

**RESPONSIVENESS SUMMARY FOR THE STUDY PLAN FOR
FRESHWATER MUSSEL INJURY DETERMINATION**

**POPULATION ASSESSMENT AND POTENTIAL
FUNCTIONAL ROLES OF NATIVE MUSSELS IN MULTIPLE
SECTIONS OF THE UPPER HUDSON RIVER: 2014 REMEDIAL
INJURY STUDY**

**HUDSON RIVER NATURAL RESOURCE DAMAGE
ASSESSMENT**

HUDSON RIVER NATURAL RESOURCE TRUSTEES

STATE OF NEW YORK

U.S. DEPARTMENT OF COMMERCE

U.S. DEPARTMENT OF THE INTERIOR

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* Names of certain individuals and affiliations have been removed to maintain confidentiality.



This *Responsiveness Summary for the Study Plan for Population Assessment and Potential Functional Roles of Native Mussels in Multiple Sections of the Upper Hudson River* was prepared by the Hudson River Natural Resource Trustees (Trustees) -- New York State, the U.S. Department of Commerce, and the U.S. Department of the Interior. The Trustees are working cooperatively to conduct a Natural Resource Damage Assessment (NRDA) for the Hudson River. This Responsiveness Summary provides Trustee agency responses to public comments on and questions about the Trustees' *Study Plan for Population Assessment and Potential Functional Roles of Native Mussels in Multiple Sections of the Upper Hudson River*, dated June 2, 2014, released by the Trustees for public review and comment.

INTRODUCTION

A 40-mile stretch of the freshwater non-tidal Upper Hudson River, from Fort Edward to Troy, NY, is the site of an extensive PCB federal Superfund remediation project being conducted by General Electric Corporation pursuant to the Record of Decision issued by EPA in 2002. Dredging to remove PCBs, followed by capping or backfilling of dredged areas began in 2009 and is ongoing. Dredging will remove about 490 acres of PCB-contaminated sediment and freshwater mussels that reside in those sediments will be removed along with the sediment. Subsequent backfilling or capping will bury any mussels in the dredge area that might have escaped removal.

Pursuant to the Hudson River Natural Resource Damage Assessment (NRDA) Plan (Hudson River Natural Resource Trustees 2002), the Trustees developed a *Study Plan for Freshwater Mussel Injury Determination: Population Assessment and Potential Functional Roles of Native Mussels in Multiple Sections of the Upper Hudson River* (Draft 2014 Mussel Study Plan; Hudson River Natural Resource Trustees 2014a) and engaged in public review of that Draft 2014 Mussel Study Plan.

On June 2, 2014, the Draft 2014 Mussel Study Plan was released by the Trustees to the public. Trustees asked the public to review the Draft 2014 Mussel Study Plan and provide feedback on the proposed approach.

The Draft 2014 Mussel Study Plan noted that the Trustees sought public input to help them in planning and conducting an assessment that is scientifically valid, cost effective, and that incorporates a broad array of perspectives. Peer review of the Draft 2014 Mussel Study Plan was conducted concurrent with the public review and comment period. Availability of the Draft 2014 Mussel Study Plan was announced by the Trustees on the Hudson River NRDA web site maintained by the U.S. Fish and Wildlife Service (FWS), and was emailed to interested parties through the Hudson River NRDA list serve, with a request that comments be submitted by July 2, 2014, providing a full 30-day public review period.

All comments received on the Draft 2014 Mussel Study Plan, as part of the peer and public review process, were considered. The Trustees appreciate the input represented by these comments and the effort by commentators to provide this level of review. The Trustees evaluated peer and public comments and, where warranted, incorporated these comments in the Draft 2014 Mussel Study Plan to produce the *Study Plan for Freshwater Mussel Injury Determination: Population Assessment and Potential Functional Roles of Native Mussels in Multiple Sections of the Upper Hudson River*, Final, Public Release Version, dated August 2014 (Final 2014 Mussel Study Plan; Hudson River Natural Resource Trustees 2014b).

PUBLIC COMMENTS RECEIVED

Two letters from the public were received in response to the Draft 2014 Mussel Study Plan: a letter from The General Electric Company (GE), the Potentially Responsible Party, dated June 28, 2014, and a letter, dated July 1, 2014, from an individual with interest in this project. The individual will not be identified by name, although the individual's comments are noted below and addressed in this document.

Text excerpted from both of these comment letters is provided below, along with the Trustee response (in italicized text) to comments. Accordingly, this Responsiveness Summary documents comments that were received, that those comments were considered by the Trustees, and how the Trustees addressed those comments.

COMMENTS IN LETTER FROM GENERAL ELECTRIC, DATED JUNE 28, 2014

General Comment:

Section 1.0 Background, paragraph 3, page 4 notes that, in general for the Upper Hudson River, information on mussel population sizes and species diversity is limited. Given the apparent paucity of relevant baseline information, how can it be confirmed that changes in the mussel community inferred for remediated areas based on comparison to reference and non-remediated sections truly reflect presumed effects of dredging?

Trustee Response:

In areas of the river where dredging/ capping/ backfilling activities (i.e., PCB remediation) have already been completed, surveys in adjacent unremediated areas and in other pools surveyed prior to remediation offer the best option to characterize mussel populations that were removed in the remediation process and/ or impacted by contamination. A reference stretch upstream of the Hudson River PCB Superfund Site offers the best opportunity to characterize mussel populations in a large river system not likely impacted by PCB contamination.

In this proposal, the lead investigators and staff aim to conduct mussel population surveys in multiple reaches of the Upper Hudson River. These surveys, along with the surveys conducted in 2013, will provide the HRNRT with mussel population information. Potential ecological services (i.e., filtration capacity and production) provided by these mussels could assist the HRNRT in making decisions about potential restoration priorities following PCB remediation activities in the Upper Hudson River.

Baseline conditions for remedial injury are the mussel assemblages and the ecological services they provide prior to remediation (unremediated and to be remediated areas). Baseline represents what likely will be lost due to remedial actions at the Hudson River PCB Superfund Site. Surveys of remediated areas in the year or years following dredging and subsequent capping or backfilling could document the status of the mussel assemblages after the remedial action, shedding light on how mussel communities responded to the altered environment following dredging and subsequent backfill or capping. By assessing mussel communities in the uncontaminated reference section, the study may also shed light on how mussel communities may have changed in response to the presence of PCBs within the PCB Superfund site.

General Comment:

Section 2.0 Introduction, paragraph 1, page 4 references the Trustees' 2013 mussel pilot study as a factor in determining that further freshwater mussel investigation is appropriate. Please provide the results of the 2013 mussel pilot study and associated study plans that describe the methodology used to conduct that 2013 work as well as all supporting information.

Trustee Response

The 2013 Mussel Pilot Study was a factor in determining that further freshwater mussel investigation is appropriate because it established that this work is feasible and that mussels exist in the river. The data collected as part of the 2013 Mussel Pilot Study is now part of the Injury Determination study. As such, the Trustees committed in the Hudson River NRD A Plan to peer review the results of such studies. As peer review of the results of the 2013 mussel pilot study has not yet been completed by the Trustees, the Trustees are not yet in a position to release those final data.

Trustees plan to conduct final QA/QC procedures on both the 2013 and 2014 survey data before releasing these data as part of the final report. In the interim, Trustees will release the 2013 Mussel Pilot Study work plan and the raw data tables from the 2013 surveys on our website. The raw data tables from the 2013 surveys are an interim work product and should not be considered final.

The final data and results of work conducted pursuant to the 2013 Mussel Pilot Study will be provided to the public, including GE, after the peer review of the injury study is complete, per the Hudson River NRD A Plan.

General Comment:

Section 4.1 Freshwater Mussel Field Study, paragraph 1, page 5 states that the Upper Hudson River freshwater mussel population and ecosystems services study will be conducted pursuant to a work plan entitled "Population Assessment and Potential Functional Roles of Native Mussels in Three Sections of the Upper Hudson River: 2014 Remedial injury Study". Please provide the referenced work plan.

Trustee Response

This work plan has now been peer reviewed and is or soon will be available on the FWS Hudson River website and NOAA Hudson web page <http://www.darrrp.noaa.gov/northeast/hudson/admin.html>.

General Comment:

Section 4.1 Freshwater Mussel Field Study, paragraph 1, page 5 states that the Trustees will "... conduct a study of freshwater mussel populations and ecosystem services ...". However, in the subsequent sections the data collected are for mussel abundances at specific locations. In the next paragraph, the purpose is described as to evaluate "... species composition, relative abundance, population estimate and potential ecosystem services ...". This is inconsistent and confusing in the plan. There is no description of how this information would be used to develop population estimates, which are very different from relative abundances. Moreover, there is no indication how any of the data would be used to characterize ecosystem services. This plan should define or indicate how either ecosystem services or ecological services (stated on page 8 in the Injury Assessment section) would be estimated from the kinds of data developed in this study. The plan should use a consistent terminology for services and, if the determination of ecosystem services is actually a goal of the study, a specific definition of this term should be included.

Trustee Response

The final study plan contains a clarification on the purpose of this study, provides details on how relative abundance, species composition, and population estimates will be calculated, and defines ecological services as filtration capacity and production.

Purpose:

The purpose of the 2014 study is to assess populations of freshwater mussels in up to four pools of the Upper Hudson River by gathering data on species composition (number of species), relative abundance (number of mussels per square meter), population estimate (number of mussels in a given pool and/or stratum (to be remediated, unremediated and remediated areas, reference)), and population structure (age and length) of freshwater mussels, and estimate two potential ecological services, filtration capacity and production, provided by the mussel communities.

Relative Abundance and Population Estimates:

Data on population estimates and relative abundance will be analyzed with survey sampling statistical software (Survey means procedure, SAS 2003). Data on size structure will follow Newton et al. (2011), and the analysis of age structure will be supplemented by the analysis of internal annuli. Potential ecological services (i.e., filtration capacity and production) will be analyzed as in Newton et al. (2011).

Data Tables:

Data tables will be created presenting mean and 95% confidence limits for mussel community attributes (e.g. relative abundance (number/ m^2), weight (wet and dry in g), biomass (g dry mass/ m^2 and g C/ m^2), age (external and internal ring counts), population estimate (total number), ecological services (filtration capacity ($m^3/m^2/d$) and tissue production (g dry mass/ m^2/yr and g C/ m^2/yr) and penetration depth (kg/cm^2) in unremediated, to be remediated, remediated and reference areas in the pools sampled. Investigators will present data tables on species composition, population structure (age frequency) and length.

Ecological Services:

From these data, we will estimate some of the potential ecological services (i.e., filtration capacity and production). To estimate some of the potential ecological services, scientists will estimate filtration capacity and production provided by the mussel community within each sampled river reach. Investigators will develop length-mass regressions from a subsample of the abundant mussel species within each river pool. For each abundant species, the mean tissue mass across all sampled individuals will be multiplied by the mean abundance to obtain an estimate of the biomass of mussels per m^2 in the unremediated, to be remediated, and reference stretches as in Newton et al. (2011). Confidence limits will be approximated by multiplying the mean tissue mass by the lower and upper confidence limits around the density. To estimate the filtering capacity of the community, a filtration rate of 0.5 L per hour will be multiplied by the pool- or stratum-wide (i.e., remediated, to be remediated and unremediated areas, reference) mean biomass. Although, the amount of water an individual mussel can filter varies with abiotic and biotic factors (e.g., water temperature, species, mussel size) and experimental procedures, several studies have produced similar volume estimates. In a recent review paper, maximum filtration has been estimated at ~0.5 to 1 L/h (Vaughn et al. 2008 and references therein) over a range of species. Carbon content of mussels (grams per m^2) will be estimated as one half of the mean dry tissue mass (Strayer and Smith 2001). Mean production (grams of carbon per m^2 per year), a measure of the energetic importance of native mussels in the Hudson River ecosystem, will be estimated from biomass using a total annual production to biomass (P/B) ratio of 0.2 (Nalepa and Gauvin 1988). The data produced from the 2013 and 2014 surveys will allow us to compare the densities and filtration rates between Upper Hudson River pools (River Sections 1-3) subjected to PCB contamination relative to the upstream reference pool(s) and to similar data from the lower freshwater tidal Hudson River (as in Strayer et al. 1994).

General Comment:

Section 4.1 Freshwater Mussel Field Study. paragraph 2, page 6 notes that sampling of River Section 3 (Upper Mechanicville Pool) is dependent upon timing and funding constraints. As this river section is a location where it is still possible to collect pre-dredge

samples of mussel abundance and diversity (as opposed to inferring these parameters from co-located non-dredged area samples), it seems as if this river section should be given higher priority in the study design.

Trustee Response

Trustees agree with this comment and have noted the prioritization of sampling of the two Mechanicville Pools. The Upper Mechanicville Pool will not be sampled this year as remediation in this pool began prior to the start of the 2014 mussel survey.

General Comment:

Section 4.1 Mussel sampling and design, paragraph 1, page 7 states that substrates sampled will be collected into a 6-mm mesh bag, rinsed through the bag and then sieved to facilitate mussel removal. Schneider (2006) notes that juvenile *Elliptio complanata* (the one species identified in the Trustee work plan) can be as small as 3 mm, possibly smaller. Based on the collection method described in the work plan it appears that juvenile *Elliptio*, and possibly other species, may be flushed from the mesh bag due to rinsing before sieving. Given that dredging has only recently occurred in most of the river sections targeted for sampling, it is possible that re-colonization by juvenile mussels could already have started. But if the smallest juveniles are lost due to the sampling methodology, this could negatively bias the study objective seeking to confirm absence of mussels in areas that have been dredged.

Trustee Response

The work plan has been modified to address this concern. The quadrat sampler will be modified slightly with a ca. 2-mm mesh bag for post-remediation sampling within areas remediated between 2009 and 2013. The ca. 2-mm mesh bag allows for the potential collection of newly transformed juvenile mussels which can be as small as 3-mm in length. The remediated areas, sampled with ca. 2 mm mesh quadrat, will be passed through a series of graduated sieves with a minimum size less than 3 mm (i.e., 2.8 mm). The graduated sieves used on the remediated area material will include the 5.6 mm sieve size, allowing for comparability with the unremediated, to be remediated, and reference areas sampled with the 6 mm mesh. The 2.8 mm sieve will provide additional information on newly transformed mussels in the remediated area as an assessment of recovery potential within the top 15 cm of sediment.

General Comment:

Section 4.1 Mussel sampling and design, paragraph 1, page 7 states that the number of fresh dead mussels will be recorded. In addition, the number of weathered dead mussels (> 1 year dead) collected should also be recorded. To avoid mischaracterization of age classification rigid, scientifically defensible aging criteria should be used and should be explicitly discussed in the work plan.

Trustee Response:

All live mussels will be identified to species, counted, aged (via external annuli count, if visible), and measured for shell length (to the nearest mm using the posterior/ anterior axis). For consistency, the aging of mussels by counting external annuli and other mussel observations will be conducted by the same technician as in the 2013 surveys. Since external aging of mussels tends to be more accurate for young mussels, the external aging will provide us with an indication of recruitment of young mussels into the population. The age of older mussels will be determined at a later date by counting growth rings of shell thin-sections. The thin-sectioning of shells will be performed by a yet-to-be-determined contract facility that specializes in this type of work and the effort will be described in a separate document. The number and species of fresh dead mussels (with soft tissue and/ or clean, shiny

nacre) will be counted as an index of recent mortality. The number and species of weathered, dead mussel shells will similarly be recorded and may provide additional information on historical species composition. However, only live specimens will be used for population measures.

General Comment:

Section 4.1 Mussel sampling and design, paragraph 1, page 7 states that habitats sampled will be characterized on the basis of water depth, substrate type, substrate penetration resistance and presence and type of aquatic vegetation. This is a limited characterization of mussel habitat type. Mussels have very specific habitat requirements and the habitat types should be carefully documented to explain any relationships among mussel densities that are not the result of remedial activities. For example, the substrate should be characterized for the particle size distribution, not just "substrate type". How will substrate penetration be measured on a standardized basis? The aquatic vegetation present should be quantified and not just described by the "presence and type". The current regime should also be measured at each sampling location.

Trustee Response:

The habitat data collected as part of the 2014 survey are not intended to be quantitative, but rather descriptive observations of the substrates from which each sample is taken. Thus, we do not intend to correlate mussel metrics and qualitative habitat metrics using statistical analyses, but may assess the general trends of substrate types, penetration resistance, and mussel assemblages associated within river pools and remediated, unremediated, and to be remediated areas. These data will likely be presented as a series of graphs depicting the relative occurrence of various substrate types, penetration depths and mussel assemblages within each river pool and stratum.

Substrate penetration resistance (in kg/cm^2), a metric not recorded in 2013, will be measured within each of the two quadrats per sampling site by pushing the tip of a hand-held pocket penetrometer (Humboldt, or similar) into the stream bed to a depth of 6 mm and the resulting resistance will be read in kg/cm^2 (Geist and Auerswald 2007). A 2.5-cm adapter foot will be attached for measurements in areas of soft sediment to increase sensitivity and the readings divided by 16 to calculate actual resistance. A minimum value of 0.001 kg/cm^2 will be assigned to areas with extremely soft mud, where even with the adapter foot the penetrometer does not produce any detectable reading (Geist and Auerswald 2007).

At each site, investigators will record the water depth in the center of each quadrat to the nearest 0.1 m, qualitatively estimate substrate type, substrate penetration resistance, and the presence and type of aquatic vegetation. Substrate type will be determined by tactile/visual methods and be recorded as an approximate percentage of cobble, gravel, sand, silt, bedrock, boulder, detritus, and/or clay (Appendix 3 - Dive Boat Data Sheet) according to Cummins (1962).

General Comment:

Section 4.1 Mussel sampling and design, paragraph 2, page 7 states that DNA tissue samples will be collected and archived. There are no details on what types of tissue will be collected nor how analyses will be performed. The plan should provide more information on this aspect of the study and how it relates to the four stated study objectives.

Trustee Response:

This plan does not include an objective relative to the study of these foot tissue samples. The study plan notes that, in the future, the Trustees may propose additional work to supplement this effort. Frozen mussels will be processed by experienced technicians. When processing the mussels, all soft parts will be removed and a small slice of foot tissue will be preserved in 95% ethanol. This foot tissue sample will be stored at -20°C to preserve DNA for extraction in

potential future studies. The remaining soft mass will be weighed (g wet weight) and packaged in a small zip-lock plastic bag and initially frozen (-20°C) for potential future analysis of PCB concentrations. Archived tissues will be held at -80°C.

General Comment:

Section 4.1 Data analysis, paragraph 1, page 7 states that population size and relative abundance will be analyzed. There is no indication in the plan of how population size would be estimated from the data collected. Please provide the work plan and other documents that explain how this will be done. Normally such information would be contained in the detailed work plan and quality assurance project plan (QAPP) for the project.

Trustee Response:

*This work plan is available on the FWS Hudson River website. Information on the calculation of population size and relative abundance is available under the Trustee's response to **Section 4.1 Freshwater Mussel Field Study, paragraph 1, page 5, above.***

General Comment:

Section 4.1 Data analysis, paragraph 2, page 7 states that production and filtering rates of each abundant species will be estimated. The plan needs to provide a detailed explanation as to how those parameters will be estimated and how they will be used to evaluate the stated study objectives.

Trustee Response:

*Information on the calculation of production and filtering rates is available under the Trustee's response to **Section 4.1 Freshwater Mussel Field Study, paragraph 1, page 5, above.***

COMMENTS IN LETTER FROM INDIVIDUAL, DATED JULY 1, 2014

General Comment

You are planning on sampling the “mussel habitat and community in a non PCB contaminated, undredged reference location.” The stretch of river identified between Corinth & S. Glens Falls however is not free of PCBs. Near the Sherman Island Dam there were PCBs, which were remediated, but contaminated sediments remain and a fish advisory also remains in this stretch of the river.

While the levels are certainly much much lower than downstream of Hudson Falls, I was wondering if there wasn't another stretch of river that could be used as a more objective reference location, perhaps closer to Corinth or upstream of the Corinth Dam. Considering the types of reproductive effects PCBs have had on the other wildlife the trustees have studied, the population between the Queensbury site and South Glens Falls may have been impacted in the past and may not be the greatest control group

Trustee Response:

The objective has been modified to acknowledge the presence of PCBs. The Trustee's fourth objective now reads: Characterize the mussel community in a relatively un-PCB contaminated, unremediated reference reach (“reference”).

The potential reference reach consists of one or more pools between the South Glens Falls Dam and Corinth, NY

upstream of the PCB-remediation project. This river stretch consists of four pools formed by a sequence of dams (Route 9 Dam in South Glens Falls; Feeder Dam; Sherman Island Dam; Spier Falls Dam; Corinth Dam). The reference stretch supports a warm water fishery (Fiorentino 2014). Since most species of freshwater mussels rely on fish to complete their reproductive cycle (i.e., mussel larvae parasitize the gills of fish), the diversity of fish species may influence mussel diversity. Based on personal communication and direct field observations, the reference area offers a suite of potential fish host species, the ecology and morphology of a large river system, and like the downstream reaches, a series of dams divide the river into flat pools.

Specific reaches within the reference stretch will be selected that appear to be similar in ecology and hydrology to the remediated stretches of the river downstream of Fort Edward while excluding known contaminated areas. The Feeder Pool, the pool downstream of the Sherman Island Dam, has been used in past studies by NYSDEC, USEPA, and General Electric as a reference stretch (USEPA 1997) and will be the primary reference pool sampled for mussels during 2014. Further observations of the overall topography, substrate type, vegetation, water depth, safety concerns, or other factors during on-site assessments of other pools within the reference reach may require adjustments to the inclusion of specific areas in the overall reference stretch, and these determining factors will be recorded in detail.

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