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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 And, although they are subject to editorial review for clarity, consistency, and brevity, these articles are not peer reviewed.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 will 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.

Rules. All submissions must be succinct: no longer than 1000 words, no more than 6 references, and at most one table or figure. Reference format must follow the journal requirement found on the Internet 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 Peter M Chapman (peter_chapman@golder.com).

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In a Nutshell...

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NONDIETARY ROUTES OF EXPOSURE IN ECOLOGICAL RISK ASSESSMENT: NOT JUST FOR THE BIRDS

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The recent Learned Discourse by Mineau (2011) highlights the importance of nondietary routes of exposure in understanding the risk of pesticides to avian species. We concur, because the available evidence strongly suggests that nondietary, and in particular, dermal exposures likely contribute significantly to total exposure. The development of data and testing methods described by Mineau will be a welcome addition to the field and will hopefully accelerate the incorporation of dermal exposure data in pesticide risk assessments for birds.

However, we would extend Mineau's argument to include other taxa, and here we focus on the potential importance of nondietary exposure to reptilian species. Reptiles have not received the attention that mammalian and avian receptors have in terrestrial ecological risk assessments or ecotoxicology. This is a well-recognized data gap driven most likely by a lack of regulations mandating the generation of reptile data for contaminant management. Nonetheless, these organisms are important ecological receptors and may generally be suffering the same fate as many amphibians, namely, declining populations around the globe (Gibbons et al. 2000). Efforts have been made to further the understanding of how reptiles respond to contaminants, and the generation of a laboratory model for testing chemicals (Talent et al. 2002) is likely one of the important advances in recent years. Hence, the generation of toxicity data on reptiles has seen some progress driven mostly by stakeholders who recognize that reptiles are important ecological receptors and/or the desire by researchers to provide data useful for managing this taxon.

In addition to the lack of a federal mandate to generate ecotoxicological data or to explicitly protect reptiles under regulatory acts such as the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), there may also be the assumption that reptiles are protected because other receptors, such as birds, are protected. In this case, birds are used as surrogates for reptiles. Because birds are endothermic with larger metabolic demands than reptiles, absolute dietary exposures are higher in birds than reptiles (Weir et al. 2010). However, because proportionally more skin surface area may contact contaminated soils or plants in reptiles, dermal exposure may be higher in these species compared to birds, at least in terms of the contribution to total exposure. In addition, because reptiles feed more sporadically than birds, the relative contribution of dermal exposure to total exposure will likely be greater for reptiles.

The long-held belief is that reptile skin is tough and relatively impermeable. Toxicity experiments, however, have shown that reptiles can receive lethal doses of contaminants via dermal exposure (Brooks et al. 1998). In fact, toxicity via dermal exposure in reptiles can equal or exceed that via the oral route, indicating that reptile skin is not an impenetrable barrier. Exposure model simulations have further confirmed the relative importance of dermal exposure to total exposure in reptiles and also point to important uncertainties regarding behavior, bioavailability, and transport across the skin (Weir et al. 2010). These uncertainties apply to other receptors as well, and we suggest, as Mineau did, that more research is sorely needed.

As an example of a data need, skin lipid content is likely to play an important role in dermal exposure and can vary according to environmental conditions. Much data have been generated to explain why reptiles in arid regions have a greater capacity to resist cutaneous water loss, and there is evidence that lipid content, rather than keratin, dictates water permeability in reptile skin (Roberts and Lillywhite 1980). Skin lipid content may vary by location, even within individuals of the same species. Relationships between contaminant physicochemical parameters and dermal exposure have been created for human cutaneous exposure, which may be applicable to other mammals (Walker et al. 2003). However, how these relationships change with changes in skin lipid content in terrestrial vertebrates is not well understood.

Although not the focus of this essay, Weir et al. (2010) also compared reptile and avian toxicity data for a small number of chemicals for which data were available for representatives from both taxa and found that reptiles were more sensitive than birds in one-third of the cases. Birds are not unilaterally more sensitive to contaminants than reptiles, which further highlights how estimates of risk to birds may not represent risk to reptiles. The extent to which reptiles may be underprotected in ecological risk assessment is unknown, but available evidence suggests that at the very least the problem requires considerably more research.

We are currently exploring the relative importance of dermal and dietary exposures to contaminants in a model reptilian species, the Western fence lizard, *Sceloporus occidentalis*. Tiered methods involving laboratory studies, mesocosms, and field studies are planned to more fully characterize the nature and extent of exposure in reptiles. The effort will culminate in a probabilistic ecological risk assessment model we hope will find utility in some site-specific risk assessments where reptiles are identified as important receptors.

We realize that research priorities are focused on improving ecological risk assessments for species that are already included in environmental laws. We also realize that it is highly unlikely new taxa will be added to current environmental regulations. However, that does not mean that no research or risk assessment attention should be paid to taxa not covered under environmental mandate. And for herpetotoxicologists, we stress the need for continuing research on the effects of and exposure to contaminants.

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RELEASE OF CHEMICALS FROM PLASTICS: LESSONS FROM FOOD CONTACT WITH PLASTICS

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Beaches covered in plastic rubbish have recently made it into the mainstream media, along with a global concern for the issue of environmental pollution with plastic debris. Most concern involves the marine plastic waste that can be found in the world's ocean gyres. This plastic waste has been shown to accumulate persistent organic pollutants. During weathering, the plastic can mechanically degrade into small enough fragments that are subsequently mistaken for food and ingested by marine animals. Apart from concerns about wildlife health, the accumulation of persistent organic pollutants across the food chain is a matter of great relevance for human and environmental health.

There is, however, another aspect of plastic marine pollution that has yet to receive increased scrutiny: chemicals inherently present in the plastic can also partition into the environment and enter the food chain. Most types of plastic used for food packaging applications have recently been shown to leach unknown estrogenic compounds (Yang et al. 2011). Thus, plastic debris may present another sentinel for release of endocrine-disrupting chemicals (EDCs) into the environment, and single-use articles such as food packaging are thought to constitute a significant part of plastic litter. In Europe, for example, around 10 million tonnes of plastic are used for food and beverage packaging; at present, packaging is