Dam Removal and the Salmon River Mussel Community

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The Fort Covington Dam was an abandoned run-of-river dam on the first riffle of the Salmon River in northern New York (Fig. 1). The dam was removed in June, 2009, 96 years after construction.

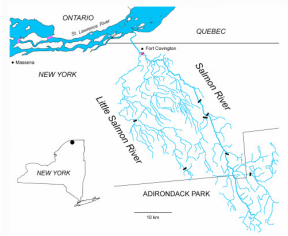

Figure 1. Watershed of the Salmon and Little Salmon rivers. The Fort Covington Dam is marked by a red bar and other river dams are in black. The Robert Moses Power Dam (right) and the Long Sault Dam (left) in the St. Lawrence River are shown in violet.

SITE DESCRIPTION and METHODS

The Salmon and Little Salmon rivers are 4th-order and have coarse sand and cobble substrate in the riffles and sand/silt in the glides.

The study site extended from the confluence of the rivers near Lewis Marina (Fig. 2) upriver 7.5 km to the Cushman Road Bridge (transect 9, Salmon River) and upriver 3.5 km to the Foster Road Bridge (transect 15, Little Salmon River).

Mussel surveys were conducted from 2005 through 2012 at ten transects (6 riffles, 4 glides). Systematic sampling with three random starts was used at riffles transects and double sampling was used at glide transects.

A maximum of 33 quadrats were sampled with each random start. Each quadrat was designated by placing a 1m^2 PVC grid, subdivided into 0.25m^2 subquadrats, on the river bottom; 20% of glide transects were excavated. Water depth at sampling sites was less than 1m.

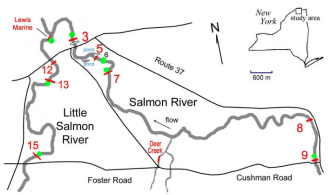

Figure 2. Transects for sampling mussels (in red). Transects at Lewis Marina and Deer Creek were parallel to the river flow, all others were perpendicular. Transect width ranged from 25 m to 70 m. Location of water level and temperature loggers are shown as green circles. The reservoir extended upriver to transect 7.

Photo provided by Jackie Nancy

The Fort Covington Dam, as seen in 1913, was used as a grist mill and for hydropower. The original dam, built in the late 1800s, was a wood-crib that was damaged in a freshet in 1912 and rebuilt as a concrete dam in 1913.

The Fort Covington Dam as it appeared in May, 2009 (upper panel), and during removal in July (lower panel). The dam was removed using a hydraulic hammer and excavator.

One option presented in the engineering report was to reduce the reservoir level gradually to allow bank sediments to be stabilized by plant cover and to allow mussels to migrate away from dewatered areas. Timing of dewatering was suggested to be in late summer during lowest flows to avoid high discharges that would scour sediments. The demolition contract allowed the demolition company to determine how and when the reservoir would be dewatered: it was done quickly and in early summer, which coincided with a rain event and subsequent discharge of nearly 20 m^3/sec (Fig. 3).

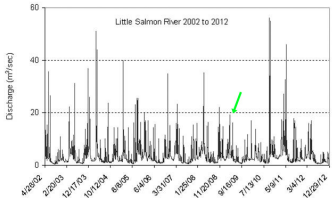

Figure 3. Discharge in the Little Salmon River from 2002 to 2012. The green arrow indicates the breaching of the dam. Data for the Salmon River was not used as it is affected by upstream dam releases and does not reflect conditions in the study area as well as the USGS gage for the Little Salmon River.

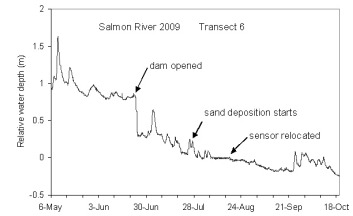

Figure 4. Water level changes in the Salmon River in 2009. Draining the 4 to 6 hectare reservoir required only 25 hours and reduced the water level at the reservoir center by 47 cm.

Lampsilis cariosa stranded on a sand bar after dam removal.

One source of mussel mortality was stranding when the reservoir was drained. An example of the extent of exposed former habitat can be seen in the photo above (white line). This habitat accounted for 30% of the former reservoir area but was home to 97% of the reservoir mussels. Photo taken in November, 2009.

The pipe above (transect 6) contains the water level and water temperature sensors that recorded the rapid decline of water in the reservoir. Water depth prior to dam removal was 103 cm and there was no sand bar present. This sand bar formed rapidly after 2.7 cm of rain in July, 2009, and was 151 m in length, 8.5 m wide, and 61 cm deep (770 m^3 in volume).

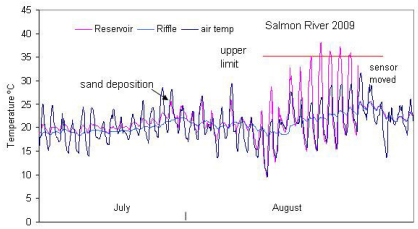

Figure 5. Temperature of water and air in the reservoir (transect 6) and riffle (transect 7) showing the effect of sand deposition (late July) on water temperature, and later, air temperature when the sand displaced the water over the sensor in August. Red line is the upper thermal limit for the mussel species present.

Sand deposition at the transect 6 water level sensor provided an estimate of the temperature that stranded mussels would experience in the exposed areas of the reservoir. Temperature exceeded the upper limit for mussels on five occasions and lasted for 4 to 6 hours during each event. The sensor was buried approximately 23 cm below the sand surface, similar to where mussels could be found. A similar effect can be seen at the transect 7 sensor (riffle) starting in mid August (Fig. 5) as sand was deposited over the sensor but to a lesser amount.

Table 1. Estimate of mortality of stranded mussels along the reservoir shoreline and ponds after the reservoir was drained. These data are from 2009 only. DS = dead stranded, shells with tissue remaining inside; RD = recently dead, no tissue but no evidence or internal erosion. More than 400 stranded mussels were moved to the river during the reservoir dewatering.

	Shoreline		Ponds		
Species	DS	RD	DS	RD	Total
Elliptio complanata	1259	1287	18	1	2565
Lampsilis radiata	24	14	1	1	40
Strophitus undulatus	18	30	0	0	48
Pyganodon cataracta	12	16	96	87	211
Pyganodon grandis	0	1	15	0	16
Pyganodon sp.	0	2	0	0	2
Lasmigona compressa	0	1	0	0	1
Lampsilis cariosa	2	0	0	0	2
Anodontoides ferussascianus	3	0	0	0	3
Total	1318	1351	130	89	2888

Sand deposition was a second source of mortality of mussels but there is only anecdotal evidence for this. Three middens at the sharp river bend downstream of transect 3 (Fig. 2) provided evidence of a large mussel bed (435 articulated shells of 6 species collected in 2008) that was subsequently covered by 3 m of sand in 2009.

Sand moved as recognizable waves within the reservoir. The wave shown above is the second wave traveling over the remains of the first wave and is about 30 cm in height. Waves moved from 4 to 9 meters per day.

Where did the sand come from? There is a glacial moraine upriver at Malone that is primarily coarse sand and sand from there had been trapped by the dam over the past 96 years. The slower water velocity within the reservoir promulgated six sand bars that were mobilized during dewatering. The erosion of the newly exposed sand bars was accelerated by rain events. Two of these sand bars can be seen in the photos below.

These photos show the sand that was trapped behind the dam (white area in top photo) and the subsequent erosion. The former footprint of the sand can be seen to the right in the upper photo. Upper photo was taken in July, 2009, and the lower photo was taken in November, 2009.

The photos on the left show the river bank downstream of transect 7 that was eroded after dewatering. A sand bar was present to the left of the right bank that was eroded completely during dewatering. The rocks to the left are part of a riffle that was exposed in the reservoir. Upper photo taken April, 2010, and the lower photo in October, 2010.