

## **2019 Special Study Proposal: Selenium in White Sturgeon Muscle Plugs**

**Summary:** In March 2016, the State Water Resources Control Board approved a Selenium TMDL for North San Francisco Bay, which established a white sturgeon muscle tissue target of 11.3 ug/g dry weight as a basis for evaluating impairment. From 2014-2017, the RMP conducted annual monitoring of selenium in sturgeon muscle plug tissue, through a collaboration with the California Department of Fish and Wildlife (CDFW) and other partners. Preliminary power analyses suggest that long-term monitoring of 60 samples per year at a biennial frequency is needed to detect long-term trends driven by changes in environmental selenium sources within a 10-20 year period. Selenium monitoring in sturgeon was last conducted in 2017, and is not planned for 2018. This study proposes to continue this sampling in 2019, to continue tracking condition relative to the TMDL target and to evaluate long-term trends.

### **Estimated Cost:**

Part I, Monitoring: \$22,000

Part II, Data Management & Reporting: \$24,000

**Oversight Group:** RMP Selenium Workgroup

**Proposed by:** Jennifer Sun and Jay Davis

### **PROPOSED DELIVERABLES AND TIMELINE**

<b>Deliverable</b>	<b>Due Date</b>
Task 1. Collect 2019 muscle plugs (field sampling)	Fall 2019 (August-October)
Task 2. Analyze 2019 muscle plugs	Winter 2020
Task 3. Data Management	Spring 2020
Task 4. Prepare draft and final data report	Fall – Winter 2020

### **Background**

In 2016, the USEPA approved a selenium TMDL for North San Francisco Bay. The TMDL established a target concentration of 11.3 ug/g dw in white sturgeon muscle tissue as the basis for evaluating impairment (SFBRWQCB 2015). In order to help implement the TMDL, the

Selenium Workgroup has developed a monitoring method that allows for the routine collection of large numbers of white sturgeon muscle tissue samples.

Muscle plug sampling provides a non-lethal method for monitoring contaminants in sport fish that has been successfully used to monitor mercury and selenium concentrations, including threatened fish species. During 2009 and 2014 RMP Status and Trends sport fish sampling, and the 2016 and 2017 RMP Sturgeon Derby special study, paired muscle plug and fillet samples were analyzed for selenium as part of an effort to establish a non-lethal and efficient method of collecting sturgeon muscle tissue using plugs. Results from these studies show that muscle plug and muscle fillet selenium are strongly correlated, indicating that muscle plugs can be used as proxies for muscle fillets to monitor selenium in sturgeon muscle tissue (Sun et al. 2017; Sun et al. [in prep]).

Muscle plug sampling from live sturgeon in the field has also been successfully piloted during the 2014-2017 RMP Sturgeon Muscle Plug studies (Sun et al. [in prep]). This monitoring is made possible through a valuable collaboration with the California Department of Fish and Wildlife (CDFW), which has collected samples for the RMP *pro-bono* during its annual sturgeon population tagging study (DuBois and Danos 2017). Over the past four years, samples have been collected in Suisun and San Pablo Bays between August and October of each year. 30, 38, and 58 muscle plug samples were successfully collected and analyzed for selenium in 2015, 2016, and 2017, with an additional 28 samples collected and archived in 2015. Sufficient sample mass was collected for most samples to also allow analysis of C, N, and S isotopes, to provide information about dietary selenium sources (foraging location and trophic position). This work has established fall muscle plug monitoring as a strong opportunity to continue tracking long-term trends.

In 2015-2016, blood plasma samples were also collected and analyzed for testosterone and 17 $\beta$ -estradiol to predict the sex and reproductive stage of each fish; however, analyses of these results indicate limited value from these analyses. No statistical difference was detected between selenium measured in males and females, and few vitellogenic sturgeon (i.e., the most sensitive population) were observed in the fall (Sun et al. [in prep]). These analyses are not planned to continue.

A preliminary power analysis conducted using all historically available data on selenium in sturgeon muscle tissue indicates that a minimum sample collection frequency of once every two years is needed to enable detection of long-term trends of 2-3% per year over a 20 year period (power > 0.8). Sturgeon muscle plug sampling was last conducted in 2017, and is not scheduled to occur in 2018.

This proposal outlines a scope and budget for continuing sturgeon muscle plug monitoring in fall 2019, analyzing the samples for selenium and C, N, and S stable isotopes, and conducting data management and reporting on this dataset.

**Study Objectives and Applicable RMP Management Questions**

The ultimate objective of this monitoring element is to obtain a relatively large number of sturgeon muscle samples to assess attainment of the North Bay selenium TMDL and other regulatory thresholds. These data will also allow tracking of long-term interannual trends. This study addresses key questions identified by the Selenium Strategy and the RMP (Table 1).

**Table 1.** Study objectives and questions relevant to RMP management questions.

RMP Management Question	Priority Management Question for Selenium	Study Objective	Example Information Application
1) Are chemical concentrations in the Estuary at levels of potential concern and are associated impacts likely? 1B. What potential for impacts on humans and aquatic life exists due to contaminants in the Estuary ecosystem?	1. Are the beneficial uses of north San Francisco Bay impaired by selenium?	Compare measured concentrations to regulatory thresholds (North Bay Selenium TMDL).	Do the data indicate a need for management actions?  What factors are influencing the observed selenium concentrations? How should the TMDL muscle tissue target be assessed?
4) Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased? 4.B. What are the effects of management actions on the potential for adverse impacts on humans and aquatic life due to Bay contamination?	2. Are changes occurring in selenium concentrations that warrant changes in management actions?	Compare measured concentrations to plug and fillet concentrations measured during past studies, including past iterations of this study.  Evaluate trends using linear regression analyses.	Are selenium concentrations increasing or decreasing?  What factors may be influencing these trends?

## Approach

Muscle plugs from the sixty white sturgeon will be collected by CDFW staff between August and October 2019, during the CDFW sturgeon tagging effort in North Bay. SFEI staff will plan and coordinate the study and CDFW staff will collect the samples. SFEI staff will retrieve samples from CDFW staff periodically throughout the duration of the field season in order to keep samples chilled at a colder and more stable temperature until sample analysis. Brooks Applied Laboratories or a similar laboratory (see laboratory inter-comparison proposal) will process the plug samples and perform selenium analyses, and subsequently prepare and ship samples to UC Davis for analysis of C, N, and S stable isotopes.

Two laboratory method blanks and one standard reference material will be analyzed with the lab batch; duplicates, matrix spikes, and matrix spike duplicates will be analyzed at a frequency of 1 per 10 samples. Costs for these QA/QC samples will be included in the sample cost; no additional QA/QC samples will be requested.

RMP staff will manage the data, including data QA/QC, formatting, and upload to CEDEN.

## Budget

The proposed budget for Part I is \$22,000. Part I includes project planning, sample collection, and laboratory analysis.

The proposed budget for Part II is \$24,000. Part II includes data management and reporting, including data upload to CEDEN.

**Table 2A. Part I Budget (Monitoring)**

<b>Task</b>	<b>Estimated Cost</b>
<i><b>Labor</b></i>	
Project Planning & Coordination	\$3,000
Field Work	\$4,000
<i>Subtotal</i>	<i>\$7,000</i>
<i><b>Subcontracts</b></i>	
BAL <sup>1</sup> – 60 samples processed & subsampled @ \$80/sample	\$4,800
BAL <sup>1</sup> – 60 selenium & total solids analyses @ \$100/sample	\$6,000

BAL <sup>1</sup> – data package, EDD, and QA narrative @ 5% cost	\$540
UCD – 60 C, N, S analyses @ \$29/sample	\$1,740
<i>Subtotal</i>	<b>\$13,080</b>
<b><i>Direct Costs</i></b>	
Equipment - biopsy plugs, sample containers, plasma sampling equipment, dry ice, etc.	\$1,100
Shipping	\$200
Travel - 6 days of staff travel to field site & partners	\$320
<i>Subtotal</i>	<b>\$1,920</b>
<b>Grand Total</b>	<b>\$22,000</b>

1 – These cost estimates are preliminary and may change depending on the laboratory selected following the laboratory intercomparison study.

**Table 2B. Part II Budget (Data Management & Reporting)**

<b>Task</b>	<b>Estimated Cost</b>
<b><i>Labor</i></b>	
Data Management	\$14,500
Reporting	\$9,500
<i>Subtotal</i>	<b>\$24,000</b>
<b>Grand Total</b>	<b>\$24,000</b>

## Reporting

Results will be presented in a simple data report, which will include comparison of results to thresholds and evaluation of trends. Data will be uploaded to CEDEN. If Part II is funded in 2019, the draft report will be prepared by September 2020 and a final report by December 2020.

## References

DuBois, J and Danos, A. 2017. 2017 Field Season Summary for the Sturgeon Population Study. California Department of Fish and Wildlife – Bay Delta Region, Stockton, CA.

San Francisco Bay Regional Water Quality Control Board (SFBRWQCB). 2015. Total Maximum Daily Load Selenium in North San Francisco Bay: Staff Report for Proposed Basin Plan Amendment. Report prepared for the California Regional Water Resources Control Board, San Francisco Bay Region, November 2015. San Francisco Bay Regional Water Quality Control Board, Oakland, CA. [http://www.waterboards.ca.gov/sanfranciscobay/board\\_info/agendas/2015/November/6\\_appendix\\_c.pdf](http://www.waterboards.ca.gov/sanfranciscobay/board_info/agendas/2015/November/6_appendix_c.pdf)

Sun, J., J.A. Davis, S.N. Bezalel, J.R.M. Ross, A. Wong, R. Fairey, A. Bonnema, D.B. Crane, R. Grace, R. Mayfield, and J. Hobbs. 2017. Contaminant Concentrations in Sport Fish from San Francisco Bay, 2014. San Francisco Estuary Institute-Aquatic Science Center, Richmond, CA.

Sun, J., et al. *in prep.* 2016-2017 RMP Sturgeon Derby Special Study report. San Francisco Estuary Institute, Richmond, CA.

Sun, J., et al. *in prep.* 2015-2017 RMP Selenium in Sturgeon Muscle Plug Special Study report. San Francisco Estuary Institute, Richmond, CA.