Goff Mill Brook Dam Removal

Report to the Maine Outdoor Heritage Fund

Grant ID 151-01-11

April 20th, 2016

Jacob Aman

Wells National Estuarine Research Reserve

wellsreserve at laudholm

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This project was funded with generous support from the Maine Outdoor Heritage Fund, Trout Unlimited, the National Fish and Wildlife Foundation, The Nature Conservancy, and the Atlantic Salmon Federation.
Thank you!

On the cover: Caribou Springs LLC removes the concrete and stone dam on Goff Mill Brook, September 18, 2015.

Goff Mill Brook now flows unimpeded to the Kennebunk River estuary and the Gulf of Maine.

Project Summary

On September 18th, 2015 the dam at the head-of-tide on Goff Mill Brook was removed and natural flow restored to the stream. The removal was carried out by Caribou Springs LLC of Gilead, Maine and took approximately 60 minutes to complete. The impoundment drained completely in a few hours restoring natural flow and exposing riffle and pool habitat upstream of the dam site. This project restores connectivity between seven miles of freshwater habitat and the Gulf of Maine and enables upstream and downstream passage by aquatic organisms. In April 2016 rainbow smelt, brook trout, and sea lamprey were found passing upstream of the former dam site.

Goals and Objectives

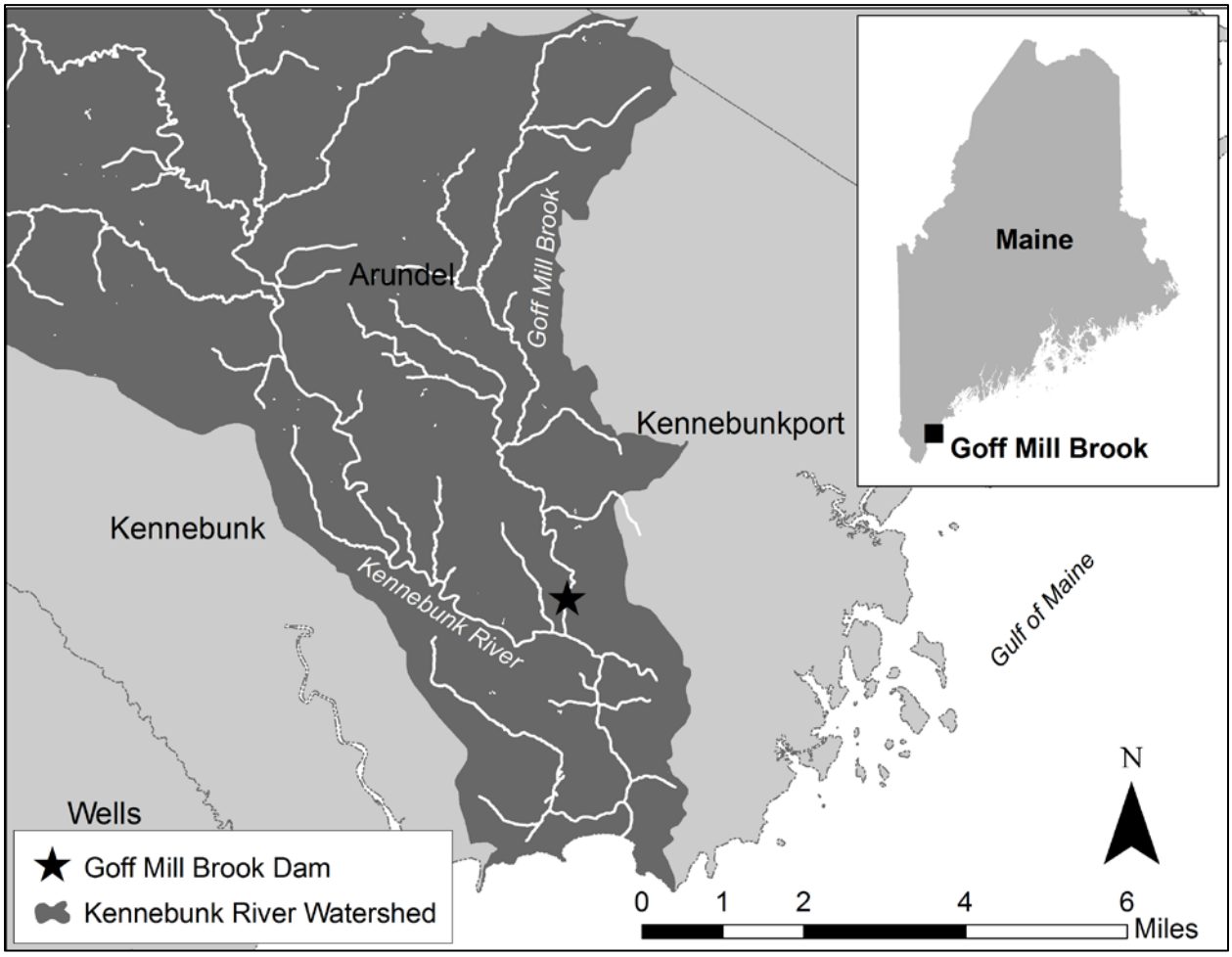
This project met its three primary objectives to restore natural in-stream conditions and fish passage to Goff Mill Brook, to increase local and regional awareness of the benefits of stream restoration projects, and to enhance the capacity of the Wells Reserve and local project partners to successfully implement stream restoration projects. Physical removal of the dam and associated debris was successfully carried out on September 18th. Local conservation groups were engaged in the project and public presentations and media outreach were conducted to highlight the benefits and challenges of stream habitat restoration. The process of permitting and planning for the removal of the dam provided Wells Reserve staff and Trout

Unlimited Sebago Chapter volunteers with valuable experience in the necessary legal and logistical steps involved with this type of restoration work.

Project Background

In 2011 Wells Reserve and partner Maine Rivers identified the Goff Mill Brook Dam (Figure 1) as a stream restoration opportunity with significant potential benefit for diadromous fish species and other aquatic organisms. The dam spanned the 30 foot width of Goff Mill Brook at the head-of-tide where it joins the Kennebunk River estuary in Arundel, Maine. With approximately seven miles of upstream habitat, the removal of the dam would provide significant spawning habitat for sea-run fish species and potentially expand the tidal range of the estuary. Migratory fish are of particular interest for restoration due to the extensive historic impacts of dam building and over fishing throughout their native range (Hall et al. 2010). Historical habitat degradation has impacted not only commercially and recreationally important species, but also those fish species that are important food sources for both migratory and marine fishery stocks (Limburg & Waldman 2009).

Figure 1. Goff Mill Brook restoration site in the Kennebunk River watershed.



Fisheries Potential

In 2011 the Wells Reserve conducted fish sampling in the Kennebunk River estuary and Goff Mill Brook in order to determine what migratory and resident species were present that could be expected to benefit from restoration work within the watershed. The estuary is an ideal location for monitoring these migratory fish species because it is the pathway from the ocean to upstream freshwater habitat; and migratory and resident fish alike will spend periods of time exploring and inhabiting the estuary at different stages of their life history. Surveys were also conducted in Goff Mill Brook, in freshwater reaches upstream of the head-of-tide dam to the headwaters. Migratory species such as American eel and sea lamprey are agile, and individuals may sometimes find a way around smaller or breached dams and reach upstream habitat. Also of interest when restoring linkages between marine and fresh water is the potential for native brook trout to access rich feeding opportunities in the estuary. This anadromous behavior in brook trout populations has become rare in coastal streams.

With no funding for prerestoration work, the scope of the study was limited to collecting presence/absence data using a variety of techniques. Fish were sampled at one site near the head of tide in the Kennebunk River, and one site near the mouth. Surveys in Goff Mill Brook were limited to four sites and one fishing event at each location from mid October to early November. Passive sampling techniques such as gill nets and traps were utilized in the estuary, and active sampling with a backpack electro-fishing unit was employed in Goff Mill Brook.

Spring surveys identified a diversity of resident and migratory fish in the Kennebunk River estuary. Sea lamprey, striped bass, American eel, and alewife represent the migratory fish that were sampled. The resident species included brown bullhead, common shiner, fallfish, white sucker, three-spine stickleback, and pumpkinseed. These species typically inhabit freshwater, with the exception of the stickleback, which is a brackish species. One juvenile pollock was also caught near the head of tide in the estuary. Fall surveys in Goff Mill Brook identified brook trout, white sucker, chain pickerel, fallfish, American eel, and sea lamprey.

Wild brook trout were sampled in Goff Mill Brook in

The presence of migratory fish in the Kennebunk River estuary indicated that given access to upstream habitat, there were still remnant populations of these species available to colonize newly accessible freshwater reaches. The presence of brook trout throughout Goff Mill Brook was a positive indicator of the quality of existing habitat in free-flowing reaches of the stream. As habitat conditions improve in the restored reach after dam removal, brook trout will likely begin to inhabit the riffles and pools that form as silt flushes out and natural substrate emerges. The presence of juvenile brook trout in Goff Mill Brook was also a good sign that the habitat is of high quality and supports a naturally reproducing population. These findings support state level data classifying Goff Mill Brook as wild brook trout habitat (MNAP 2015). Once the dam was removed, any brook trout that dropped down to the estuary would be able to return

upstream to spawn in the fall potentially leading to a recovery of an anadromous population. The presence of one juvenile sea lamprey in Goff Mill Brook surveys was of great interest, and a testament to the drive of this species to complete its life cycle. Clearly, some individuals have been able to get past the dam, likely during high water events during the spring migration season. These individuals found suitable spawning habitat, and this indicated there was potential for an increase in the population of this important native species once fish passage was restored.

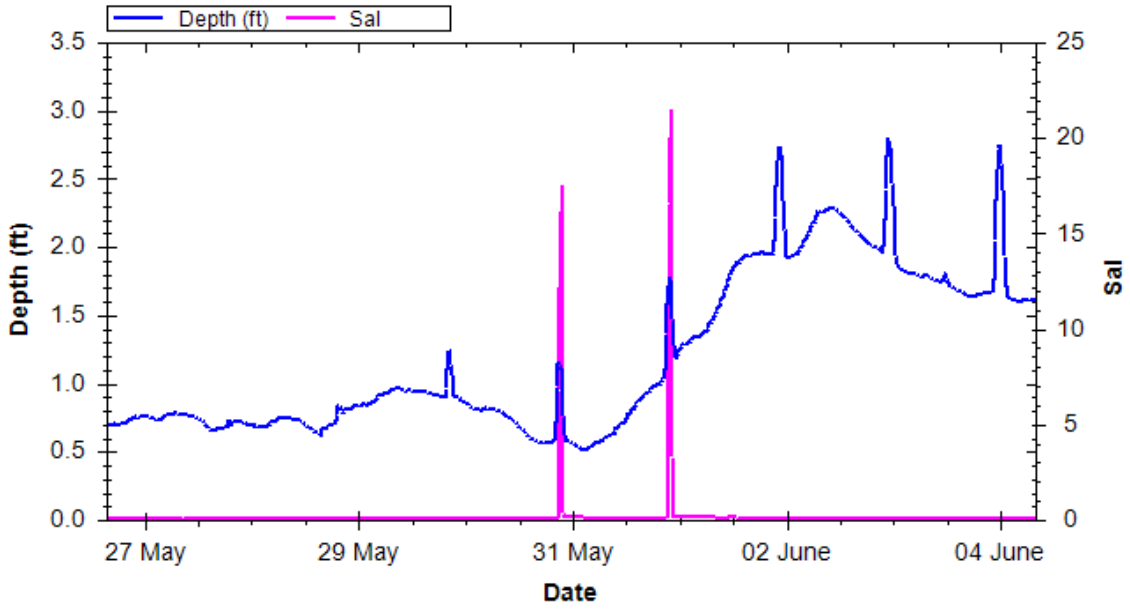
Tidal Restoration Potential

In order to better answer questions related to the physical changes that could occur after the removal of the head-of-tide dam on Goff Mill Brook, a YSI 6600 data logger was deployed near the base of the dam to measure changes in depth and salinity in spring 2015. This information was expected to characterize the extent of tidal flooding and the range of incoming salt water during high tide. The logger was set to record measurements every 15 minutes from 5/26/15 to 6/4/15. The logger recorded measurements over 16 high tide periods. The high tide height based on available tide chart predictions ranged from 8.4 to 10.5 feet (Tidelines, 2015). A total of 2.5 inches of rain fell during the study period based on provisional precipitation data recorded at the Wells Reserve weather station approximately 4.5 miles away (NERRS, 2015). All of this rain fell during a two day period from May 31 to June 2.

Depth data revealed that incoming tides measurably increased the water level of the stream at the base of the dam when tide height reached nine feet. The maximum increase observed was one foot during a 10.5 foot tide. Salinity data showed that high tide could increase salinity during periods of lower stream flows. High tides on May 30 and May 31 increased salinity above one part per thousand (ppt) for approximately one hour and 1.25 hours respectively, with the maximum salinity recorded at 21.4 ppt. However, average salinity during the study period was 0.27 ppt. Depth and salinity data are shown in Figure 2.

Tide water inundates the site of the former dam on Goff Mill Brook in September 2015.

Figure 2. Depth and salinity measurements reveal some tidal influence at the foot of the dam.

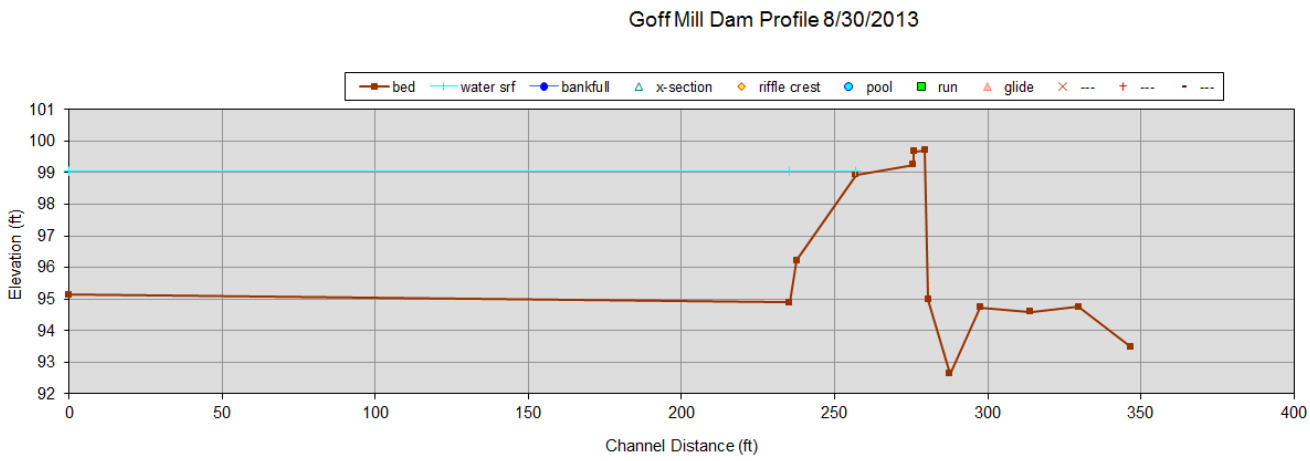


Based on these observations it appears that the influence of incoming tidal water varies with tide height, and base stream flows. During periods of low base flow, salinity levels may increase around peak high tide. Stream level currently increases during high tides greater than 9 feet in height; however, it is not clear from this study to what degree the tidal restriction of the dam increases the depth by blocking tidal range from moving further upstream, and to what degree the stream elevation may decrease after removal of the dam.

Elevation measurements were collected with a Total Station to help quantify the changes expected from dam removal.

Longitudinal elevation measurements of Goff Mill Brook were collected with a Total Station in August 2013 (Figure 3). These measurements included stream bed and dam elevations from approximately 70 feet downstream of the dam to approximately 270 feet upstream of the dam, along the thalweg of the channel. Based on a comparison of longitudinal elevation of the stream bed with depth data from this study, incoming tidal influence was expected extend upstream of the current dam location. However the extent of this influence is unclear and will be variable depending on the elevation of the stream bed once it has stabilized. The stream elevation profile showed that significant filling has occurred within 50 feet upstream of the dam.

Figure 3. Comparison of upstream and downstream elevation shows effect of dam on stream elevation.



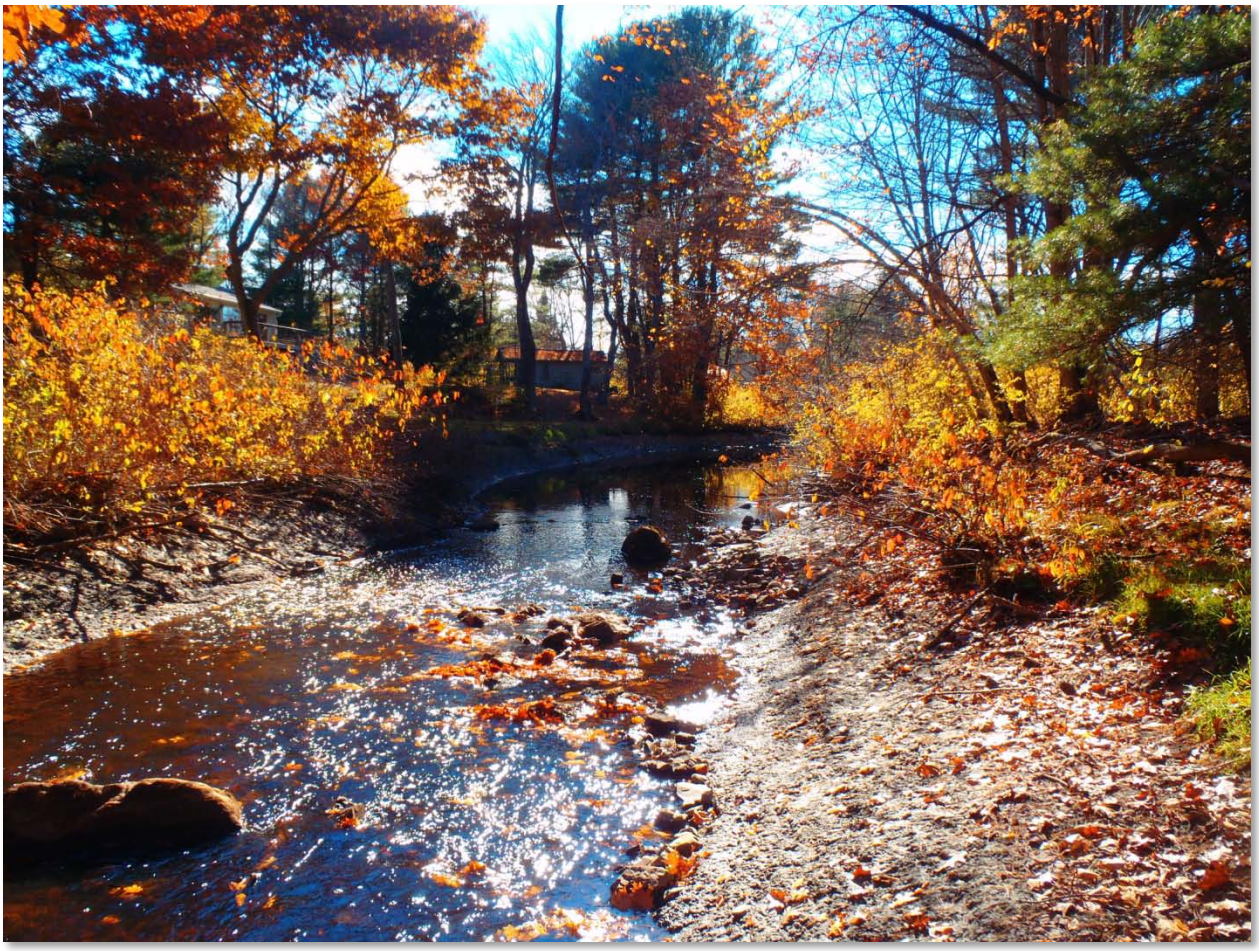
This study provided a basic analysis of existing conditions in Goff Mill Brook, and established pre-restoration conditions against which post-restoration changes will be evaluated. Removal of the Goff Mill Brook Dam was expected to result in the recovery of a small reach of upper estuary. However, given the limited amount of saline water below the dam, and the absence of a riparian floodplain upstream of the dam, it seems unlikely there will be an increase in fringing salt-marsh vegetation in the restored reach of Goff Mill Brook in the near future.

Project Timeline

Initial contact was made with landowners in 2011 but no real progress to restore habitat connectivity was made until 2013 when funding became available for project planning. USF&WS Gulf of Maine Coastal Program provided field support for baseline elevation surveys of the site and this early data was useful in communicating project goals and assessing approximate project costs. Negotiations with the landowner culminated in an agreement in November 2014 to proceed with the dam removal. At that time fundraising efforts were begun in earnest. The Nature Conservancy was identified as a project partner early on and provided the first committed funding. The Sebago Chapter of Trout Unlimited (TU) was identified as a potential funding partner and Wells Reserve collaborated with the chapter on a proposal to the TU National Embrace a Stream Program (TUEAS) in December 2014. Wells Reserve submitted a final funding request to the Maine Outdoor Heritage Fund (MHOF) in March 2015. Both the TUEAS and MOHF requests were successful, and with full funding in place the permitting process began in May 2015. State and federal permits were obtained by June but the project hit a snag during the Shoreland Zone permitting process through the Town of Arundel. A three month permitting process ensued which required numerous presentations to the town of Arundel planning board, retention of legal counsel on the part of the Wells Reserve, and a public hearing. In the end, the Town approved the project in late August.

Caribou Springs Watershed Solutions LLC was identified as the contractor and several site visits were conducted with the landowner to develop the work plan for removal of the dam and stabilization of the site. Demolition of the dam was carried out on September 18th and took only a few hours from start to finish. All manmade debris was removed from the stream channel and the stream bank was stabilized with native grass and straw.

Post-restoration site visits have been conducted on a monthly basis to photo document changes to the site. High tides have been observed flooding the stream above the former dam site. Post-restoration monitoring of fish communities and water level and salinity commenced in early April 2016 and will continue through June 2016.



Gravel and cobble substrate emerges upstream as flow returns to normal and accumulated sediment has flushed away.

Project Outcomes

With removal of the dam the entire length of Goff Mill Brook is now accessible to sea-run fish species. The restoration has expanded the range of tidal flooding in the upper estuary which will provide additional habitat for estuarine species. The reduced depth of the channel will facilitate access by wading birds and fishing birds and mammals, and provide a travel corridor for other riparian dependent wildlife.

As of April 2016, natural substrate continues to emerge as accumulated silt flushes out of the restored stream. The emergence of hard cobble and gravel substrate has provided habitat for aquatic invertebrates to colonize, improving food sources for insect-eating fish and wildlife. Initial surveys of fish utilizing the restored reach have yielded immediate positive results. On April 13th several fish were caught moving upstream of the former dam site including a brook trout and a rainbow smelt. The following day, on April 14th, two sea lamprey and two white suckers were captured, along with three-spine sticklebacks and mummichogs. These species would not have been able to pass the dam. Presence of rainbow smelt is an important find as this species is a federally listed species of concern. The presence of mummichogs and 3-spine sticklebacks, which are estuarine resident fish, demonstrates that the project was successful expanding tidal range and increasing the area of the Kennebunk River estuary.

Rainbow smelt sampled in April 2016 successfully passing upstream of the former dam site.

Challenges and Lessons Learned

Project partners spent a significant portion of their time in communicating the need for this restoration to stakeholders. Initial conversations with the landowner lasted over a year and required several face to face meetings attended by partners to convey the goals and benefits of the restoration project. This communication was critical because there was little initial incentive for the landowner to remove the dam, except that eventually it would fall apart, potentially creating a hazardous situation. Taking time to address landowner concerns and convey the scientific basis for the restoration project built trust between the project partners and the landowner, which ultimately enabled the success of the restoration. This trust became extremely important when the project became controversial due to objections raised by abutting landowners. Here, too, extensive efforts were made to communicate project goals and benefits. However, these efforts were not successful in overcoming the misconceptions and objections of several abutting landowners.

During the local permitting process significant time was spent engaging both the Arundel Planning Board and the Arundel Planner in an attempt to convey the goals and benefits of the project. The Wells Reserve and partners went above and beyond to provide the board with requested information to help them understand the implications of a small dam removal project, which was a first for this board. The board raised personal objections to the project, citing personal opinion that there was little merit to carrying out the restoration, despite significant support from state and federal fisheries and wildlife agencies, and environmental NGOs and published scientific literature demonstrating the benefits of stream restoration. However, there were no legal grounds for denying the permit, and it was ultimately approved only a few weeks before work was required to be completed according to federal and state permit requirements. This process was a significant drain on project funding and staff time,

requiring retention of legal counsel that amounted to one quarter of the project contracting costs.

This experience speaks to the need to raise public awareness of the value of stream restoration activities, and removal of historic remnant dams in particular. The benefits of restored habitat connectivity and associated increases in fish and wildlife are difficult to quantify beforehand. Many of the historical uses associated with free-flowing rivers and streams (harvesting of sea-run fish for example) are no longer valued because they have not been available in recent memory. The public often perceives greater ecological value of an impounded stream than of a free-flowing one, conflating quantity of water with quality of habitat. It will be important to the success of future projects to quantify the benefits of ongoing and past restoration activities to both fish and wildlife. This is being done for larger projects in Maine, but more information is needed on the benefits of restoration through removal of small dams, as these represent the majority of dams in Maine.

Project Communication

Project related activities and outcomes were communicated through press releases, organizational media, and public presentations.

Press

- "Dam removal in York County opens brook habitat for migratory fish, wildlife." KeepMeCurrent. Sep 23, 2015. URL http://www.keepmecurrent.com/sports/dam-removal-in-york-county-opens-brook-habitat-to-fish/article_00138084-620d-11e5-9212-c3602088871a.html
- "Dam removal opens brook habitat to migratory fish." Seacoast Online. Sep 23, 2015. URL http://www.seacoastonline.com/article/20150923/NEWS/150929609
- "Land owners angered over dam removal." WMTV. Sep 18, 2015. URL http://www.wmtw.com/news/land-owners-angered-over-dam-removal/35356584
- "Dam Removal Creates Divide." Kennebunk Post. Aug 28, 2015. URL http://post.mainelymediallc.com/news/2015-08-28/Front_Page/Dam_removal_creates_divide.html
- "Goff Mill dam can go, says Planning Board." Journal Tribune. Aug 28, 2015. URL http://www.journaltribune.com/news/2015-08-28/Front_Page/Goff_Mill_dam_can_go_says_Planning_Board.html
- "Arundel Planning Board considers removing Goff Mill dam." Journal Tribune. Jul 31, 2015. URL http://www.journaltribune.com/news/2015-07-31/Front_Page/Arundel_Planning_Board__considers_removing_Goff_Mi.html

Media

- "Goff Mill Brook Dam Removal." Sebago Chapter of Trout Unlimited website. URL http://www.sebagotu.org/conservation.html
- "Coastal Stream Monitoring." Mainstream, Newsletter of the Sebago Chapter of Trout Unlimited. March 2016. URL http://www.sebagotu.org/images/news_latest.pdf

- "62 Dams Removed to Restore Rivers in 2015." American Rivers. URL http://www.americanrivers.org/initiative/dams/projects/2015-dam-removals/
- "Letting It Flow." The Wrack, Wells Reserve Blog. Nov 20, 2015. URL http://www.wellsreserve.org/blog/766-letting_it_flow
- "Dam Removal Opens Brook Habitat to Migratory Fish." The Wrack, Wells Reserve Blog. Sep 21, 2015. URL http://www.wellsreserve.org/blog/754-dam_removal_opens_brook_habitat_to_migratory_fish
- "Letting It Flow." The Watermark Fall 2015, Wells Reserve Newsletter. URL http://www.wellsreserve.org/writable/files/watermark/watermark-32-2_fall2015.pdf

Presentations

- Aman, J. Stream Habitat Connectivity Restoration. NOAA CFO briefing. Wells, ME, Dec 2, 2015. Public Programs
- Aman, J. Stream Restoration. Laudholm Trust Annual Meeting. Wells, ME, Dec 2, 2015.
- Aman, J. Stream Restoration 2015. Maine Stream Connectivity Work Group. Yarmouth, ME, Nov 4, 2015.
- Aman, J. Stream Habitat Restoration in 2013 – 2015. Update to the Reserve Management Authority. Wells, ME, Oct 21, 2015.
- Arundel Planning Board Public Hearing. Arundel, ME, Aug 13, 2015.

Partnerships were the key to successful habitat restoration in Goff Mill Brook.

Acknowledgements

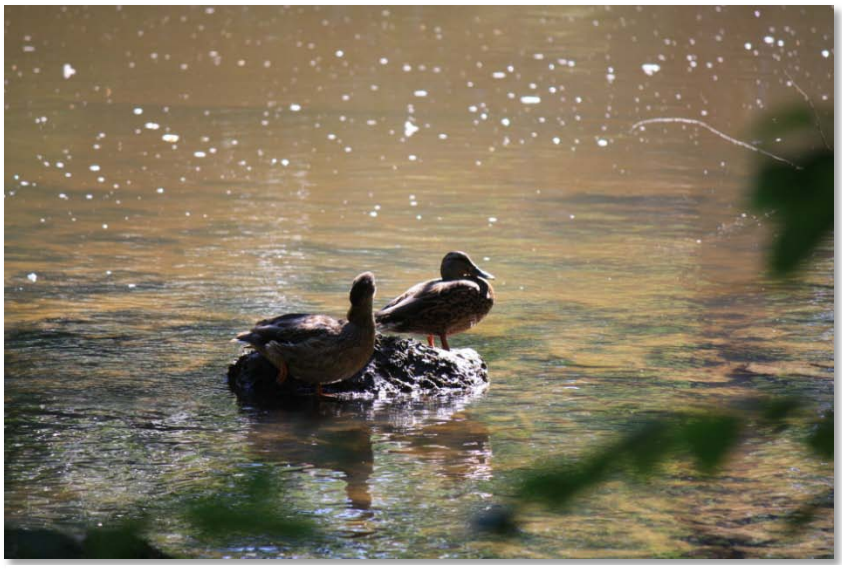
This project was made possible by support from a diverse group of committed volunteers and partner organizations and by generous funding support through completive grants and in-kind contributions.

We would like to thank Jed Wright of the U.S. Fish and Wildlife Service Gulf of Maine Coastal Program for providing support for field data acquisition and analysis, and project communication. Thanks also to Claire Enterline of the Maine Department of Marine Resources and Scott Lindsay and Tim Spahr of the Maine Department of Inland Fisheries and Wildlife for conducting site visits to assess the benefits and potential

impacts of the dam removal. Thanks to John Burrows and Bill Grabin of the Mousam and Kennebunk Rivers Alliance for providing support with project communication.

We would like to thank Jay Milot of Caribou Springs LLC for providing in-kind site assessments and facilitating project permitting and communication. Thanks also to Bruce Read of Shepard and Read Law Firm for invaluable help navigating the local permitting process.

We would like to thank Paul Dest, Director of the Wells Reserve, for his commitment to seeing this project through, despite the major headaches that it caused. Thanks also to Scott Richardson and Nik Charov of the Laudholm Trust for providing support with project communication.



A pair of ducks rest on newly exposed boulders after the dam removal in Goff Mill Brook.

We would like to thank Steve Heinz of the Sebago Chapter of Trout Unlimited for the many hours he spent helping to make this project possible, through fundraising, permitting, and communication. Steve's energy and enthusiasm for stream restoration provided the key components that made this project happen. Thanks also to the many other volunteers with TU that contributed to this project.

This project would not have been possible without the commitment of the dam owners, Mary and Milda Castner. We appreciate the thoughtfulness with which they considered this project and their resolve to see it through despite the challenges that arose along the way. They have made a truly positive impact on the ecology of the Kennebunk River watershed and the Gulf of Maine that will be realized by generations to come.

Funding for this project was provided by diverse organizations that recognized the value of this project. Thank you to the Nature Conservancy for their early commitment of funding that propelled this project through the initial phases by supporting project management costs. Thanks also to the Atlantic Salmon Federation and Sebago Chapter of Trout Unlimited for funding permitting and contracting costs. Thank you to the National Fish and Wildlife Foundation for allowing the reallocation of existing grant funds to support this project.

The National Trout Unlimited Embrace a Stream Program provided critical funding for contracting without which this project would not have been possible. The Maine Outdoor

Heritage Fund provided the largest source of funding for this project, which supported contracting and project management, both critical aspects of the project. Thank you to both of these programs for their generous support.

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