1.0 Performance Measure Title

TS-3 Mercury Bioaccumulation

Last Date Revised: March 3, 2004

2.0 Justification

Mercury is a contaminant of concern in South Florida. The concern stems from the fact that mercury is a persistent, bioaccumulative toxicant (PBT) that can build up in the food chain to levels that are harmful to human and ecosystem health. Widespread elevated mercury concentrations were first discovered in freshwater fish from the Everglades in 1989, which resulted in the issuance of fish consumption advisories for select species and locations. Elevated mercury levels had subsequently been found in predators like raccoons, alligators, wading birds, and Florida panthers. Methylmercury is the most toxic and is the bioaccumulative form of mercury.

Although CERP projects are not primarily designed to address toxicants and pathogens (SFWMD and USACE 2003), these pollutants may compromise restoration and they may be constraints on the restoration effort if they are not properly addressed in design and operations. The CERP is not expected to alter atmospheric loading of mercury. However, it is expected to alter the timing, extent, magnitude and duration of flow and hydroperiods, which under certain conditions can influence methylmercury production, bioaccumulation, exposure, and risk of toxic effects. Nevertheless, while valuable insight into the factors that govern biogeochemistry has been gained over the last eight years, uncertainties remain that constrain our ability to predict the extent to which CERP activities will alter, either directly or indirectly, the sedimentary release, downstream loading, net methylation, or bioaccumulation of mercury. Consequently, the overall goal of this performance measure is to monitor mercury bioaccumulation to ensure that the CERP does not inadvertently worsen the existing mercury conditions in South Florida to the point that risks to humans or wildlife outweighs restoration benefits. RECOVER will measure and assess mercury bioaccumulation and will report findings.

3.0 Relationship to CEMs and Adaptive Assessment Hypotheses

Total System Model (Ogden et al 2005)

4.0 Desired Restoration Condition

4.1 Predictive Metric and Target

4.2 Assessment Parameter and Target

No statistically significant (90-percent confidence level) increase in levels of mercury bioaccumulation in tissue of fish, by association fish eating wildlife, and, in accordance with CGM 23, state water quality standards will be met.

5.0 Evaluation Application

5.1 Evaluation Protocol

5.2 Normalized Performance Output

5.3 Model Output (example attached)

5.4 Uncertainty

6.0 Monitoring and Assessment Application

Twenty fish of appropriate size class from each indicator species within the habitat (i.e., estuarine and freshwater) will be collected annually from each region listed in section 3.6.3.1. of the MAP (seven fish maximum from any one location within a region). The estuarine mercury indicator species are Crevalle jack (*Caranx hippos*) – filet (12 -15 inches) and Gray snapper (*Lutjanus griseus*) – whole and filet (10 - 13 inches). The freshwater mercury indicator species are: Sunfish (*Lepomis* spp. – preferably bluegill) - whole (6 - 8 inches), and Largemouth bass (*Micropterus salmoides*) **-** filet (10 - 13 inches). Additional wildlife species may be incorporated into the RECOVER's MAP and evaluated for mercury tissue concentrations and bioaccumulation in the future as warranted by new regulations and the adaptive management process.

Virtually all (>85%) of the mercury in fish tissues is in the methylated form (Grieb et al. 1990, Bloom 1992, SFWMD unpublished data). Therefore, fish tissue will be analyzed for total mercury, which is a more straightforward and less costly procedure than for methylmercury and can be interpreted as equivalent to an analysis of methylmercury. For gray snapper, samples of both a small portion of the filet as well as the whole fish should be analyzed until a relationship between fillet concentration and whole body concentration can be adequately developed (50 – 60 specimens); after which, only the filet should be analyzed. Such a relationship has already been established for largemouth bass (Lange et al. 1998, Bevelheimer et al. 1997). Otoliths should be reserved for determining the age of fishes. If it is later determined that certain species are not to be aged, then fish of a given size range should be targeted. Twenty fish of each species identified should be collected for each of the areas described in section 3.6.3.1. of the MAP, preferably within a specific time frame each year.

To be consistent with the reporting protocol used by FWC, mercury concentrations in largemouth bass should be standardized to an expected mean concentration in 3-year-old fish at a given site by regressing mercury against age (for details see (Lange et al. 1998 and references therein). To adjust for month of collection, otolith ages will first be converted to decimal age using protocols developed by Lange et al. (1998).

The resulting data will then be assessed by RECOVER to determine if additional monitoring is needed. Additional monitoring might include additional samples, additional target species, additional media (e.g., sediment, pore water) or additional analyses (e.g., isotopic carbon, nitrogen). All tissue samples should be archived to allow for subsequent pesticide analysis if later deemed advisable.

7.0 Future Tool Development to Support Performance Measure

8.0 Notes

9.0 Working Group Members

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10.0 Acceptance Status

TS Working Group	March 3, 2004
ET	
AT	
Public Review	
Final Acceptance Date	

11.0 References

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Mercury Bioaccumulation MAP module (RECOVER, In Progress)

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