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A Catalog of Barriers to Upstream Movement of Migratory Fishes in Hudson River Tributaries

Final Report

to

The Hudson River Foundation

by

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INTRODUCTION

The purpose of this study was to document the presence, location, and magnitude of obstructions that may bar upstream migration of anadromous fishes, primarily river herring, in Hudson River tributaries. The term "river herring" includes alewife (*Alosa pseudoharengus*) and blueback herring (*A. aestivalis*). The life history of these species is fairly well known (Loesch, 1987). Streams tributary to bodies of saltwater or estuaries are known as important spawning habitats for river herring (Everly and Boreman, 1996). In some streams, especially very small ones, anadromous fishes are a highly significant food resource for aquatic and terrestrial wildlife (Willson and Halupka, 1995). For anyone who wanders around the Hudson River, it is obvious that many tributaries have natural or anthropogenic barriers that limit or prohibit migratory fishes from using these streams. This catalog is an attempt to summarize what we know about these barriers.

Inevitably we have missed some things. If you notice omissions or errors in this catalog, particularly if we omitted some tributaries that should be included or if you have information on migratory fish runs in tributaries that we have included, I (RES) would like to hear from you. I intend to update this catalog as more information appears and I will be happy to add any relevant information.

River Herring in the Hudson

Since the emphasis of this study was assessing access to Hudson River tributaries for river herring, we thought it would be appropriate to summarize some of our understanding about these species in the Hudson estuary. The two river herring species are lumped together primarily because of difficulties in distinguishing them. The adults can be told apart with a little effort (MacNeill, 1995) and these characteristics are somewhat applicable to small juveniles (especially the color of the peritoneum). Despite rather recent work (Sismour, 1994), eggs, yolk sac larvae, and early postlarvae cannot be distinguished until the dorsal fin forms (Chambers et al., 1976).

River herring adults enter the Hudson estuary in early spring and river herring eggs are collected in the main Hudson in mid-April (Schmidt et al., 1988). River herring appear in tributaries about the same time. Schmidt and Limburg (1989) found river herring eggs in tributaries in the first week in April, 1988. The highest densities of eggs are seen in mid to late May in the main estuary (Schmidt et al., 1988) and in the tributaries (Schmidt and Limburg, 1989; Schmidt and Stillman, 1994). Timing of the runs in the tributaries does not seem to be related to the location of the tributary in the estuary (Limburg and Schmidt, 1990).

We have little data on which species may be spawning in different parts of the Hudson estuary, and some of these data conflict. Blueback herring do pass through the locks in the Troy Dam and spawn in the Mohawk River. The presence of large numbers of young bluebacks has stimulated the game fish populations (especially smallmouth bass and walleyes) in that area. Examination of herring runs in Wappingers Creek over several years indicated that this run is 99+% alewives (T. Lake, pers. comm.) and Schmidt and Limburg (1989) saw nothing but alewives in Crum Elbow Creek and the Saw Kill (both in Dutchess County). Many Hudson River naturalists have assumed that blueback herring spawn in tributaries in the northern end of the estuary, the tributaries close to the Troy Dam (T. Lake, pers. comm.), but we have not seen documented evidence. Brandt (1983) indicated that the recreational scap net fishery in tributaries primarily catches alewives.

Schmidt and Stillman (1994) and Schmidt and Limburg (1989) observed bimodal spawning of river herring in several Hudson River tributaries. The river herring spawning in these tributaries are most likely alewives and thus there is evidence of distinct spawning runs separated by 1-2 weeks in Hudson River tributaries.

Schmidt et al. (1994) calculated the numbers of river herring eggs being exported from 17 Hudson River tributaries and found that the magnitude of export was about the same as the river herring egg production in the Hudson estuary. Schmidt et al. (1994) assumed that blueback herring eggs were the majority of river herring eggs in the estuary, an assumption similar to other researchers (Everly and Boreman, 1996). Limburg and Strayer (1989) found that identifiable alewife and blueback herring larvae were represented about equally in their samples and therefore one could assume that the eggs were roughly in the same proportion.

The magnitude of egg export from tributaries argues for the significance of these spawning areas to the river herring populations (Schmidt et al., 1994). The comparison of tributary export with the Utilities' density data (Schmidt et al., 1988) may be spurious, however. Metzger et al. (1992) showed that eggs and larvae of several Hudson River fishes were found in higher densities in nearshore habitats (shallow water) than reported by the Utilities' surveys in deeper waters. Metzger et al. (1992) did not report on river herring early life stages but Bohne and Schmidt (1989) did report densities of river herring in the near shore environment that were much higher than reported in the main river (Schmidt et al., 1989). It may be that previous research efforts have not adequately sampled the river herring early life stages.

Juvenile river herring are very abundant in the Hudson estuary and are forage for a variety of piscivores. Limburg (1994) documented that American shad juveniles move downstream and leave the estuary very quickly, her "Grow and Go" model. This downstream movement is strongly related to age and/or size, the larger/older individuals from a cohort emigrating first (Limburg, 1994). Schmidt et al. (1988) provided some evidence that at least alewives behave in a similar fashion, as judged by comparing length frequencies in different parts of the river.

Options for Managing River Herring in Hudson River Tributaries

River herring stocks on the Atlantic coast have declined drastically in the last 25 years as measured by commercial landings (ASMFC, 1995): landings in the 1980s are less than 30% of the landings in the late 1960s. Many states have reported that runs of alewife and blueback herring are in decline (Rulifson, 1994). There are several reasons given for these declines, but construction of dams and declines in water quality are prominent issues (ASMFC, 1995; Rulifson, 1994).

In the Hudson River, blueback herring runs increased in size in the late 1970s-early 1980s due to water quality improvement in the Albany Pool (Richkus and Dinardo, 1984). More recently, the Hudson River populations of alewives were considered stable and blueback herring to be increasing (Rulifson, 1994) in contrast to many declining northeastern runs. The

New York DEC does monitor the numbers of river herring juveniles in the Hudson River, and I presume these data were used by Rulifson (1994). Pace et al. (1992) cautioned that these kinds of surveys may only be able to detect very large changes.

If the river herring runs in the Hudson are at least stable, we should count ourselves lucky compared to other Northeastern states (Rulifson, 1994). Regardless, it is obvious that historically valuable spawning areas in tributaries have been denied to the river herring due to dam construction and, since some sources of mortality like predation and intercept fisheries occur in the ocean, we cannot count on the populations remaining stable in the Hudson. It seems like a good time to think about restoring or enhancing the runs we do have while the fish are available and populations are in apparently good shape.

Obstructions that limit upstream migrations of river herring can be bypassed. There is considerable literature available on design and implementation of fish passage facilities (Quinn, 1994; Clay, 1995). There is a long history of construction of fish ladders in the Canadian Maritimes and the northeastern United States (Clay, 1995). Maryland (Bisland and O'dell, 1993) and Virginia (Weaver, 1995) now have substantial programs designed to bypass barriers to herring migrations. I am not aware of any fish passage facilities in the Hudson Valley.

In this study, we documented both natural and anthropogenic barriers. We understand that there is considerable reluctance to alter natural barriers for migratory fish passage (given that these fishes had no history of bypassing these barriers) but there are factors that may make passage around some natural barriers a reasonable option if we are interested in restoring the Hudson River herring populations. There are some large artificial barriers that would be very expensive to bypass (Murderers Creek, for example) but could be justified based on restoring migratory fish runs. There are also some important barriers where there are legal concerns that may limit our ability to pass migratory fishes (Eddyville Dam on the Rondout, for example). Finally, there are tributaries where the water quality may not be suitable for migratory fishes even though passage might be easy (Mill Creek in Rensselaer, for example). Passage of herring around natural barriers in tributaries with good water quality could serve as surrogate populations for areas that are currently inaccessible for the above reasons and therefore we looked at natural barriers in the same way as artificial ones.

With all the experience that people have had in building successful fish ladders, there is still a large element of uncertainty about whether a ladder will be successful in terms of establishing a spawning population. Durkas (1992, 1993) povided results of a survey similar to ours in the New York/New Jersey Harbor area and she also provided a way of testing whether herring would spawn in a tributary. Durkas (1992) discusses "herring heaves", throwing individuals over barriers to observe their behavior. We suggest that a "herring heave" on a larger scale would be an excellent way to assess the ability of a tributary to support herring (both adequacy of water quality and spawning habitat). Either direct observation and/or subsequent sampling for drifting eggs and larvae could be used to document whether herring find a particular area acceptable. This would be an inexpensive prelude to investing money in a passage facility.

One final aspect of building fish passage facilities is long term maintenance. In Massachusetts, this aspect of fish ladders is being addressed by a "Fishway Stewardship Program" where local groups, after being trained, provide frequent low level maintenance of fishways during the spawning season (Anonymous, 1995). This maintenance consists of removing debris and generally keeping the facility operational. Such a program could certainly work in Hudson River tributaries.

METHODS

Choice of streams to investigate was based primarily on stream size. We began this study looking at all tributaries that we could locate on USGS topographic maps, but we rapidly decided that the smaller streams were very questionable as to their ability to support migratory fishes so we ignored them. For most of the study, the initial decision to visit a tributary was made by a subjective examination of topographic maps. Streams were further eliminated if they were very small (1 m wide or less). We may have excluded streams that in fact do have migratory fishes, but we are not aware of any at present.

The first and second barriers were located by following the tributary upstream from its mouth. We did this by driving along roads, walking the banks or up the stream bed itself, or by canoe. In many cases, barriers to upstream migration were obvious, in some cases they were not. This study was done during a severe drought and some of the tributaries we examined were very low or even dry. The determination of whether a steep rapids, under drought conditions, is usually a barrier was rather subjective.

When barriers were located, we noted their locations on topographic maps, measured or estimated their size, and wrote a description of the barrier and surrounding landscape. These descriptions were supplemented with the Dept. Environmental Conservation's Inventory of New York Dams database (but a number of the dams we visited were not listed in this database). Some barriers were designated as "ultimate" barriers; these delimited the absolute upstream limit for migratory fishes (often where the streams became very small and/or steep).

Presence of herring or other migratory fishes was determined by visual assessment, published information, previous experience, and/or interviewing knowledgeable individuals. Water quality was assessed visually. We measured water temperature with a hand-held thermometer and collected and fixed a Winkler dissolved oxygen sample in the field. Temperature and dissolved oxygen samples were collected at the base of the first barrier unless that area was tidal. Titration of the Winkler samples was done in the laboratory on the following day. Dissolved oxygen saturation was determined from a table of saturation values in APHA et al. (1965). We subjectively categorized water quality as apparently unpolluted (=1) through very degraded (=5) based on our visual assessment, the parameters measured, and published information.

We examined dams and natural barriers with the presumption that a Denil-type ladder would be constructed on the site. Denil passage facilities are the most common in the Northeast and are the cheapest to build and maintain (Clay, 1995; Quinn, 1994). Culverts were presumed to be partial or complete barriers for river herring (Quinn, 1994) and they were assessed as to how easily they could be modified or replaced. Other types of barriers were noted and again assessed as to how easily they could be bypassed or removed. A code number was assigned to each barrier suggesting how easily migratory fishes could be passed where 1= very easy with little expense through 5= prohibitively difficult and/or expensive. We did not consider historical value of an obstruction nor did we consider any legal or political aspects of actually constructing a passage facility.

We also subjectively established a priority for constructing a fish passage facility based on our knowledge of presence of migratory fishes, size of the run, and the amount of spawning area that passage would open up for the fishes. This priority ranged from 1-5 with 1 being the highest priority and 5 the lowest. Barriers were also assigned a "5" if we had no data on presence of migratory fishes. We expect some of these latter assignments to change. A summary rating, "Priority for Enhancement", was the sum of the ease of fish passage construction rating and the priority rating for the first barrier on a tributary. This rating ranges from 2-10, with two being the highest priority for enhancement and 10 the lowest.

We photographed each barrier except when access was restricted or when visibility did not allow a good picture. The distances of barriers from each other and from the mouth of the tributary were measured from the topographic maps or, when barriers were very close together, were measured in the field with a tape. Maps of each stream we visited were drawn by Kathleen Schmidt from the topographic maps and/or from Jimmapco maps of the Hudson Valley. These maps were meant to allow others to easily find and visit the sites we saw.

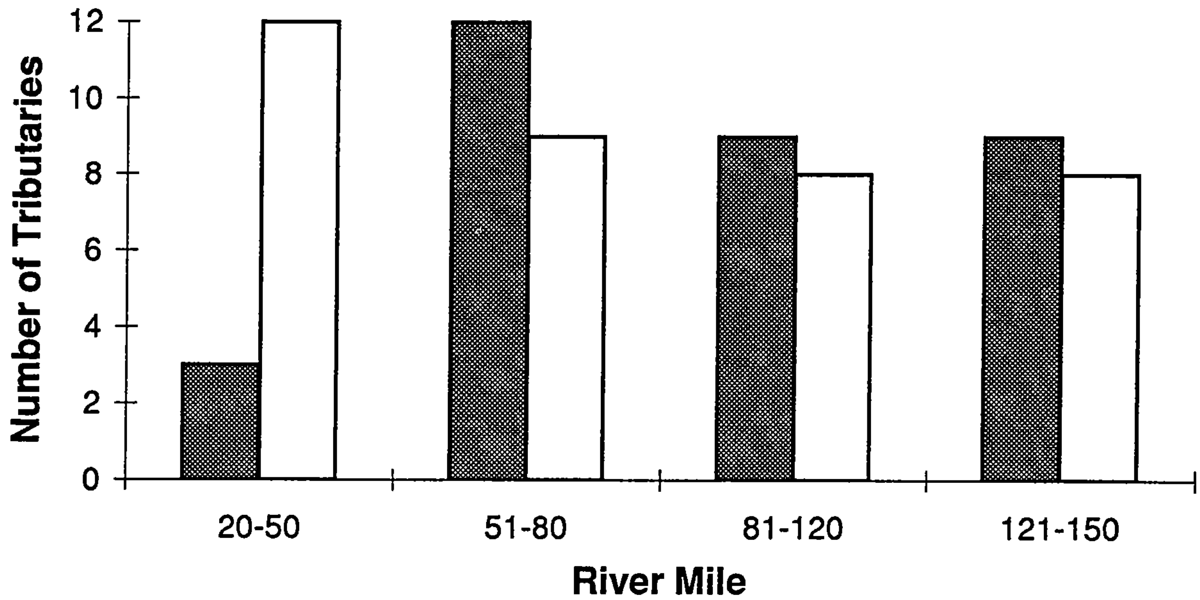
RESULTS

Sixty-two of the tributaries we visited had, or were likely to have, herring runs. Only one of these streams, the Vlockie Kill in Rensselaer County, has no barriers- migratory fishes have access to all the habitat suitable for spawning. Thirty-one of the remaining tributaries are blocked, partially or completely, by natural barriers and the other 30 have artificial barriers, dams or culverts, that reduce or eliminate access to spawning areas. In the southern end of the estuary, near New York City, streams have many more artificial barriers than natural ones (Summary Figure 1), but the numbers of the two categories of barriers are about equal in the rest of the river.

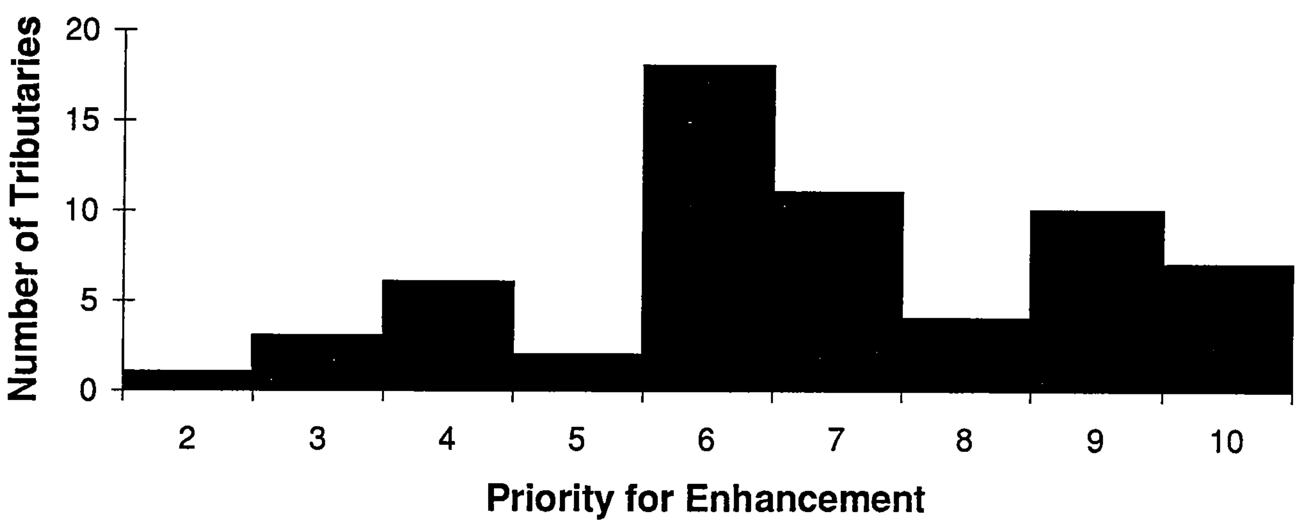
The priorities for enhancement that we determined were skewed towards the low priority end of the spectrum (Summary Figure 2) but with the modal priority of 6- also the modal category. Part of the reason for the skewed distribution of priorities is that we assigned a "5" to the priority for fish passage construction when we had no data on the presence of migratory fishes. We expect (and hope) that data will become available and many of these tributaries will be assigned higher priorities.

The ten streams that are the best candidates for enhancing migratory fish runs (Table 1) were surprisingly evenly distributed on either bank of the Hudson (5 each) and upstream and downstream along the estuary. Only Putnam and Albany Counties (of the 10 counties we visited) lack a stream in the top ten.

Following this narrative, each of the 62 tributaries are described. We have grouped them by county and presented the counties in alphabetical order (see Table of Contents). Within each county, the tributaries are in alphabetical order. For each tributary we have presented a narrative sketch of the migratory fish runs, water quality, location and description of the barriers, a brief statement of our logic in assigning priority for enhancement, and some ideas for further research. We also included photographs of barriers (in most cases) and a map indicating where barriers are located. Please see the Index of Streams if you wish to find a particular tributary quickly.



Summary Figure 1. Numbers of tributaries with natural (shaded bars) and artificial (unshaded bars) barriers as the first barrier to upstream migration. The tributaries we visited are grouped into four areas of the Hudson River estuary indicated by the range of river miles.



Summary Figure 2. Hudson River tributaries grouped by priority of enhancement for migratory fishes. A "2" is high priority for enhancement and a "10" is low.

Table 1. List of the ten highest priority Hudson River tributaries for enhancement of migratory fish runs. These streams are listed in descending order of priority for enhancement.

Rank	Stream Name	County	River Mile
1	Rondout	Ulster	91
2	Pocantico River	Westchester	28
3	Coxsackie Creek	Greene	127
4	Stockport Creek	Columbia	121
5	Sparkill Creek	Rockland	26
6	Muitzes Kill	Rensselaer	135
7	Poesten Kill	Rensselaer	150
8	Wappingers Creek	Dutchess	67.5
9	Quassaick Creek	Orange	62
10	Black Creek	Ulster	84

ALBANY COUNTY

Coeymans Creek

Priority for Enhancement: 10

River Mile: 133
USGS Quadrangle: Ravena
Date Visited: June 8, 1995

Status of Herring Run:

Unknown. Herring and other migratory fishes have access to the mouth of the creek and past a marina. The banks in the town of Coeymans are heavily modified with bulkheads. The mouth of the creek is fairly small and restricted and therefore it would be a simple task to determine the presence of fishes after gaining access to the creek.

Status of Other Migratory Fishes:

Unknown. See comments above.

Water Quality: Overall assessment= 5

Temperature: 20 C
Dissolved Oxygen: 7.7 mg/l
D.O. Saturation: 84%
Narrative:

Water above the falls was very turbid and had a distinct green color with a lot of algal growth on the rocks. There is obvious nutrient loading occurring in this system and, we suspect, other types of pollutants from the decaying factory buildings along the bank upstream of the falls.

Barrier #1: Figure 1, p. 10

The first barrier is a steep, high (at least 7 m) natural falls at the head of tide, 0.5 km from the mouth in the Hudson River. The falls is just downstream (SE) of Rt. 144 north of the town of Coeymans (Map 1, p. 11).

Ease of Construction of Fish Passage Facility: 5

The stream is in a narrow vertical cut and the falls are high. It is probably not possible to construct a Denil-type ladder here.

Priority of Fish Passage at Barrier: 5

This priority would change if herring or other species were shown to be present at the base of the falls.

Barrier #2: We did not document any further barriers in this stream due to the magnitude of the first barrier and limited access to the stream corridor.