon TM, Read LB. 2005. Approaches for linking whole-body fish tissue residues of mercury or DDT to biological effects thresholds. *Environ Toxicol Chem* 24(8):2094–2105.

Bowerman WW, Evans ED, Giesy JP, Postupalsky S. 1994. Using feathers to assess risk of mercury and selenium to bald eagle reproduction in the Great Lakes region. *Arch Environ Contam Toxicol* 27:294–298.

Fuchsman PC, Henning MH, Sorensen MT, Brown LE, Bock MJ, Beals CD, Lyndall JL, Magar VS. 2016. Critical perspectives on mercury toxicity reference values for protection of fish. *Environ Toxicol Chem* 35(3):529–549.

Marvin C, Painter S, Rossman R. 2004. Spatial and temporal patterns in mercury contamination in sediments of the Laurentian Great Lakes. *Environ Res* 95:351–362.

[USEPA] United States Environmental Protection Agency. 2016. National coastal condition assessment 2010. Washington (DC): Office of Water. EPA/841-R-15-006. [accessed 2018 Dec 21]. https//www.epa.gov/national-aquatic-resource-surveys/ncca

Wierda MR, Leith KF, Grubb TG, Sikarskie JG, Best DA, Bowerman W. 2016. Using bald eagles to track spatial (1999–2008) and temporal (1987–1992, 1999–2003, and 2004–2008) trends of contaminants in Michigan's aquatic ecosystems. *Environ Toxicol Chem* 35(8):1995–2002.