Filename: State Canal Mollusk Survey as it Relates to South Davis Sewer District North Plant Effluent

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# State Canal Mollusk Survey as it Relates to South Davis Sewer District North Plant Effluent

## Progress Report 2020

By

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# Introduction

Freshwater mollusk diversity is depauperate in the western USA with the exception of waters in the Bonneville Basin, including the Jordan River drainage, UT (Richards 2015, 2017a, 2017b, 2018, 2019, Miller and Richards 2019). No intensive mollusk surveys have ever been conducted in State Canal, a man-made conveyance canal of lower Jordan River water.

In addition to the importance of understanding the status of native mollusks in the Jordan River drainage, including State Canal, native mussel surveys documenting their presence/absence are critical for ammonia criteria development and regulation. Two species of native mussels, *Anodonta* sp. and *Margaritifera falcata* may have occurred in the lower Jordan River, UT in the past but were unlikely to have occurred in State Canal. Unfortunately, severely degraded ecological conditions; host-dependent, dispersal- limited metapopulation dynamics; absence of past monitoring and legal protection; and inadequate management have likely eliminated the possibility of their continued existence in the lower Jordan River (Richards 2017a and b, USEPA 2013a, Miller and Richards 2019). Even though there are no historical records of *M. falcata* or *Anodonta* sp. occurring in State Canal, their present status in the canal is unknown.

Richards (2017a, b), Richards et al. 2020, and Richards and Miller (2019) conducted the most extensive native mussel surveys in the Jordan River drainage to date but did not find any live or recently dead native mussels. However, several highly weathered *Anodonta* sp. shell fragments were found indicating that this species occurred in these or nearby waters in the past. Even though Richards and Miller (2019) concluded that native mussels were likely absent in the Jordan River, absolute determination of absence in any water body, including State Canal, is not possible without a complete and thorough examination of the entire substrate (Richards 2017, USEPA 2013a, 2013b); an unrealistic endeavor. However, probability of detection and survey efficiency statistical models in conjunction with knowledge of native mussel ecology and population dynamics can be employed to help justify a presence or absence conclusion for management purposes in State Canal (UDWQ 2017a, Richards and Miller 2017, Richards 2017).

The USEPA published updated Clean Water Act § 304 (a) recommended water quality criteria for ammonia in 2013. The calculation of these criteria included updated toxicity data for members of the phylum Mollusca, particularly for mussels of the superfamily, Unionoidea. This resulted in much more stringent ammonia criteria (USEPA 2013a). Recognizing that these species may be absent from many of the nation's waters, EPA published a supplemental technical support document (*TSD; Technical support document for conducting and reviewing freshwater mussel occurrence surveys for the development of site-specific water quality criteria for ammonia, August 2013, EPA 2013b*), that outlines survey procedures to determine presence or absence of native mollusks on a site-specific basis. In turn, this would allow site-specific criteria modification of the ammonia criteria. Consequently, the Wasatch Front Water Quality Council and Utah Division of Water Quality (UDWQ) concluded that a site-specific survey of State Canal be performed to determine if mussels are currently present or if the presence of unweathered or weathered empty shells indicate that they were extant in the recent or historic past.

# Objectives

The specific objective of this study was for us to provide site-specific survey data sufficient to determine a likelihood estimate of presence or absence of mussels near the South Davis Sewer District North Plant

discharge (ammonia zone of influence) in State Canal using the most appropriate EPA approved survey methods, including Eckman and Ponar grabs (dredges). Our objectives were to also perform recommended probability statistical analyses following that of Smith et al. (2001) and Smith (2006) as adopted by UDWQ (2017a) and then provide a detailed report of survey methods used, summary statistics, data interpretation and recommendations to UDWQ and USEPA. It is intended that this progress report contain sufficient quality data and analysis for UDWQ/USEPA to make a regulatory determination of the presence or absence of native mussels in the survey area.

# Methods

## Survey Area

Mollusk surveys were conducted in State Canal beginning at the diversion dam downstream of SDSD North Plant at 40.910854° latitude; -111.928022° longitude and continued every 100 m upstream to the State Canal diversion (latitude = 40.871337°; longitude = -111.964996°) (N = 162 transects) (Figure 1). Surveys were conducted in late summer and early autumn 2019.

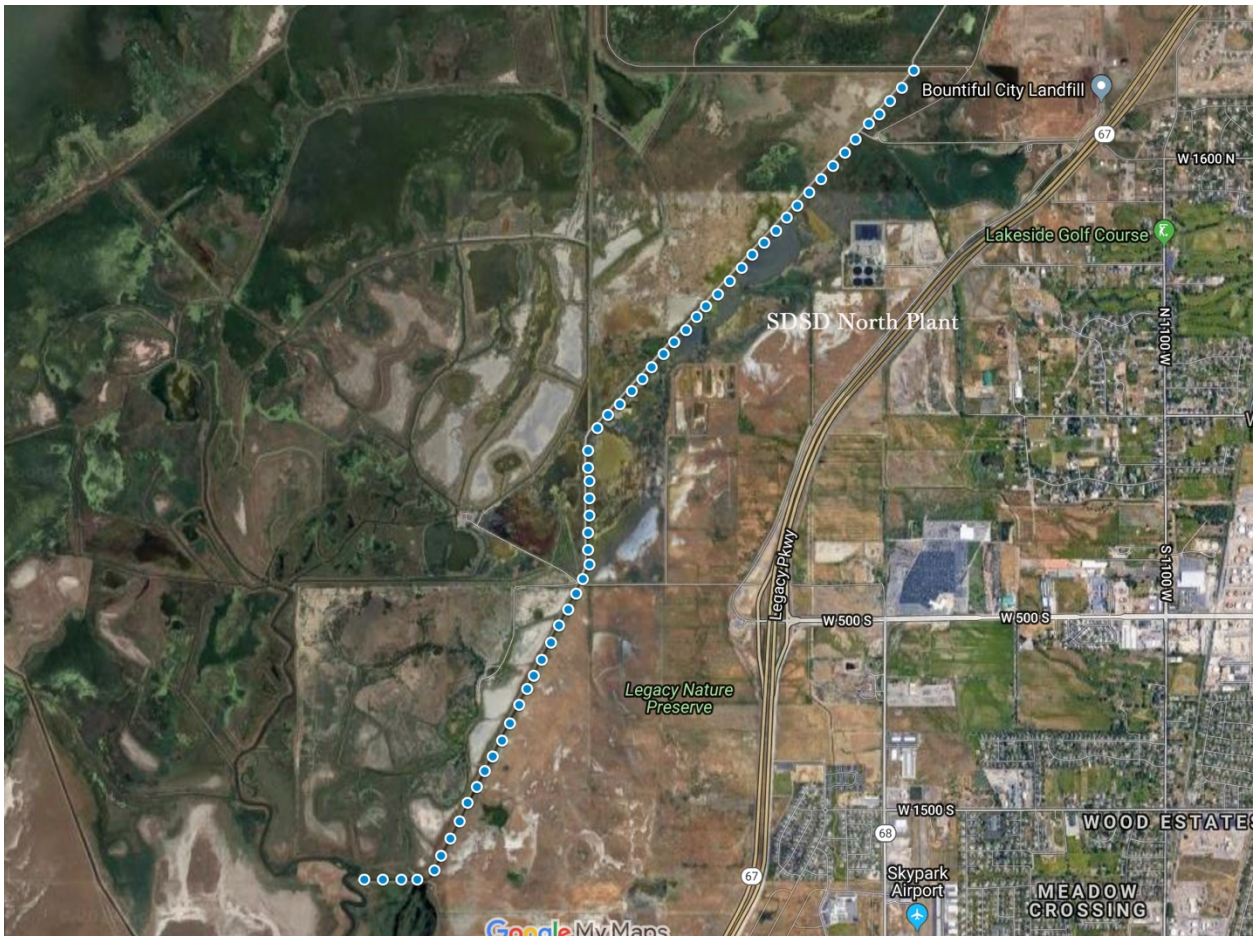


*Figure 1. Mollusk survey locations in State Canal 2019. Blue circles are transect locations. N = 162 transects, nine dredge samples collected at each transect.*

### Mollusk Survey

Mollusks were sampled using a long handled 15.24 x 15.24 cm Ekman Dredge operated from a small john boat. Three dredge samples were taken at each site: one near the left descending bank, one in approximately the center of the channel, and one near the right descending bank for a total of 486 samples processed, which accounted for approximately 11.29 $m^2$ of substrate sampled. Spoils from each dredge sample was processed independently by sieving through a 3.2 mm mesh dip net. Material retained in the dip nets was examined for presence of live, fresh dead, and relict empty shell mussels. Non-native Asian Clam (*Corbicula fluminea*) were also counted and recorded.

### Substrate Evaluation

Dominant and subdominant substrate types in each dredge sample were also recorded. Substrate categories included combinations of silt, sand, detritus, clay, gravel, concrete, cobble, large woody debris, and smaller wood fragments (e.g. twigs and branches). Substrate analysis will be provided in an additional pending report.

### Probability of Detection and Search Efficiency as Related to Density Estimates

Estimating probability of detection (POD) given known or assumed search efficiencies, densities, and known search area is problematic when mussel population densities are at critically low levels or when mussels are expected to be absent based on historical data and literature review (Richards 2017). However, given these admonitions, UDWQ (2017a) recommends using methods such as those proposed by Smith (2006) for estimating these values. UDWQ recommends surveying enough area with 100% search efficiency at density = 0.1 $m^{-2}$ to obtain a 90% POD based on formulas presented by Smith (2006).

We used the Smith (2006) formula (equation 4 page 703):

$$POD = 1\text{-}e^{-\beta\alpha\mu}$$

where POD = probability of detecting at least on individual mussel; $\beta$ =search efficiency (SE), $\alpha$ =search area = 37.59 $m^2$ (State Canal and lower Jordan River combined)[1]; and $\mu$ = density $m^{-2}$ to develop a probability of detection (POD) model as a function of density $m^{-2}$ at search efficiency of 1.00.

Excavation tools, including Ekman dredge, are considered the most effective sampling methods used to detect mussel communities (USEPA 2013b). When sieved materials from dredges are thoroughly examined; survey results are considered to be at 100% search efficiency (USEPA 2013b).

## Results

No live native mussels were found in the survey. The only living bivalves found in the survey were invasive, non-native Asian Clams, *Corbicula fluminea* (N = 28). Two weathered *Anodonta* sp. shell fragments were found.

[1] State Canal and lower Jordan River mussel survey areas were combined for the Smith (2006) model (Figure 2) because the lower Jordan River mussel survey was a continuation of State Canal survey and the lower Jordan River habitat was considered superior to State Canal, consequently any live mussels were more likely to have occurred in the lower Jordan River than State Canal (see Richards et al. 2020).

### Control vs. Impacted Sites

The apparent absence of native mussels in the control site of State Canal and lower Jordan River upstream of SDSD North Plant strongly suggests that factors other than SDSD North Plant discharge, including chronic dredging, prevent viable native mussel populations from becoming established anywhere in State Canal. For example, as a surrogate for native mussels, the prolific *Corbicula* clam only occurred at about 2.5 live individuals $m^{-2}$ in State Canal, whereas in the lower Jordan River estimated *Corbicula* densities were 34.4 $m^{-2}$. See Richards (2017) for a detailed discussion of other likely factors affecting native mussel declines and absence in the drainage.

### Probability of Detection, Search Efficiency, and Density Models

Mussel densities in the lower Jordan River and State Canal only had to be $\geq 0.06$ $m^{-2}$ to obtain a UDWQ recommended POD of 0.90 using the Smith (2006) model (Figure 2). Based on the Smith (2006) model (Figure 2), we should have observed at least one mussel if they occurred in the lower Jordan River-State Canal survey area at densities $\geq 0.06$ $m^{-2}$, which is less than UDWQ's recommended density = 0.1 $m^{-2}$. Thus, our mussel survey results clearly exceed UDWQ recommendations for a determination of 'absence' of live or recently dead native mussels in the lower Jordan River.

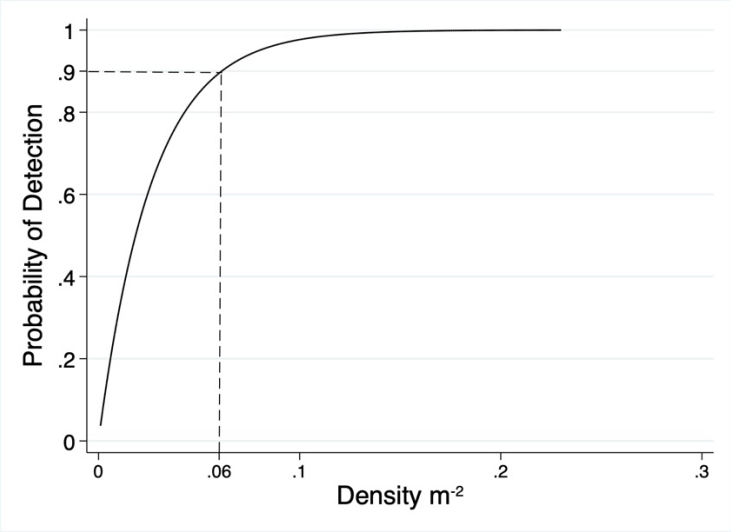


*Figure 2. Mussel probability of detection (POD) in the lower Jordan River and State Canal as a function of density ($m^{-2}$) at 1.00 search efficiency and search area = 37.59 $m^2$. POD equates to a density estimate of 0.06 $m^{-2}$ at DWQ recommended POD = 0.90 (dashed lines). Based on Smith (2006).*

## Discussion

Results presented in this progress report and results from other mussel surveys on Mill Creek and Jordan River provided multiple- lines- of- evidence in support of mussel absence in State Canal. Richards (2017) included multiple lines of evidence surveys from several agencies including UDWQ and USU/USGS that showed 'absence' of native mussels in the Jordan River. Richards et al. (2020) recently conducted mollusk surveys in the lower Jordan River and did not find any live mussels. These lines of evidence are directly applicable to State Canal and further support our conclusion of 'absence'. In addition, State Canal is a man-made conveyance canal and is highly ecologically impaired relative to the Jordan River. Subsequently, State Canal is not expected to support viable native mussel populations. Most of the

substrate in State Canal is composed of chronically dredged, hard-pan clay that is poor mussel habitat (see pending report). Potential obligate fish host densities are very low, as well (Richards 2019).

## Conclusion

Results of this native mollusk survey combined with other surveys provide a multiple-lines-of-evidence that clearly show that viable native mussel populations do not occur in State Canal such that no live individuals have ever been documented. Reasons for their rapid decline, decreased metapopulation viability, and potential complete demise throughout the Jordan River drainage are numerous and have been discussed at length by Richards (2017a, b and Richards and Miller 2019).

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