Rock Ramblings: Exploring the Geologic Foundations of the Penobscot River

by Johannah Withrow-Robinson

Part 1: The free flowing river

I hear rapids looming in the distance. The *whoosh* of running water builds to a roar as I stumble over rounded river rocks, clumsy in my haste to greet the swells and waves that surge over ledges and outcrops on their way to the calm summer bay. This will be my first view of Penobscot white water. Although whitewater is a rarity today on the lower stretches of the river, when the Veazie and Great Works dams are removed it will reappear, foaming over exposed ledges where the dams now stand.

Working my way up a seasonal channel that slips undetected behind Ayers Island in the summer months, unstable cobbles slow my journey up the exposed river bottom. Black and dull, the rocks tipping under my feet puzzle me: they look nothing like the glowing silver rocks I expected to line the shore. Curious, I crouch down to examine the cobbles more closely. Uniformly colored in an uncanny way, these rocks remind me that in geology, like many aspects of life, appearances can be deceiving.

I smash one rock over another until chips and flakes cartwheel around my face and hands; my eyes close in defense. This results in a few misplaced hits and a couple of sore fingers, but my persistence pays off as the rocks crack open to reveal their true identity.

Granite cobbles transported from the east by gravity and water crumble as they break; the salt-and-pepper rock is soft and weathered from its' travels. The majority of the river rocks, however, struggle against my pounding, and break off reluctantly into thin flakes. I have found the schist, a blue-grey stone that glistens with a subtle silver sheen. Geologists call it the Vassalboro Formation, and it forms the bedrock of much of the lower Penobscot Basin.

Over 400 million years ago, layers of mud and clay deposited around an island off the eastern coast of North America were pushed onto the growing continent by the movement of the earth's plates. Over time, thick sediment accumulated through this process, and the lower layers were subjected to extreme heat and pressure. The result was metamorphosis; the atoms and minerals that made up the clays and mud moved and changed to become the layered, silver rock that crops out below the dams and lies scattered beneath my feet.

Today, much of this ancient geology is hidden along the Penobscot River beneath the remains of younger geologic events. The Laurentide Ice Sheet, the most recent in a series of glaciers that covered the upper portion of North America, made its final retreat

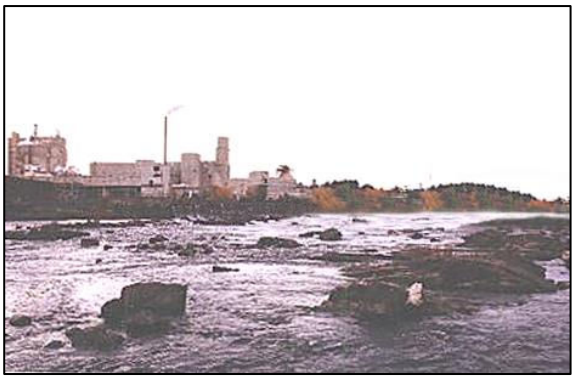
from this area 13,000 years ago. Soon after, the Penobscot forged its' path to sea: weaving through an area pockmarked with glacial lakes and mounded with debris dropped by the retreating ice sheet. In areas where the land reached toward the ocean at a steeper gradient, or where the glacial deposits lay thinner, the ancient bedrock surfaced once again.

I've finally made it to one such place. With the dry cobbles of Ayers Island behind me, I now stand at the main stem of the lower Penobscot, just below a set of boiling rapids. At these rapids, locally known as Basin Mills Rips, the river rushes over the dark, resistant bedrock in a cacophony of water droplets bouncing off rock and sandy bottom into the air. Here, the Penobscot is alive with noise as the rocky ledges and hidden holes give life *to* the river, and allow life to thrive *in* the river.

Part 2: The impoundment

The noise and movement of Basin Mills Rips are a sharp contrast to the still, quiet impoundment I float down in the early morning a few days later. Here, water trapped behind the Great Works dam makes its slow and lazy way through close to a mile and a half of flooded river above the ancient timber crib structure.

I studied a geologic map of the section of river that is currently home to the Great Works and Veazie dams. I traced the red pluses that indicate outcrops of the Vassalboro Formation through the more common white of glacial deposits. On the map, the stretches of river above and below the Veazie and Great Works dams look as if they've caught a bad case of the chicken pox. Due to the presence of large outcrops, the river should run fast and shallow over the rocky bottom, but while the Great Works dam still braces against the river's steady pulse, the pock marks are covered with a solid blue line indicating the engorged channel.



With the removal of the dam, however, the river will once again rise and fall with storms and dry spells, with summer and winter. As the river shifts back to braided channels flowing over exposed ledges, it will deliver the bright sounds of water arching off the back of bedrock lining the river bottom to the houses that sit in the trees along the bank. I know that the chickenpox outbreak of bedrock within these dammed stretches are comparable or greater in volume to the exposed rock at the raging Basin Mills Rips, but now floating in a canoe just above the Great Works dam, the only bedrock I see rises in a jumble of boulders from the lapping edge of the impoundment.

By effectively covering the ledges that define the shape of the channel, the impoundments changed the quality and character of the river. Evidence of the ecosystems' struggle reared its head in plummeting fish populations. When white settlers first arrived on the Penobscot, the river ran silver each spring as fish returned from the sea to spawn, and the culture and livelihood of the Penobscot Indians and other local tribes were built around the river's natural bounty. Within only a few years following the installation of the first dams, the fish runs rapidly declined and the river began to change dramatically: in both physical form, and in the composition of species that inhabited the river. The loss of enormous runs of anadromous fish has been both noticeable and devastating to particular

human communities within the watershed. However, other species, ranging from the majestic bald eagle to the diminutive mayfly larvae, have also been severely impacted by the changes within the river ecosystem.

Part 3: Insects in the changing river

Mayfly larvae and other bugs, collectively known as benthic macroinvertebrates, comprise the foundation of the river's food web and ecosystem in rivers. Worms, insects, snails, and other small critters live in the sediment on the river bottom, and are a primary food source for many fish and waterfowl. The health of a river ecosystem depends on the diversity and abundance of these insects throughout their different life stages. These insects are present from the larval stage, seen in the intricately woven caddisfly larvae casings, built out of twigs, leaves, or the tiniest of pebbles; as emergent mayfly and stonefly nymphs that surface just before shedding their last skin to become airborne; and as winged damselflies and dragonflies that attract leaping fish. The health of all small aquatic creatures depends on water quality and habitat availability.

Greater diversity in the river leads to greater diversity within the river ecosystem. Once dammed, the Penobscot lost diversity as the current slowed and the water level rose in the impoundments. Variation in flows was reduced, and the gravel and cobbles lining the river bottom – which often serves as ideal habitat for spawning sea-run fish - were smothered in a fine layer of silt.

Although it is difficult to predict exactly how the river and its inhabitants will respond, insect populations in the Penobscot River will likely diversify after the removal of the Veazie and Great Works dams. As the water level recedes from covered boulders and cobbles, rapids and riffles will re-form and the pattern of sediment deposition will shift to reveal the rockier river bottom. The new accumulation of sand, gravel, rock and silt will create ideal habitat for the varying needs of multiple insect species. The rushing current, bouncing between rock and air, will supply insects and other small creatures with a constant supply of fresh, oxygen-infused water. The river level will fluctuate with the seasons, and the variable flows and temperatures that this more native cycle brings will be optimal for different species at different times of the year.

The more I learn about river ecosystems, the more fascinated I become with the intertwined web of living and non-living elements. The river water, as old as time, rushes over rocks that are over 400 million years old and supplies ageless oxygen to insects and fish that will be gone in the blink of an eye. These rocks, only one factor in an equation that contains hundreds, play an important role in the condition and health of the whole. The presence of these rocks means foaming, oxygen-rich water that moves swiftly down the changing river channel. It means abundant life for the smaller water creatures, a source of energy for the fish and small mammals, as well as spiritual and physical sustenance for humans that weave in and out of the river system. The river rocks I stumble over along the river bank and glide over in a canoe are an important but often unrecognized aspect of the greater Penobscot ecosystem, and their renewed exposure with stretches of the water around the Veazie and Great Work dams will herald the return of a renewed order to the Penobscot River.

For more information on the Penobscot River Restoration Project, visit our web site at www.penobscotriver.org!