

SWAMP-FS-SB-2015-0001

Fact Sheet Mercury in Wildlife

MERCURY RISKS TO WILDLIFE IN CALIFORNIA LAKES: Statewide Survey Finds Fish-Eating Birds At Risk in Many Lakes



This fact sheet is based on a USGS Report:

Ackerman, JT, CA Hartman, CA Eagles-Smith, MP Herzog, J Davis, G Ichikawa, and A Bonnema. 2015. Estimating exposure of piscivorous birds and sport fish to mercury in California lakes using prey fish monitoring: a predictive tool for managers. U.S. Geological Survey Open-File Report 2015-1106, 48 p.

<http://pubs.usgs.gov/of/2015/1106/>



Additional information on this study is also available on the California Water Quality Monitoring Council's "My Water Quality" web Healthy Rivers and Lakes portal:

http://www.mywaterquality.ca.gov/eco_health/streams/

The State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP) has released findings from the first statewide survey of contaminants in wildlife from California waters. The findings are summarized in a technical report, *Estimating Exposure of Piscivorous Birds and Sport Fish to Mercury in California Lakes Using Prey Fish Monitoring - A Predictive Tool for Managers*. The study:

- evaluated mercury risk to wildlife (fish-eating birds) in a representative sample of California lakes,
- documented correlations between concentrations of mercury in birds and fish that can be used to estimate risk to birds in lakes where fish data are available, and
- established methods for monitoring birds and fish in lakes to estimate mercury risk to wildlife.



About the Survey

Numerous water bodies in California are listed under the Clean Water Act as being impaired by mercury contamination.

Mercury generally poses risks both to humans who consume fish from these water bodies and to wildlife species at the top of the aquatic food chain. The SWAMP has recently completed statewide surveys of contaminants in sport fish from California lakes, rivers, and coastal waters. These surveys generated information regarding potential human exposure to mercury, but did not include monitoring to assess risks to wildlife.

This study was performed to address critical information gaps related to mercury risks to wildlife in California lakes. Western grebes and Clark's grebes were chosen as the wildlife indicator species. These grebe species are widely distributed and breed in lakes throughout California, are piscivorous (fish-eaters) near the top of the lake food chain, and become flightless after they arrive at their summer locations. This makes them excellent indicators of lake-specific contaminant exposure. Mercury concentrations were measured in grebe blood at all of the lakes, and in grebe eggs where they could be collected. Mercury also was measured in the small fish species that grebes eat and in sport fish in order to determine whether correlations between fish and grebes could be used to estimate risk to grebes in cases where direct measurements of mercury in grebes are not available. Grebes, prey fish, and sport fish were sampled at 25 lakes throughout California (Figure 1) during the spring and summer of 2012 and 2013, seasons when breeding occurs and birds are vulnerable to mercury-induced impairment of reproduction. Mercury concentrations were measured in blood from 354 grebes at 25 lakes, 101 grebe eggs at 7 lakes, 505 prey fish from 14 species at 25 lakes, and 230 sport fish from 5 species at 24 lakes. The lakes included in the survey were selected to be a representative sampling spanning the entire state, a range of mercury contamination, and a variety of sizes, shapes, and elevations.



Nesting Clark's grebe. Photograph by Alex Hartman, USGS

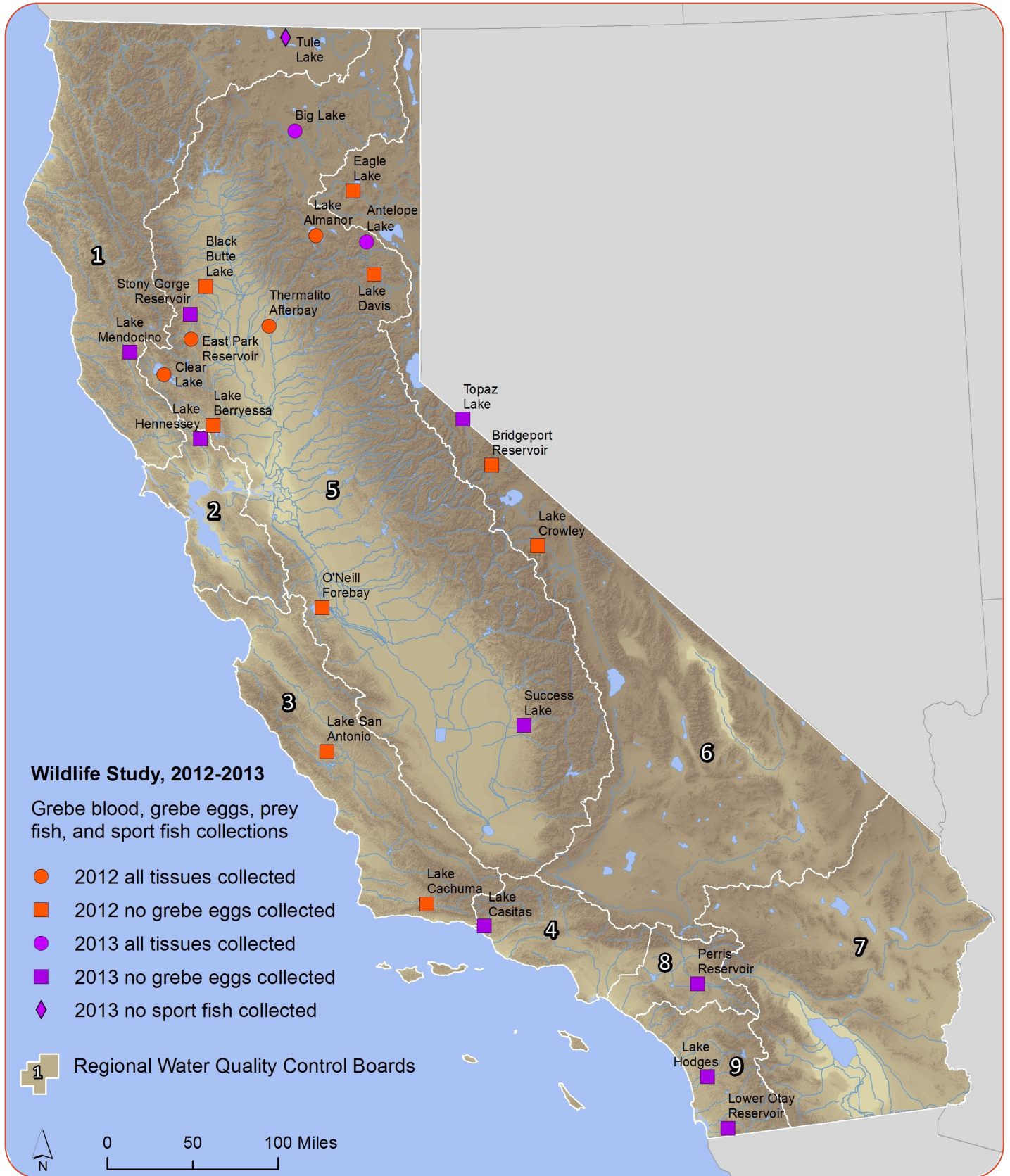


Figure 1. Tissues collected at each location.

Strong correlations observed between mercury concentrations in fish-eating wildlife and prey fish served as the foundation for a tool that natural resource managers and regulators can use to estimate lake-specific risk of mercury to wildlife on a statewide basis.

Birds at Risk in Many Lakes

The survey found that mercury concentrations in grebe blood were high enough to potentially translate to harmful impacts on grebe reproduction in most of the lakes sampled (Figure 3). Published studies suggest that blood concentrations between 1.0 ppm and 3.0 ppm are associated with a moderate risk of effects on reproduction, and concentrations above 3.0 ppm are associated with high risk. Grebes with blood mercury above 1.0 ppm (facing a moderate risk of mercury impact on reproduction) were observed at 14 of the 25 lakes sampled. At seven lakes, more than 50% of the grebes had concentrations above 1.0 ppm. Grebes with blood mercury above 3.0 ppm (facing a high risk of mercury impact on reproduction) were observed at six of the 25 lakes. Lake Berryessa had the most severe contamination, with concentrations above 3.0 ppm in 88% of the grebes sampled.

Strong Correlations Provide a Tool for Managers

Strong correlations were observed between mercury concentrations in fish-eating wildlife (represented by western grebes and Clark's grebes) and prey fish in California lakes. Mercury concentrations in prey fish also were a strong predictor of mercury concentrations in sport fish. Using a statistical approach, equations were developed to predict mercury concentrations in bird blood, bird eggs, and sport fish based on mercury concentrations in prey fish, sampling date, and lake attributes. These equations served as the foundation for a tool (Figure 2) for natural resource managers and regulators to use for estimating lake-specific risk of mercury to wildlife and sport fish. This tool, which can be downloaded at: <http://www.werc.usgs.gov/mercuryriskinlakes>, can be used to estimate mercury risk to grebes on a statewide basis in California lakes.

Managers interested in using the tool are encouraged to read the supporting information on the project web page and contact the principal investigators to understand the tool's strengths and limitations. Although this tool can be highly useful in estimating levels of risk, there is still no substitute for direct sampling of birds and other wildlife for more precise estimates.

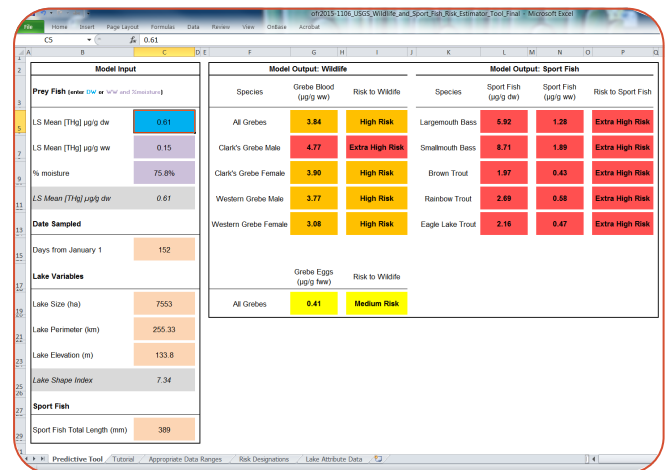
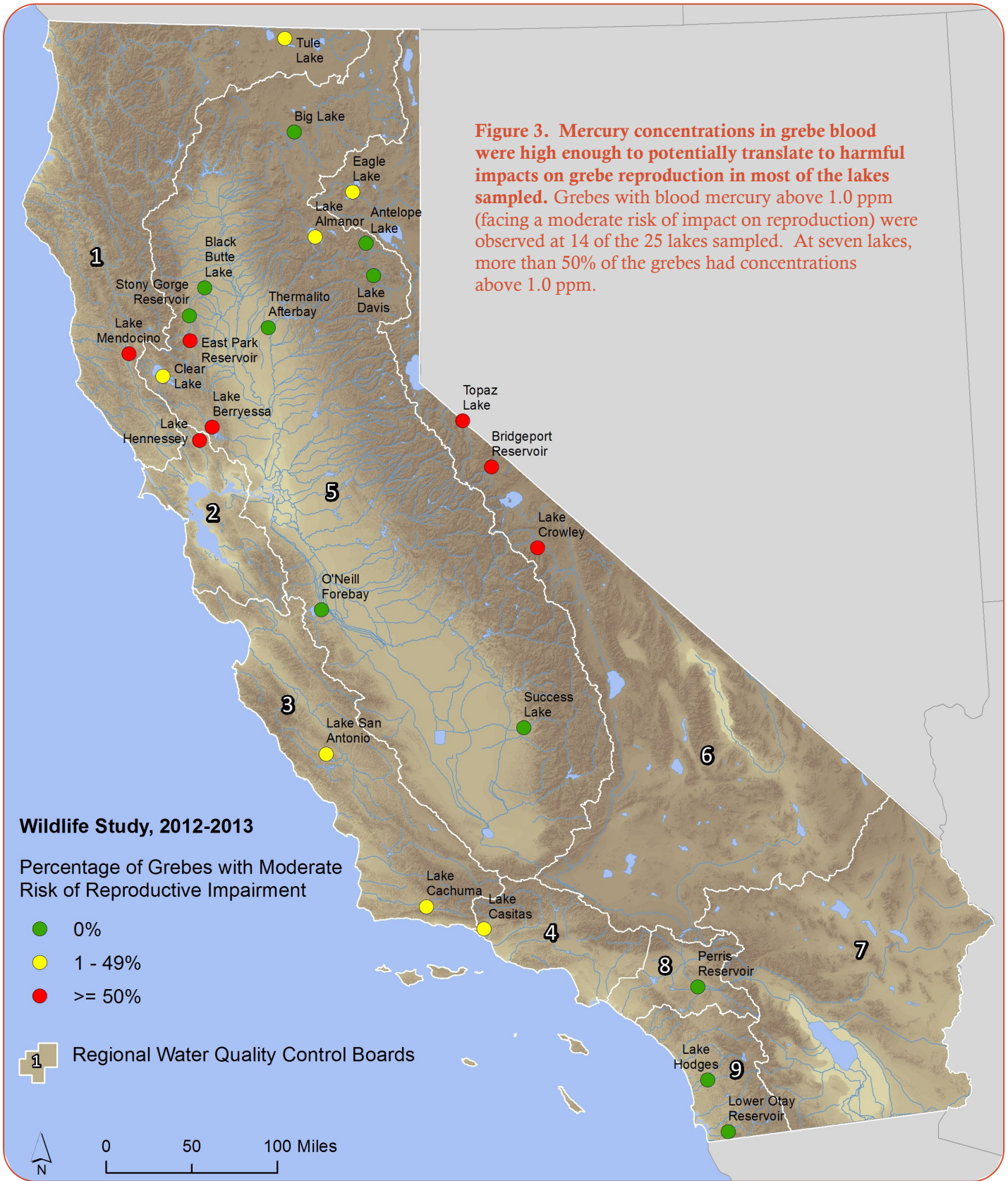


Figure 2. Screenshot of a tool that can be used to estimate mercury risk to grebes on a statewide basis in California lakes.

Monitoring Recommendations to Address Risks to Wildlife

This study developed and demonstrated methods for monitoring mercury in two closely-related avian wildlife species that are widely distributed across the state. Monitoring mercury in blood proved to be a particularly effective technique for obtaining estimates of wildlife risk across all of the lakes. The study also provided guidance on the prey fish monitoring that is needed to support estimation of wildlife risk, when wildlife cannot be directly sampled. The recommended alternative approach is to sample at least 20 prey fish individuals from two species from each lake, during the breeding season, and to analyze mercury in each individual fish.



What's Next?

State and Regional Water Board staff are developing a statewide water quality control program for mercury (Statewide Mercury Program) that will include: 1) a mercury control program for reservoirs; and 2) mercury water quality objectives (http://www.waterboards.ca.gov/water_issues/programs/mercury/). The risk-estimation tool and monitoring protocols generated in this study will be valuable in implementation of both of these efforts.

In 2014, SWAMP conducted sampling for a one-year study that is refining the characterization of the status of lakes and reservoirs with regard to impairment due to bioaccumulation. SWAMP bioaccumulation surveys to date have focused on identifying water bodies with elevated concentrations of bioaccumulative contaminants so that managers can develop strategies for addressing problem areas. In contrast, this survey will provide information on another facet of status: identification of lakes and reservoirs with relatively low levels of contamination. The results of this study will be available in 2016.

In 2015, SWAMP began implementing a long-term plan to update information on mercury contamination in warm-water lakes where largemouth bass are present. The plan calls for sampling each of 190 high-priority lakes on a 10-year cycle. Five groups (or "panels") of 38 lakes each were established, with sampling to be conducted every other year. The sampling design will also allow tracking the statewide trend in average mercury concentration in largemouth bass. The results from the 2015 sampling will be available in May 2017.

Acknowledgments

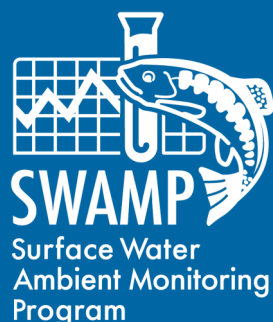
SWAMP bioaccumulation surveys are funded by the United States Environmental Protection Agency (USEPA) and monitoring fees collected by the State Water Board for wastewater discharge permits. Additional funding was provided by the U.S. Geological Survey Ecosystems Mission Area, and U.S. Geological Survey Contaminants Biology Program.



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