THE LEGACY OF HISTORIC LOGGING ON HEADWATER STREAMS IN PENNSYLVANIA

by Benjamin Hayes

The countless streams that drain the tangled headwaters regions of Pennsylvania watersheds are distinctly rugged and remote. Their channels are relatively wide and shallow, with beds and banks comprised of loose sand, gravel, and cobbles (Figure 1). Fallen trees create natural log jams that trap sediment upstream and create scour pools. Its no wonder that Pennsylvania headwater streams contain more brook trout than any other state in the conterminous US. In the steepest parts of the headwater streams, bedrock outcrops constrict the riparian corridor and create beautiful waterfalls and bedrock knickpoints. The fingerprint of Pleistocene is also evident in many of these watersheds, where barren rock fields ("felsenmeir") or pockets of glacial till mantle the hill slopes and coarse, glacio-fluvial outwash gravels fill the valleys (Figure 1).

SPIKED BOOTS AND PEAVEYS - THE HISTORIC LOG DRIVES

These headwaters of Penn's Woods contained vast tracts of timber, but the only way to get it out was by water. However, with their wide and shallow channels and numerous bedrock constrictions, the headwater streams were not suitable for the navigation of lumber schooners or for rafting, like on the larger rivers. In headwater forests, the logs came down loose, and they had to come in the spring, when the melting snows provide a brief period of high water. Two phrases coined from this log-driving era remain in our popular language: "Come hell or high water" and "as easy as falling off a log."

Timbering operations had a seasonal rhythm. The wood hicks spent the fall and winter months felling the trees and hauling them down to the valley bottoms where they would stack them in sidings erected along the stream banks (Figure 3). Then during the spring freshets, they would float the logs downstream (Figure 4). Blackbird crews - the brave rivermen who wore spiked boots and carried peavies to roll logs to the side of channel had the dangerous job of removing log jams during the log drives (Figure 5). The rivermen would make note of any channel features that tended to cause log jams and later give word to stream cleaning crews who spent the low flow periods of late summer and early fall, going up and down the streams blasting bouldery obstructions, dredging gravel bars, straightening channels, and any other feature that tended to cause jams.

By 1857, at the peak of the canal network and as railroad and logging operations were expanding across the Commonwealth, the Pennsylvania legislature passed a bill classifying streams as "commercial transportation routes." Stream "improvement" companies were formed, where crews with mules and draft horses, later steam donkeys and steam shovels, were used to modify the headwater streams for log drives. As boasted in this 1861 advertisement for the Cush Creek Stream Improvement Company, "stream improvements" consist of dams erected on streams, the building of cribs, piers, etc. and the cleaning out of streams between the points heretofore designated, the removal of rocks, bars, logs, and driftwood and trees, the widening and deepening the channel

Figure 1. Arial view of Grays Run and Lycoming Creek from Google Earth, shows the braided channel pattern of headwater streams draining steep, narrow headwater valleys filled with coarse glacio-fluvial outwash.

Figure 2. A typical Pennsylvania headwater stream, Big Bear Creek, a tributary to Lycoming Creek, which is located in the West Branch of the Susquehanna River basin. Note the wide and shallow alluvial channel, with loose gravel bars and multiple channels.

Figure 3. Wood hicks in a Pennsylvania lumber camp.

and the general improvements for the purposes of floating lumber thereon." By 1895, large sections of the braided headwater streams were converted to single channels devoid of large woody debris, gravel bars, and other natural complexities.

ALTERATIONS TO HEADWATER CHANNELS FOR HISTORIC LOG DRIVES

Modification to headwater streams primarily include:

1. Channel straightening and realignment. This was done not only for log drives, but also for railroads, flood control, hydropower. The evidence is visible today, where the stream channel hugs the valley sides, with meanders and abandoned braid channels still present on the floodplain (Figure 6).

2. Channel enlargement. Some widening of the streams occurred in response to straightening, but others were purposefully enlarged.

3. Berming. Logs and sediment dredged from the stream were placed along the sides of the channel, to elevate the banks to keep the logs and water in the channel during the spring freshets. Many berms were constructed after log drives were completed, to prevent flooding caused by the barren hillslopes as forests were clearcut.

4. Removal of wood. Early written accounts of Pennsylvania headwater streams describe small boulder-strewn brooks, with log jams and thick brush along their corridors. The channels today are largely devoid of wood, as statutes allowed for the removal of these obstructions.

5. Removal of boulders or moving them to margins of channels. Many headwater streams contain massive boulders deposited by glaciers. When present in a channel that caused log jams, they were blasted and moved to the side of the channel.

6. Blasting of bedrock constrictions. In some headwater streams, bedrock outcrops cause a sudden constriction of the valley and channel. These constrictions were blasted to widen and deepen them. Often times a log apron was built across the constriction, to prevent log jams (Figure 7).

7. Construction of dams. There were big ones and small ones, cheap ones and costly ones, but each dam was made by hand, usually of large and solid hardwood logs felled close at hand. Dams used for several years or longer typically had a superstructure of timbers squared with a broadaxe. Larger "splash" dams were equipped with a plank gate in the middle, which was raised vertically in order to let logs be driven through. This operation was

Figure 4. Log drive in headwater stream.

Figure 5. Blackbird crews, or riverman, working a log jam on the margin of a channel during a log drive.

Figure 6. A LiDAR digital terrain image of Muncy Creek, showing the braided, or multi-threaded channel pattern visible on the valley floor, with the artificially straightened and deepened channel dredged to drive logs downstream.

Figure 7. Log apron built across bedrock constriction, to prevent log jams at the waterfall.

Figure 8. Sluicing logs through the gate of Flooks Run Splash Dam on Little Pine Creek in Lycoming County, Pennsylvania (Forest Leaves, published by the Pennsylvania Forestry Association, vol. 17, no. 12, pg. 185, (December 1920). Note the clearcut hillslopes.

Figure 9. Susquehanna log boom and crib structures at Williamsport, PA.

known as sluicing. The gateway, along with the attendant log apron below, was called the sluice. One "splash" dam built across a headwater stream in the Little Pine Creek watershed, cost over fifty thousand dollars and had a sluice over 22 feet wide that could handle 12 million feet of logs a day (Figure 8). A "roll" dam was a smaller affair without gates, when a sufficient head of water could be obtained in the swell of the river's surface. The logs floated up an inclined plane and down the other side, thus causing the roll after which the dam took its name. A "squirt" dam were temporary structures, rebuilt every year after purposely being breaching by blasting the crude log dam apart, creating a flood that enabled the logs to float downstream.

8. Boom and crib structures on the larger receiving streams and rivers. Hundreds of 20 by 40-ft log cribs, filled with rocks and extending 20 ft high were built in a line along the river with chained logs or "booms" stretched between them. These structures enabled lumber companies to catch and hold floating logs until they could be processed at local mills. One of the larger booms was on the West Branch of the Susquehanna River between Lycoming Creeks, which operated from 1851 to 1909, and extended seven miles upstream (Figure 9).

FUTURE CONSERVATION AND RESTORATION APPROACHES

The last log drive of any size took place in 1908, when the Central Pennsylvania lumber company drove 12 million feet of logs from Little Pine Creek to the boom at Williamsport. Yet over one hundred years later, many headwater streams remain in a protracted phase of fluvial adjustment to the modifications done to them over a hundred years ago. During floods, such as Tropical Storm Lee in September 2011, meanders and new channels are formed when artificially straightened channels become clogged with wood, sediment, or ice. Conservation and stream restoration strategies should focus on assisting the recovery of ecological integrity in headwater streams by (1) reestablishing hydrologic, geomorphic, and ecological processes and (2) replacing lost, damaged, or compromised biological elements.

Relic logging features such as splash dams and berms should be removed and large woody debris reintroduced to the channel, so that over a range of discharges, the headwater streams can naturally form a complex, irregular network of log jam/step/pool and gravel bars. Such efforts focus at the head of large bars and profile inflection points, to encourage the stream to reconnect with its floodplain, improve flow in abandoned side channels, and permit more uniform distribution of energy throughout the fluvial system. This results in sediment being filtered out, water quality improved, groundwater recharge increased, and downstream flood peaks reduced. These kinds of adaptive stream restoration approaches will improve carbon sequestration within the watershed and the branches and leaves reintroduced to the stream provide food for macroinvertebrates and shelter for fish, amphibians, and reptiles.

Benjamin Hayes directs the Watershed Sciences and Engineering Program at Bucknell University, where he conducts research on headwater streams throughout Pennsylvania and teaches classes on fluvial processes and stream restoration.

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