MIDCOAST CONSERVANCY

Office: 290 U.S. Route 1, Edgecomb, ME 04556
Mail: PO Box 439, Edgecomb, ME 04556
Phone: (207) 389-5150
www.midcoastconservancy.org

# Sheepscot Pond & Sea-Run Species

A Treatise on Current Issues

## Introduction

This document is intended to provide historic context and factual information regarding major concerns which have been voiced regarding the restoration of sea-run species to Sheepscot Pond in Palermo, Maine.

## Background

Sheepscot Pond in Palermo is the primary headwater pond of the main stem of the Sheepscot River. The pond is 1,215 acres large and has a maximum depth of 132 feet.[1] Active fisheries management of the pond is currently focused exclusively on recreational freshwater species. The Department of Inland Fisheries and Wildlife stocked 2,500 brook trout in the pond in 2017.[2] Despite being managed exclusively for freshwater game species, Sheepscot Pond also represents approximately 40% of the historic alewife habitat in the Sheepscot River watershed above the Head Tide Dam.

The Department of Inland Fisheries and Wildlife (DIFW) owns and manages a dam and fish ladder at the outlet of Sheepscot Pond. The Department also owns the Palermo State Fish Rearing Station near this dam, which raises brook and brown trout for release. This facility is referred to as a "rearing station" and not a "hatchery" as there is no incubation or hatching of eggs at the site.[3] Water for the rearing station is sourced directly from Sheepscot Pond. The pond had a historic run of alewives in the 1960s and 1970s, as the dam has an operational Alaskan steeppass fish ladder. However, due to concerns of potential diseases, in 1980 DIFW began to block the fish ladder during the two-month spring spawning migration to prevent alewives from accessing the pond. As the Department of Marine Resources manages sea-run species, the Commissioners of both Departments have continued to restrict alewife access under an informal handshake agreement.

Since at least the 1990s, the Sheepscot Valley Conservation Association has attempted to advance passage of sea-run species in the Sheepscot River watershed. That organization merged with several others in 2016 and became Midcoast Conservancy. For several years, the Atlantic Salmon Federation (ASF) has been working in the Sheepscot River watershed to improve passage and access to historic habitats for sea-run species. Working diligently with municipalities and many other partners, ASF has successfully established agreements to improve sea-run species passage through the Head Tide Dam in Alna, the Coopers Mills Dam in Whitefield, and into Branch Pond in Palermo and China. Sheepscot Pond represents a significant portion of historic habitat for sea-run species that has yet to be connected to the remainder of the Sheepscot River and Gulf of Maine watersheds.

## Alewives & Disease

The vast majority of alewives evolved as a sea-run species. The native range of alewives extends along the Atlantic coast of the United States and Canada.[4] The most important fact to consider

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[1] Maine Volunteer Lake Monitoring Program
[2] Maine Department of Inland Fisheries and Wildlife. 2017 Stocking Report. http://www.maine.gov/ifw/docs/2017%20Annual%20Fish%20Stocking%20Report.pdf
[3] Maine Department of Inland Fisheries and Wildlife. http://www.maine.gov/ifw/fish-wildlife/hatcheries/palermo.html
[4] Fuller, P., E. Maynard, D. Raikow, J. Larson, A. Fusaro, and M. Neilson, 2018, *Alosa pseudoharengus* (Wilson, 1811): U.S. Geological Survey, Nonindigenous Aquatic Species Database, Gainesville, FL,

when discussing alewives is that there is also a land-locked population in the Great Lakes. This population has become land-locked due to human intervention through the construction of dams and canals. Because of this, alewives in the Great Lakes are considered non-native and invasive, and much research is available on the effects these land-locked populations have had on other native Great Lakes fish species. Therefore, it is crucially important to differentiate between research on non-native land-locked alewives in the Great Lakes and native sea-run alewives on the Atlantic coast. Simply, alewives in the Great Lakes spend all of their lives in freshwater, while sea-run alewives on the Atlantic coast migrate from sea to freshwater lakes as adults in the spring, reproduce, and adults and newly-hatched juveniles return to sea by early fall of the same year. As such, no research presenting data exclusively on alewives in the Great Lakes is relevant to Maine.

One persistent question has been whether alewives have the potential to transmit the pathogen Viral Erythrocytic Necrosis, or VEN. VEN may cause anemia in some marine and anadromous fish species.[5] This is a unique concern for Sheepscot Pond due to the presence of DIFW's Palermo Fish Rearing Station which utilizes Sheepscot Pond as an intake water source. The concern is that if alewives potentially carrying VEN are allowed into the pond, the virus could enter the rearing station and threaten the fish being raised.[6]

First and foremost, the DIFW rearing station at Palermo does not have any kind of filtration or disinfection equipment for its water intake. The majority of other hatcheries in the state which utilize an open body of water as a water source include ultraviolet light disinfection and outlet microscreen filtration, including hatcheries at Casco, Grand Lake Stream, Embden, and Enfield.[7] This issue should not be taken lightly. The state had previously appropriated funds to install these protections at most other hatcheries in the state, but not at Palermo.

Maine does have an expert panel to address issues of this nature. The Aquatic Animal Health Technical Committee (AAHTC) is established within the Maine Department of Marine Resource's rulemaking in Chapter 24: Importation of Live Marine Organisms. This Committee is charged with, among other things, "Procedure for disease and pathogen surveillance and health monitoring among aquatic animal resources."[8] The Committee is currently comprised of members representing the U.S. Fish & Wildlife Service, National Oceanic and Atmospheric Administration, Kennebec River Biosciences, State of Maine Veterinarian, University of Maine Cooperative Extension and Aquaculture Research Institute, Maine DMR, and Maine DIFW.

The AAHTC was requested by DIFW to address these pathogen concerns.[9] In a conference call meeting on February 23, 2017, meeting minutes show that "the consensus of the group is that the open water source (lack of filtration and UV) at the hatchery is already a major risk." The

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https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=490, Revision Date: 9/25/2015, Peer Review Date: 4/1/2016, Access Date: 2/2/2018

[5] Winton, J. R. and P. K. Hershberger. "Viral Erythrocytic Necrosis." Western Fisheries Research Center. *FHS blue book: Suggested procedures for the detection and identification of certain finfish and shellfish pathogens, 2014 edition*. American Fisheries Society, 2014.

[6] "'Hackles are up' on issue of Sheepscot Pond restoration plan." *Kennebec Journal*. September 23, 2017. Newspaper.

[7] Maine Department of Inland Fisheries and Wildlife. http://www.maine.gov/ifw/fish-wildlife/hatcheries/index.html

[8] Maine Department of Marine Resources. Chapter 24, Section 24.04: Aquatic Animal Health Technical Committee, as amended March 9, 2015.

[9] Sheepscot Pond Fishway Disease Assessment and Implications for the Palermo State Fish Hatchery and Associated Stocking Program for Brown Trout and Brook Trout.

Committee concluded that "the recommendation of the AAHTC was that the opening of the Sheepscot Pond fishway did not constitute a significant added risk over current practices and that installation of UV treatment at the Palermo State Fish Hatchery should be prioritized to protect the hatchery water supply."[10]

One other concern for the rearing station is the potential for small juvenile alewives to be pulled into the water intake, potentially overcrowding the facility and requiring staff to attempt to remove hundreds or thousands of juveniles from the thousands of brook and brown trout being raised. This would be a significant waste of time and resources. Fortunately, a fairly simple solution is to install a screen on the intake pipe to prevent juvenile alewives, or any other small fishes, from being unintentionally pulled into the hatchery. Project partners had in the past agreed to assist with the cost of installing such a screen.[11]

It should also be noted that there are other examples of Maine lakes which are accessible to the sea and have active annual runs of alewives, as well as healthy populations of landlocked salmon, lake trout, and brook trout. Examples include Tunk Lake (Sullivan), Donnell Pond (Franklin), Alamoosook Lake (Orland), and Toddy Pond (Orland). In DIFW's lake survey report for Alamoosook Lake, the Department states that "[i]n addition to their commercial value as adults, young-of-the-year alewives constitute an excellent forage item for the lake's sportfish."[12]

**Game Fish Consumption of Alewives & Thiaminase**

As mentioned above, it is important here to recall the difference between land-locked alewives in the Great Lakes and sea-run alewives on the east coast. Thiaminase is a naturally-occurring enzyme found in certain fish, shellfish, ferns, and bacteria. When ingested, the enzyme renders thiamine (Vitamin B1) inactive and unavailable for use in an organism's metabolism. This can lead to thiamine deficiency and ultimately death.[13]

Alewives contain thiaminase in their guts. It has been postured that because of this, freshwater game species which consume adult or juvenile alewives while in freshwater could suffer from early mortality. However, rainbow smelt also contain thiaminase. Alewives contain 357 picomol/gram of thiaminase, and rainbow smelt contain 362 picomol/gram.[14] The difference comes in the alewife residence period in freshwater. In the Great Lakes where alewives are landlocked, other fish species may prey exclusively on alewives year-round. As their diet is not diverse, those predators may then develop a thiamine deficiency. However, in Maine where alewives are present in freshwater lakes only seasonally, predators must find new food sources when the alewives migrate out of the lake, thus a diverse diet reduces the potential risk for thiamine deficiency. As rainbow smelt are also

[10] Final Minutes of the AAHTC Meeting on Subject of Sheepscot Pond Fishway. February 23, 2017.
[11] Testimony of Patrick Keliher, Commissioner, Department of Marine Resources. LD 922: An Act Directing the Commissioner of Marine Resources To Investiage the Conditions of Sheepscot Pond Related to a Management Plan for Anadromous Fish Species. March 22, 2017.
[12] Alamoosook Lake. Maine Department of Inland Fisheries and Wildlife. August, 1942, Revised 1979.
[13] Cornell University College of Agriculture and Life Sciences. Department of Animal Science – Plants Poisonous to Livestock. Thiaminases. http://poisonousplants.ansci.cornell.edu/toxicagents/thiaminase.html
[14] Ji, YQ; Adelman, IR. 1998. Thiaminase activity in alewives and smelt in Lakes Huron, Michigan, and Superior. In McDonald, G; Fitzsimons, JD; Honeyfield, DC. Early Life Stage Mortality Syndrome in Fishes of the Great Lakes and Baltic Sea. American Fisheries Society Symposium. Vol: 21, p. 154-159.

present in Sheepscot Pond, one could predict that if predatory game fish are at risk of thiamine deficiency from the consumption of thiaminase, the risk already exists in the consumption of smelt.

**Sea Lamprey**

Sea lamprey are very similar to alewives in that there are non-native, invasive, and landlocked populations in the upper Great Lakes, however, sea lampreys present in Maine are native and migrate between freshwater and the sea. Therefore, it is crucially important to identify information referring to the Great Lakes population and distinguish that from the native Maine population. Once again, research referring to landlocked sea lampreys in the Great Lakes is not applicable to sea lamprey in Maine.

Adult sea lampreys spend 1.5 – 2 years growing to maturity in the ocean and return to rivers and streams to spawn in the late spring. Adults lay eggs in freshwater streams and then die in the stream. Once hatched, juvenile lampreys burrow into soft, muddy bottoms of streams, rivers, and lakes where they feed exclusively on plankton drifting through the water. After 4 to 8 years as filter-feeders, juveniles "transform," changing their digestive system to enable them to predate on oceanic fish species as adults. These young adults are often referred to as "transformers." Once transformed, these young adult lampreys soon begin migrating downstream to the ocean, where they will spend 1.5 – 2 years as adults.[15]

In regards to Sheepscot Pond, it is quite possible that sea lamprey already have a population in the pond. With an operational fish ladder at the downstream Coopers Mills Dam, adult sea lamprey can migrate at least to the base of the Sheepscot Pond outlet dam. With their sucker-like mouths, they can typically overcome any obstruction to passage.[15] Historic, anecdotal reports of sea lamprey scars on game fish were most likely a result of a lack of downstream passage due to low water levels. If lamprey transformers are unable to migrate downstream due to insufficient flow past barriers such as dams, they may remain in the system until flows are restored, allowing them to migrate to sea. Native Maine sea-run sea lampreys cannot survive in freshwater as adults.[15]

Sea lampreys are not unique to Sheepscot Pond. Virtually every other lake and pond in Maine which has access to sea-run species will also have sea lamprey present. Locally, sea lampreys have been documented in Sheepscot Pond, Long Pond (Somerville), Webber Pond (Vassalboro), and Threemile Pond (China).[15]

**Water Levels & Flooding**

Of concern here are two separate yet correlated issues. First is the question of whether allowing outflow from Sheepscot Pond through the fish ladder for another two months of the year (i.e. allowing fish passage in the spring) would cause a significant decline in the water levels of Sheepscot Pond. Second is whether this increased outflow from Sheepscot Pond would affect downstream flooding of Long Pond.

Obviously, lake water levels are significantly influenced by precipitation and snowmelt. In the case of Sheepscot Pond, lake levels are also influenced by the outlet dam as well as the DIFW Palermo Fish Rearing Station, which extracts water from Sheepscot Pond for its operations and discharges

[15] Kircheis, F.W. Sea Lamprey, *Petromyzon marinus* Linnaeus 1758. January 2004.

this water downstream into the Sheepscot River. Having no control of precipitation or snowmelt, we must focus on the outlet water controls over which there is control.

It is important to keep in mind the scale of operations at the outlet of Sheepscot Pond. The DIFW Palermo Fish Rearing Station extracts water from Sheepscot Pond at approximately 14 cubic feet per second (CFS). This equates to approximately 9.05 million gallons per day (MGD). The Alaskan steeppass fish ladder installed at the dam is designed to maintain a flow of 6 CFS when in operation. At this rate of flow of 6 CFS, the fish ladder discharges about 3.87 MGD. Using these figures, we can calculate the approximate drop in water level of the pond using this equation[16]:

$$Water\ level = \frac{Total\ inflow - Total\ outflow}{Area\ of\ lake}$$

For ease of this exercise, we could estimate that there is absolutely no inflow over the course of a month. This is of course quite unreasonable, as precipitation, stream flow, and ground water flow all contribute to the inflow of a lake in Maine. However, we can estimate no inflow and an outflow at the fish ladder of 6 CFS as an exercise of theory. To adjust to the correct units, one month of flow at 6 CFS = 15,552,000 cubic feet in a month, equal to 357 acre feet. 357 acre feet divided by 1,200 acres of Sheepscot Pond = 0.2975 feet = 3.57 inches. Again, this assumes absolutely nothing flowing into the pond. Inflow from rain, snow, streams, or groundwater would lead to an even smaller change. Therefore, operation of the fishway for one month leads to a fairly insignificant change in water levels, well within the range of the normal fluctuations of a Maine lake.

The affect that these flows have on the water level of Sheepscot Pond are all controllable. A survey of waterfront property owners can help determine an appropriate water level target, and engineers can create a solution which incorporates the usage need for the rearing station to determine a flow regime at the dam which would maintain those levels as best as can be predicted. In a February 15, 2017 letter to the Sheepscot Lake Association from the Atlantic Salmon Federation, ASF offered to conduct such a study of lake water levels in Sheepscot Pond to provide certainty that any change of management at the fish ladder would not affect desired lake levels.[17]

As mentioned above, also at issue is the potential for downstream flooding if this fish ladder were discharging at 6 CFS for two more months in the spring as a result of being accessible to sea-run species. An exact answer to this question would be determined by engineers in a water level study of Sheepscot Pond, however, it is possible to infer from existing data. Using the month of April as a reference, as this is when many sea-run species are migrating and when the fish ladder would be operational, we can look to records from the USGS gage in the Sheepscot River in North Whitefield, downstream of both Sheepscot and Long Ponds. In records for the month of April from 1939 to 2016, the mean flow during April is 734 CFS. The mean rate of flow has been as high as 1,345 CFS (2005) and as low as 255 CFS (1985). April is also the month with the highest mean rate of discharge throughout a calendar year, over this same time period from 1939 to 2016.[18] While it is crucially important to remember that the USGS gage is approximately 11 miles downstream from

[16] Szesztay, K. Water Balance and Water Level Fluctuations of Lakes, 1974. *Hydrological Sciences Journal* 19(1): 73-84.
[17] Goode, Andrew. Letter to the Sheepscot Lake Association. Atlantic Salmon Federation. February 15, 2017.
[18] U.S. Geological Survey. USGS Surface-Water Monthly Statistics for Maine. USGS 01038000 Sheepscot River at North Whitefield, Maine. Monthly mean in ft3/s from 1939-01-01 to 2016-11-30.
https://waterdata.usgs.gov/me/nwis/monthly?referred_module=sw&search_site_no=01038000&format=sites_selection_links

the fish ladder at Sheepscot Pond, this data shows the magnitude at which the river system is operating during this time of year. An increase of 6 CFS to the April mean of 734 CFS would be an increase of only 0.82%.

One other important aspect in the consideration of water flows is downstream passage for sea-run species out of Sheepscot Pond. Anecdotal data has been provided which suggests that sea lamprey had attached to freshwater game fish species, as fishermen recall catching fish with circular scars which were assumed to be caused by sea lamprey. These reports all referenced fish caught in Sheepscot Pond from approximately the 1960s to the 1980s. In his 2004 report on sea lamprey, F.W. Kircheis states that "it is worth noting that the 1960's were a time of extreme and extended drought, which could have hampered the sea lamprey's ability to emigrate from the lake."[15] If sea lamprey transformers are not able to leave a pond due to impediments such as a dam and emigrate to the sea, sea lamprey may attach to freshwater fish primarily because they are weak swimmers as juveniles, not as an act of predation.

In order to prevent sea lamprey transformers from any delay in migration out of Sheepscot Pond, engineered solutions exist and can be installed which would allow flow out of the dam even if water were not passing through the fishway or spillway of the dam. As long as there is flow, sea lamprey transformers would be able to emigrate out of Sheepscot Pond, vastly reducing the potential for transformers to attach to any freshwater fish. An example of an engineered solution would be a V-shaped notch in the dam, through which water passes to allow downstream passage. As water level drops, the volume of flow is reduced to maintain appropriate water levels and emigration of sea-run species at the same time. It is important to recall that many other lakes and ponds in Maine are accessible by sea lamprey and yet there are no widespread reports of sea lamprey causing harm to freshwater fish species or humans. "It is the consensus of Maine fisheries biologists that there are no cases of sea lamprey negatively affecting populations of freshwater fish in Maine."[15]

**Dam & Fishway Ownership**

In referring to the legislative bill LD 922 in Maine's 128th Legislature, some have incorrectly cited that the bill's language gives control of the Sheepscot Pond dam and fishway to the Department of Marine Resources from its current owner, the Department of Inland Fisheries and Wildlife. This is false. A thorough reading of the bill gives no indication that the ownership of the dam would change with the passage of this legislation. The only language that could possibly be construed to imply a transfer of ownership would be the unallocated language in Section 3 of the bill. This language would require the Commissioner of the Department of Marine Resources to develop a management plan for anadromous (sea-run) fish species and to investigate the conditions of the fishway. There is nothing to indicate that a transfer of property would take place. On March 22, 2017, DMR Commissioner Patrick Keliher testified at the public hearing on LD 922 that the language in Section 3 "is not needed."[11]

**Property Values**

One argument opposing the re-establishment of native sea-run species in Sheepscot Pond is that the various factors required for sea-run species to access the pond could, in turn, reduce the monetary

value of property abutting Sheepscot Pond. Factors cited in this argument include adjustment of lake water levels and presence of native sea lamprey.[19]

There is no evidence suggesting that re-introduction of native sea-run species into a Maine lake or pond negatively affects property values. In fact, several studies show that when dams on rivers are removed and sea-run fisheries restored, Maine property values have increased. One should be clear that removal of the dam at Sheepscot Pond is not a reasonable consideration and has not been proposed, however, these studies on dam removals can offer valuable insight from elsewhere in Maine.

In 2008, Lewis et al. published a study on the removal of the Edwards Dam in Augusta, Maine in 1999 and its effect on property values in proximity to the dam. The study found that when the dam was in place, property values increased the further the property was from the dam, suggesting landowners placed negative value on being close to the dam. After the dam's removal, that difference in values declined. When the dam was in place, residents were willing to pay an additional $2.43 per meter of property to be farther from the dam, however, after the dam was removed that value dropped significantly to $0.16 per meter.[20] Another 2008 study found that anglers are spending more time visiting the restored Kennebec River fishery since removal of the Edwards Dam and are willing to pay for more angling opportunities on the river.[21] Finally, Bohlen and Lewis in 2009 found that landowners were willing to pay more for properties *further* from the Penobscot River, likely reflecting the history of poor water quality on Maine's rivers and suggesting that river restoration will improve property values along waterfront properties. In that study, landowners were paying 1.6% more for a house as its distance from the river increased by a factor of 2.[22]

One must also consider how the value of property is assessed in Maine. Town assessors most commonly value a property based on the sale prices of similar properties in the area. There is no evidence that any assessor in Maine uses the number or species of fish in a lake to determine the property's value. Even the mechanics of actually changing a property value based on fish species is suspect. Would a seller have to disclose that information when selling the property? Would buyers consider that information when in the market?

For property values to actually decline, an assessor would need evidence that the value of other comparable properties on the pond has actually declined. In order for that to happen, many buyers would have had to pay below fair market value for comparable homes because they had prior knowledge of certain fish species present in the pond. As there have been many other lakes and ponds in Maine where sea-run species have been restored, one would also assume those property values would have declined. The fact is that Maine waterfront property owners often pay a premium for the privilege to own waterfront property. Therefore, it is quite an unfounded assumption that property values would drop around Sheepscot Pond due to fisheries restoration when there has been no such evidence of declining waterfront property values due to sea-run fisheries restoration anywhere else in the state of Maine.

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[19] "Legislative hearing scheduled on Sheepscot dam issue." *The Town Line*. January 24, 2018. Newspaper.
[20] Lewis, Lynne, Curtis Bohlen, and Sarah Wilson, 2008. Dams, Dam Removal, and River Restoration: A Hedonic Property Value Analysis. *Contemporary Economic Policy* 26(2): 175-186.
[21] Robbins, Jesse Lance and Lynne Lewis, 2008. Demolish It and They Will Come: Estimating the Economic Impacts of Restoring a Recreational Fishery. *Journal of the American Water Resources Association* (JAWRA) 44(6):1488-1499.
[22] Bohlen, Curtis and Lynne Lewis, 2009. Examining the economic impacts of hydropower dams on property values using GIS. *Journal of Environmental Management* 90: S258-S269.

**Conclusion**

A plethora of false and misleading information has been circulating regarding the status and efforts at Sheepscot Pond. The resources in this document are intended to provide true statements and research applicable to all of the concerns surrounding this issue.

This document and all of the references cited are available on our website at www.midcoastconservancy.org/sheepscotpond/

Prepared by:

Garrison Beck
Midcoast Conservancy
Director of Water Conservation
garrison@midcoastconservancy.org
207-389-5157

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