CRRC Professional Development Proposal

Developing a Method for Estimating Injury and Risk to a Major NOAA Trust Resource (Finfish) due to Persistent Bioaccumulative Chemicals: Mercury

Submitted 10/31/06 by Dr. Tom Dillon and Ms. Nancy Beckvar (ORR/ARD)

Problem Statement: Many NRDAs case teams around the country have struggled with quantifying ecological injury to finfish, a major NOAA trust resource, arising from the release of persistent bioaccumulative (PB) chemicals to the aquatic environment. At an even larger number of sites, ORR staff wrestle with this same issue while conducting Remedial Investigations to assess the ecological risk posed by PBs to fish. Currently, NOAA has no published guidance, model or recommended approach for quantifying the risk or injury of PB chemicals to fish. In contrast, there is a plethora of publications and technical support that ORR staff can draw upon to assess the risk or injury to the benthic community arising from contaminated sediments. Elevated levels of PB chemicals in fish tissue are a significant, national problem. In all but 2 states (Alaska, Wyoming), more than 3,200 fish advisories have been issued for PB chemicals. The number of water bodies under advisories represents 65% of this nation's contiguous coastal waters (excluding Alaska). While the advisories frequently focus on five PB chemicals (mercury, PCBs, chlordane, dioxins/furans and DDT/metabolites), the vast majority (>80%) involve elevated levels of mercury (Hg) in fish.

Proposed Project: In 2005, the Co-PIs for this proposal published a peer-reviewed journal article (ETAC 24:2094-2105) identifying "protective" tissue concentrations of Hg

and DDT in fish. This was a valuable contribution in that it identified for ORR staff in a peer-reviewed journal format, what levels of PB chemicals represent *de minimus* injury or risk to fish. What the paper did not do is report what levels of adverse effects may be expected at tissue concentrations above the "protective" concentrations. For example, what is the injury to a fish carrying a Hg body burden of 1 mg/kg that is above the protective concentration of 0.2 mg/kg? ORR staff are asking this type of question right now at sites and cases around the country involving PB chemicals.

The proposed work will, in short, produce two needed tools; 1) a complete whole-body residue-based dose-response curve for mercury in fish based on extant published toxicological data and 2) the quantitative relationships between disparate measures of adverse effects (e.g., reduced survival, growth, reproduction) and fish injury. For example, 0% survival could be construed as 100% fish injury; 0% hatching success as 100% injury; and so on. This latter approach, using injury as a common metric for integrating multiple data sets, is a truly innovative aspect of this work. Results will serve both the injury assessment and risk assessment communities within ORR and the broader scientific/regulatory communities.

Briefly, the approach will be to review and synthesize existing Hg residue-effects literature (≈ 20 papers). We will develop criteria to exclude suspect or questionable data in a consistent and unbiased fashion. We will establish the quantitative relationships between disparate biological endpoints and the common "injury" metric. The residue-based dose-response curve will then be "field verified" by examining model outputs

against the previously published “protective” tissue concentration as well as independently derived national “background” tissue concentrations.

Benefit to ORR and CRRC: If funded, this work will meet the immediate needs of ORR staff as outlined above. That is, the completed project will provide a published model for quantitating injury and risk posed by an important PB chemical (Hg) to a major NOAA trust resource, finfish. This model will supplement existing parallel guidance we currently have for assessing the injury and risk posed by contaminated sediments to the benthic community. We anticipate feedback from anonymous peer-reviewers following manuscript submittal as well as from the user population within ORR. Based on that feedback we will seek to improve and/or refine the approach. Long-term benefits include the application of this approach to other PB chemicals in fish such as PCBs, dioxins/furans, DDT. The approach may also be applicable to oils and PAHs by coupling with the novel dose-based toxicity benchmark approach recently proposed for fish (Driscoll et al. 2005) where residue-based injury and risk assessment are more problematic. This project, if funded, will permit the Co-PIs to accelerate an ongoing, low-level effort to develop a residue-base dose-response injury curve for mercury. The funding will elevate the priority of this work allowing us to “get the product to market” in an expedited manner. This will meet the immediate needs of the user community within and outside of ORR.

Project Outcomes: The major work product will be a draft manuscript prepared for a peer-review journal. Peer-reviewed publication establishes greater visibility and

credibility for our program within the broad scientific community. Journal publication also represents a significant milestone in professional development for both Co-PIs. The draft manuscript will be submitted to CRRC in Adobe PDF format. In addition, a summary data table with more detailed information not appropriate for journal publication will be submitted to CRRC in Adobe PDF format. Prior experience suggests to us that information in this table will be of direct use to ORR staff.

Timeline: This work will be accomplished over a 6-week period (April 9, 2007 to May 18, 2007) in five 1-week professional development mini-sabbaticals (2 for TD and 3 for NB, see budget below). The additional week for NB is to prepare the tabular work product described in Project Outcomes. The mini-sabbatical format will allow the Co-PIs to reap the rewards of professional development (focused, highly technical collaboration, preparation of manuscript for journal publication) while not abandoning for extended periods on-going responsibilities to multiple projects and ORR case teams.

Location and Logistics: Almost all of this funded work will be accomplished at the NOAA Sand Point Laboratory in Seattle, WA. During the period of performance, one of us (TD) will travel to Seattle in early April and late May to collaborate with NB exclusively on this project. Experience has clearly demonstrated to us that face-to-face collaborations are more productive and more effective than a series of abbreviated periodic telephone calls conducted over an extended period of time interrupted by ongoing work responsibilities.

Project Budget:

Co-PI labor for Dr. Tom Dillon	2 weeks @ $3,600/week	$ 7,200
Co-PI labor for Ms. Nancy Beckvar	3 weeks @ $3,400/week	$10,200
Travel (2 trips to Seattle by TD @ $1,300/trip)		$ 2,600
	Total	$20,000

Any project costs in excess of $20,000 will be covered by ORR.

Statement from Partner Institution: NA

Supervisor Approval: See attached letters.