

AQUATIC COMMUNITIES AND HABITATS OF THE YORK RIVER WATERSHED

A FISHEYE PERSPECTIVE



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WHAT IS A WATERSHED?

A watershed is an area of land connected by a common web of rivers, streams, and groundwater that drains into a large body of water. The York River watershed begins with small tributaries that flow into Cider Hill Creek, Curtis Ridge Brook, Rogers Brook and Smelt Brook (Fig. 1). These tributaries converge to form the York River estuary before entering the Atlantic Ocean. The York River Watershed drains an area of 21,179 acres or 33 square miles, and rises from sea level to 660 feet in elevation, at the summit of Mt. Agamenticus. While the watershed includes parts of Eliot (14% of total area), Kittery (9%) and South Berwick (5%), most of the watershed lies within York's town boundaries (72%). The river, along with Mt Agamenticus, is recognized as one of the defining characteristic of the town's landscape. The watershed is not well recognized by the other communities in its watershed except for Kittery, which draws municipal drinking water from several headwater reservoirs. About 4% of the land within the watershed is protected in some way, with about half of the protected lands being managed by the Kittery and York Water Districts.

The York River Watershed encompasses a wide diversity of habitats and ecological communities. This diversity invites a variety of uses. The harbor, estuary and extensive pristine salt marshes are frequented by boaters in vessels of many kinds. The Wiggly Bridge Preserve and River Walk provide some of the most scenic public walks anywhere in the region. Fishing and birding opportunities are renowned. The largely forested watershed along the slopes and summit of Mt. Agamenticus provides a haven for hiking, riding, mountain biking and hunting.

NATURAL RESOURCES OF THE YORK RIVER WATERSHED

The Department of Marine Resources allows shellfish harvesting year round between Ramshead and Sewell Bridge; and between Sewell Bridge and Stage Island from November 15 through April 30th. The actual harvest periods are set by the Clam Commission each year. The Kittery Water District draws water from Foley, Middle, Boulter, and Belle Marsh ponds in the drainage. The District serves 4900 accounts in

Kittery and portions of Eliot and York, plus the Portsmouth Naval Shipyard, which is a major customer (43% of the Districts water in 2001). Beginning in 1907 the District has purchased approximately 2600 acres of land in the watersheds of the ponds to protect water quality. The headwaters drain a portion of the Mount Agamenticus region a 33,000 acre 5 town area targeted for protection.

Many terrestrial species make their home here, from the rare Blandings and spotted turtles to one of Maine's few Atlantic white cedar swamps, and one of only two stands of flowering dogwood in the state. Three animal and 20 plant species are restricted to this extreme southern portion of the state. The tidal meadow marshes of the York River encompass one of Gulf of Maine's least disturbed marsh-estuarine ecosystems. The expansive high and low marsh of the York River provides diverse habitat for many aquatic and terrestrial animals. Animals that inhabit the salt marsh include deer, coyote, fox, rabbit, raccoon, otter and a multitude of bird species including the salt marsh sharp-tailed sparrow (a species of global conservation concern), egrets, great blue herons, and many other species of wading birds and waterfowl. The fish communities of the estuary and its freshwater tributaries are highly appreciated by local fishermen, but have been little studied. In this report we summarize our findings from a survey of fish species and habitats conducted from May – October in 2001.

PROJECT OVERVIEW

OBJECTIVE

Our objective in this study was to assess the vitality of the York River ecosystem through a survey of fisheries resources and their supporting habitats.

GOAL

Our goal in this study was to assist the York Rivers Association and partners in their work as stewards of the York River and its watershed, by documenting the current and potential fish habitat value of this exemplary coastal ecosystem. Our study provides data that is essential for wise stewardship of this precious but threatened community resource.

STUDY DESIGN

For this initial characterization of fish distribution of the entire York River ecosystem, we used an extensive sampling scheme, with many sampling sites distributed throughout the estuary and watershed. These sites were sampled only once or twice, during the appropriate season. We conducted a fyke net survey for evidence of fish migrations at four locations both day and night in late April and early May of 2001, and coordinated a volunteer visual survey to look for evidence of fish spawning runs at 15 locations during May and June. We used an electroshocker to sample fishes in 44 freshwater stream segments (each 200 ft in length) during June and July, and mapped instream and riparian habitat and flows in each segment. We sampled the tidal wetlands within the estuary with fyke nets at four sites both day and night during the month of August. Finally, in late August we sampled the main stem of the estuary at nine stations from the inlet up to the tidal marshes with a beam trawl, both day and night.

STUDY SITES

Materials and Methods

SPRING MIGRATIONS

1. Visual survey of migratory fish arrival

After constructing a fish life history timeline, consulting with local fishermen, and a meeting of York residents at the Grant House, we recruited volunteers to document the arrival of migratory fish at 15 locations on the York River watershed. These locations, or sites, mostly corresponded with a recent culvert survey to document tidal restrictions. The culvert survey fit well because most of the culverts exist near the head of tide, are known spots for recreational fishing, are easily found, and have good access for a visual survey.

Volunteers, most whom were local residents, were equipped with data sheets, thermometer, and incoming tidal chart- a simple calendar marking the incoming tide (1-2 hrs before high tide). The incoming tide is optimal for migratory fish movement to

spawning habitat. Volunteers attended a brief training session on what generally to look for and how to record what may be seen. They arrived at their designated sites and watched (sometimes equipped with flashlights) for fish arrival.

WHY: This effort was carried out to document the first arrival of the many migratory fish species that use the York River and its tributaries as spawning habitat. Also to give an idea of what areas have more significant fish movement. This prompted us for when, and some extent where, to set our fyke nets to sample for migratory fish.

2. Fyke net sampling for migratory fish

After studying the map of the York River watershed, receiving feedback from the visual survey, and consulting with York residents on the whereabouts of “hot spots” for spring fish movement, 4 sites were chosen to set fyke nets (fish nets). The sites were set at head-of-tide in well-known areas for fish movement, such as Smelt Brook, a locally famous smelt-fishing spot.

This effort involved volunteers and Wells NERRS staff and was carried out on 2 dates in late April to look more specifically for rainbow smelt and on 2 dates in May to look for river herring. There was a day sample and a night sample for each set of dates. We separated into 2 teams and set fyke nets at low tide to sample for fish with the incoming tide, 2 nets per team, 1 net per site.

The opening (passage) of the nets were set facing the direction of the incoming tide with the fykes (holding compartments of the net) set parallel to the creek banks, as close to the center of the channel as possible, and the wings running at 45 degree angles from the first fyke opening as far as they could go (47') sometimes running over the banks and onto dry land blocking the entire channel as with sites 21, 25 and 32. The fyke net at site 105 was set below the mouth of the targeted tributary within a larger body of water but within the channel of the mud flat leading to the creek, both wings extending their entire lengths without running into land. An additional net was set for curiosity at a sight named 'DS' in a channel in the upper reaches of the York River. 'DS' was at a location known for

historical alewife runs. The net was set just above a pool and just below the remnants of an old mill, with wings spanning the entire length of the channel.

The fyke nets are 15' long with two 47' x 4' wings with ½" mesh. The opening of the first fyke is 4' x 4' and the opening of the next five hoops are 2.5' x 2.5'. There are three throats total. All fykes and throats have ¼ " Delta mesh. Wings have sinkers on the bottom line and floats on top to keep the top of the wings up in the water and the bottom on the ground. Additional plastic tent stakes were applied to the bottom line to ensure there would be no gaps for fish escape. A danforth anchor was attached to each wing tip and sunk into the ground to secure the wings from being pulled away in current. A danforth anchor was attached to the hood of the first fyke and another to the tied cod end for stabilization and security.

The nets sat through high tide and once the tide ebbed below the wings and fykes to the point that the net stopped fishing but the fish were not out of water, the sample was then collected. Each species was identified, counted for a total number, and a maximum of 30 individuals were measured for total length and width.

WHY: The fyke nets will catch predominately juvenile fish due to the nets' size, though some adults of certain species are small enough to be caught (e.g. river herring, silversides). This sampling procedure was done to gain data on population parameters for spring migratory fish, as well as clue us in on what fish are utilizing the river.

SALT MARSH FYKE NET FISH SURVEY

This fyke net sampling was similar in approach as the earlier effort for migratory fish: 4 nets, 4 dates (2 day & 2 nighttime samples). The differences were the location, timing, what fish were targeted. The nets were set in August, in 4 designated locations in the large marsh system surrounding the confluence of York River and Smelt Brook (northwest of Scotland Bridge).

Two of the nets were set to sample the fish specifically utilizing the flooded high marsh during the higher (spring) tides of the month. The fykes were placed in the channel with the opening facing the high marsh. The 47' wings were extended out of the channel at 45 degree angles from the first fyke opening and up onto the high marsh in order to direct fish into the net once the tide ebbed. The flood line on the marsh was marked at high tide for sample area measurements. The area of habitat that was sectioned off by the wings and the high tide line was later measured to quantify the sample area- the area that would have drained into the fyke net. Vegetation within the drainage area was measured with respect to species.

The other two nets were placed in channels in the marsh complex- one in the main channel of York River and one in the mouth of Roger's Brook. Roger's Brook is a tributary that flows into the upper reaches of York River before the large confluence with Smelt Brook. Primarily, these were set to sample for juvenile fish using the marsh as a nursery and feeding ground. The opening (passage) of the nets were set facing the direction of the incoming tide with the fykes (holding compartments of the net) set parallel to the creek banks, as close to the center of the channel as possible, and the wings running at 45 degree angles from the first fyke opening as far as they can go (47') sometimes running over the banks and onto dry land blocking the entire channel.

The 4 nets sat through high tide and once the tide ebbed below the wings and fykes to the point that the net stopped fishing but the fish were not out of water, the sample was then collected. Each species was identified, counted for a total number, and a maximum of 30 individuals were measured for total length and width, and then released.

FYKE NET SITE DESCRIPTIONS

Physical characteristics of spring and summer sampling sites (Maps 4-6) are described below.

Spring Sampling

Site # 21

Beech Ridge Road – Fyke net was set in a channel, roughly 10 m wide, just downstream (Northeast) from the bridge (road crossing). The bottom substrate was mostly mud and some rock. Patches of salt marsh exist on both sides of the channel with trees and vegetation further up until it turns into landowners' yards, which is sometimes very close. A strong current occurs during tidal change.

Site # 25

Outflow of Boulter Pond Reservoir, Rte 91 – Fyke net was set roughly 50-100 m downstream from outflow pipe in a salt marsh channel roughly 10 m wide. Muddy bottom. Steep forested banks surround this small salt marsh system.

Site # 32

Rte 91, Smelt Brook – Fyke net set just below the Rte 91 box culvert in a channel roughly 4-5 m wide. Rocky, gravelly bottom with steep (about 1 m or so) mud banks leading up to short expanse of grassy marsh surface. It looks like a salt marsh surface at a glance but is obviously dominated by fresh water grasses as well as patches of *phragmites* and *typha* further up from the channel. A very large patch of phrag exists to the east. A decent flow occurs in the channel during tidal change. No canopy coverage exists right at the site though there appears to be plenty buffer vegetation.

Site # 105

Rte 103, mouth of South Side Brook – Fyke net set just below where South Side Brook empties into the harbor (adjacent to the body of water next to Wheeler Marsh). At low tide this area is a large mud flat with a very shallow channel leading out from South Side Brook. Along the edges of the water body there is a rocky shoreline and patches of fringing marsh with some trees and vegetation above.

Summer Salt Marsh Sampling

Site # 1

Fyke net set in a side channel that separates a small island of salt marsh from the main channel of the river. This side channel is roughly 10 m wide and has a mud bottom, surrounding completely by the large salt marsh system.

Site # 2

Fyke net set on the edge of the main channel fishing the high marsh. Steep peaty/muddy banks.

Site # 3

Fyke net set on the edge of the main channel fishing the high marsh. The main channel is narrower at this point. Steep peaty/muddy banks.

Site # 4

Fyke net set in the mouth of a tributary, Rogers Brook, right where it empties into the main channel of the river. The main channel of the river is narrow here, roughly 5-7 m and so is the mouth of the brook, roughly 4-5 m. Very thick mud and very tall *Spartina* in the mouth of the brook.

ESTUARINE MAIN STEM BEAM TRAWL FISH SURVEY

We sampled using a 1 meter beam trawl, with ¼” Delta mesh, with the Wells NERRS research vessel on 2 dates: 2 daytime and 2 nighttime samples. We trawled on 3 main stem locations of the river, dividing each into 3 segments: middle, left, and right. Typically one person drove the boat, and two people deployed the trawl and measured the sample. Each species was identified, counted for a total number, and a maximum of 30 individuals were measured for total length and width, and then released.

WHY: The beam trawl allows for fish sampling in the bottom communities of the river. The river-bottom habitats may include mudflat, rocky substrate, and eel grass beds. Eel grass beds are a special type of habitat important for fish feeding and shelter.

WATERSHED ELECTROFISH STREAM FISH SURVEY

The Wells NERRS staff, with the assistance of volunteers, carried out an electrofish survey of the 44 stream segments previously mapped. We borrowed an electroshocker from the US Fish & Wildlife Service and shocked each segment for fish. All water within the segments was shocked with roughly medium strength with special attention paid to

pools where fish might be in higher abundance. The electroshocker had to be turned up to higher strength at Libby Brook due to salinity. One person shocked the water, several people with nets stood by to collect the stunned fish, and several more people took measurements. Each species was identified, counted for a total number, and a maximum of 30 individuals were measured for total length and width, and then released.

WHY: This is a standard procedure in fisheries research to identify what species exist in freshwater habitats. The data gathered from electroshocking also correlates with the information from the fish habitat mapping to help us better understand the quality of the York River's freshwater tributaries as fish habitat and spawning grounds.

WATERSHED STREAM FISH HABITAT MAPPING

The fish habitat mapping was done on freshwater tributaries of the York River watershed. A variety of tributaries were selected across the watershed, trying to cover a sufficient cross section knowing time would be a limiting factor. After dividing the watershed into four major drainage sections- Cider Hill, Smelt Brook, Upper York, and Dolly Gordon, all tributary lengths were measured on a map for a section length total. Each drainage section was delegated habitat mapping sections in proportion to its section length total. Cider Hill was assigned 3 habitat mapping sections, Smelt Brook was assigned 4, Upper York 6, and Dolly Gordon 2- a total of 15 for the entire watershed. Each of these habitat mapping sections were randomly placed within the drainage sections and were broken into roughly 3 segments each. Wells NERRS staff and volunteers mapped 44 segments, each 200 ft long, in 7 separate streams.

Fish habitat mapping is a descriptive process consisting of many qualitative and quantitative measurements within the 200 ft segment, such as: estimating tree canopy cover, substrate type, riparian vegetation and measuring depth, temperature, gradient, flow, areas of aquatic vegetation, pools, riffles, runs.

Wells NERR staff and volunteers would locate the designated tributary area and measure a 200' length marking both a beginning and end point with a small, labeled piece of PVC pipe. The tributary segment would then be given an abbreviated name, and graded for its accessibility. Measurements for upstream and downstream channel variables of the segment would be taken including wet width (width of channel with water), dry width (wet width + additional width of channel that holds water during flooding), depth at 3 points across, and temperature. Estimations for substrate type, canopy cover, and riparian vegetation type and cover were recorded for the entire segment. Gradient was measured for the entire segment using a Sokkia Abney level and stadia rod. Presence of pools were recorded with lengths, widths, mean depth and estimations of subdominant and dominant substrate noting if the substrate was embedded or not. Presence of riffles and runs were recorded with lengths, widths, and estimations of subdominant and dominant substrate noting if the substrate was embedded or not. The presence of large woody debris was recorded and noted if it was embedded or not. Major migration barriers were also noted and measured for length, height, and width.

Total stream discharge was measured with a Swiffer 3000 Current Velocity and Stream Discharge Indicator at the downstream point of every segment during the driest part of the season (mid-late August). This was not possible at all segments due to the Situate Road tributary drying out completely. Some segments were still retaining water and with some water movement but could not register on the Swiffer. This was noted in the data.

Temperature was also taken at each downstream point. Presence of aquatic vegetation within the entire segment was also noted at this time with measurements of length and width on areas of growth.

WHY: This mapping process clues us into the present condition of the freshwater stream habitat in the watershed. These freshwater reaches are home to many species of fish at different stages of their life and serve as spawning habitat for several migratory species. We also measured flow at the critical point- when the water levels are usually at the lowest (late summer), documenting some of the more stressful conditions fish may endure.

FINDINGS

STREAM PHYSICAL CHARACTERISTICS

Stream Flow

Several years of below average precipitation resulted in the lowest stream flow conditions in decades throughout Maine. Three of the four subwatersheds (Cider Hill, Upper York and Dolly Gordon) had very little flow (less than 0.3 cfs on average). The flow in Smelt Brook was an order of magnitude greater, but still very low, and likely much lower than a normal year. It is also likely that the minimum flows during the low flow summer months are lower now than they were prior to the creation of the Belle Marsh Reservoir.

Reductions in original stream discharge during the spawning season due to impoundments and diversions have a direct negative impact on fish habitat suitability. Conversely, increased discharge during the spawning period due to increased stormwater runoff (often accompanied with erosive channel straightening or “channelization” and stream “flashiness”) will have direct negative effect on fish habitat suitability. In order to determine the suitability of stream flow characteristics for the suite of fish species now using the drainage, as well as those that are candidates for restoration, we will use discharge and stream cross-sectional area to calculate flow velocities. We will compare these velocities to critical velocities identified for each species, using existing species profiles and habitat suitability models developed by the U.S. Fish and Wildlife Service.

Stream Temperature

Stream temperature is a critical determinant of the fish species that will inhabit a watershed. Despite the extreme low flow conditions during the survey period, stream temperature remained well within the range required by of the suite of species of interest (current residents and candidates for restoration). The Cider Hill, Upper York and Dolly Gordon subdrainages experienced similar temperatures typical of coldwater systems in the summer season (18°C to 22°C). Smelt Brook was also within this range in the early summer, but dipped down to 13°C to 14°C in July and August. Several factors may have contributed to this decline: cold bottom water releases from the Belle Marsh Reservoir, increased shading from shoreland vegetation, or coincidentally low nighttime air temperatures prior to our temperature sampling dates. We will acquire the data regarding Reservoir releases and air temperature bracketing the dates on which we measured stream water temperature to further investigate the unusual seasonal temperature decline in Smelt Brook.

Pool Surface Area

A considerable amount of pool habitat was found in each subdrainage, with Smelt Brook having the greatest area per 200 ft stream length, followed by the Upper York, the Dolly Gordon and the Cider Hill subdrainages. When expressed as the average percent of the

total stream surface area, the Upper York has the highest value (31%) followed by Dolly Gordon (18%), Smelt Brook (16%) and Cider Hill (12%).

SPRING MIGRATIONS

Visual Survey

Several areas of fish spawning habitat were observed at, or near to, our visual fish survey and fyke netting sites in the York River watershed. Spring migratory fish were observed and/or caught while sampling at several sites. Alewives and rainbow smelt were caught at site # 32, a site that exhibited areas of spawning habitat. Alewives were observed migrating heavily past site # 21, indicating an upstream area of spawning habitat, since this is a reoccurring phenomenon according to our fish observer. Rainbow smelt were caught and smelt eggs observed at site # 105, Southside Brook. Southside brook seems to have a stretch of good spawning habitat right before it empties into the harbor, though a mat of algal / fungal matter was growing over substrate. A smelt egg was found under the mat on a rock, a sign of possible eutrophication that can eventually kill fish eggs.

Additional spawning habitat for migratory fish species could exist, or one time has existed, upstream from site # 20 and 25 and downstream from site # 30 and 35. Local knowledge recollects herring migrations, and smelt fishing, during past springs at these sights. Lobstermen would catch alewives near site # 30. Local residents remember collecting alewives below site # 35, and catching smelt at site # 25. It is no doubt that additional spawning habitat exists that has been impacted or cut off by tidal restrictions or human alteration, was not encountered during sampling, or simply overlooked.

Fyke Net Sampling for Migratory Fish

Twenty species of fish and two crustacean species were identified at head of tide survey sites (Map X) during the period of spring migration, about twice the number found during the summer period in the estuary and salt marsh (Fig X, Table X). A broad mix of marsh resident, migratory, marine, estuarine and even freshwater fish were found. This is an

impressive species list for such a limited sampling effort. The diversity of fish life histories indicates an ecosystem that provides a broad array of habitats and niches for use by the Gulf of Maine coastal fish fauna. Notable species include, in order from higher to lower abundance, Atlantic herring, rainbow smelt, alewife, and brook trout. The presence of brook trout at these sites suggests that the York River may support a sea-run population of this species. This life history phase of the brook trout is unique to Northern New England and Atlantic Canada, and has been in decline in coastal areas in recent years (cites). Other abundant species were (in order from higher to lower) the non-native green crab, mummichog, white sucker, and Atlantic silversides. The green crab had the highest relative abundance of all species.

The largest fish by total length were Alewife, American eel, and golden shiner (all between (250 and 325 mm) . The next size group was the sticklebacks (between 150 and 200 mm). The remaining 16 species ranged from 25 to 125 mm in total length. Only the Alewife were present in adult size classes; all other species were present only as juveniles.

SALT MARSH FYKE NET FISH SURVEY

The relative abundance of fish species in the expansive tidal marshes at the upper reaches of the estuary is typical of a healthy Gulf of Maine salt marsh ecosystem. The marsh resident mummichog was the most abundant fish species, followed by the Atlantic silversides, the banded killifish (a relative of the mummichog that occurs at lower salinities), and the American eel. Alewives, winter flounder and bluefish were present in lower abundance. In all, 12 young-of-the-year bluefish were captured, strong evidence for a locally spawning population of this species. Only one other study has provided evidence for this in the Gulf of Maine (Creaser cite). Notable also was the capture of a single Y-O-Y striped bass, suggesting a local spawning population of this species. This species has not spawned in the Gulf of Maine in many years (Little cite); only recently has the Maine Department of Marine Resources initiated a striped bass restoration program on the Kennebec River (DMR cite). The most abundant larger fish was the American eel, a species valued for its elver (Y-O-Y) fishery. Again, the non-native green crab was the

most abundant species sampled. The mummichog, killifish, and silversides are all important forage species, providing an important food resource for larger marine species such as adult striped bass and bluefish.

The largest species by total length was the American eel, with an average length of 350 mm. Flounder were the next largest species, with an average length about half that of the eel (170 mm). The remaining species ranged in length from 125 mm down to 50 mm. All species were present as juveniles only.

ESTUARINE MAIN STEM BEAM TRAWL FISH SURVEY

Although our ability to survey the tidal main stem of the York River was limited by a very narrow beam trawl, the bottom fish fauna reflects the presence of both soft sediment and rocky substrates. A number of new species associated with hard substrates appear – sea robin, cunner, lobster, lumpfish and rock gunnel. Atlantic silverside, a pelagic forage species (i.e. inhabits open water rather than bottom habitat) had the highest relative abundance among the fishes, reflecting the estuary's deep channel. Also present were winter flounder and rainbow smelt, estuarine dependent species valued by the recreational fishery. The American eel is present in low numbers, in contrast to the relatively high abundance of this species in the salt marsh. The non-native green crab maintains its standing as the most abundant species.

As in the salt marsh, the American eel exhibited the greatest average length in the main stem of the York River (nearly 150 mm). All other fishes were half the length of the eel. Lobster were second to the eel in average length (90 mm).

WATERSHED ELECTROFISH STREAM FISH SURVEY

Watershed

The freshwater portions of the York River watershed support a diversity of warm water and cold water fish species. At least 13 species were present in the samples (unfortunately, the minnows were not identified to species), about a third of the total

freshwater species present in Northern New England. The white sucker was the most abundant species. This species is a cold water bottom feeder that is very typical of healthy stream ecosystems (cite). American eel was next in abundance, indicating that Y-O-Y migrating back from the Sargasso Sea (where all American eel migrate to spawn) are able to gain access to the freshwater habitats they require to mature and complete their life cycle. Brook trout were also relatively abundant, indicating the watershed's suitability for salmonid species. Brown trout were present but rare. This is a northern European salmonid that has become naturalized in New England through fisheries stocking practices. A number of warm water species were also found: chain pickerel, smallmouth bass, and golden shiner. Fishes that typically reproduce in salt marsh habitat but rather tolerant of freshwater were present : two stickleback species at relatively high numbers, and two marsh minnow species (mummichog and banded killifish). Their presence suggests that these species are able to move between estuarine and freshwater portions of the watershed, indicating at least minimal fish passage within the system. Notably absent were the swamp darter, a threatened species in Maine that occurs in a few York County drainages, and the rainbow smelt. The absence of smelt in the watershed suggests that little or no spawning occurred in the system during 2000, in spite of the presence of migratory adults in the upper reaches of the estuary during the spring migratory season. Since smelt are unable to negotiate the shallowest of barriers to fish passage (12-18 in cite), they are very sensitive indicators of a watershed's connectivity with regard to fish spawning migrations.

The largest fish in the watershed were the brook trout, with a tight average around 280 mm in length. Given their large, uniform size, these fish are most likely stocked by the Maine Department of Inland Fisheries and Wildlife. Based on habitat characteristics presented in a later section of this report, we suggest that stocking of hatchery reared brook trout be terminated in the York River watershed to allow wild fish to populate the drainage and possibly support a sea-run subpopulation. Chain pickerel were present in adult size classes, although no juveniles were found. American eel, white sucker, and small mouth bass were present in juvenile size classes, indicating the presence of viable reproducing populations of these species.

Subwatersheds

When the data is grouped by subdrainage, the highest fish densities are found in the Upper York (section 2) and Dolly Gordon. These high numbers are due to the high densities of white sucker. American eel was the species best represented across all subdrainages. Next in abundance is the brook trout, present at highest density in Cider Hill Creek, followed by Smelt Brook, and at much lower abundance in the Upper York (section 1). Cider Hill, Smelt Brook and Upper York (section 1) fish densities are about half those of Upper York (section 2) and Dolly Gordon. Cider Hill has the highest abundance of trout (coldwater species) relative to warmwater species.

FLOW ALTERATION

Man-made structures often have the unintended consequence of seriously altering the hydrology and connectivity of natural stream systems. Such structures include dams where impoundment of water changes the flowing river system into a man-made lake or pond. Dams also present generally insurmountable obstacles to fish species attempting to move upstream to feed or spawn. Roads with poorly placed culverts of inadequate size also pose serious impediments to fish passage. Although this study did not include a systematic survey of flow alterations, we describe here a number of dams encountered during the survey (Map 10). A more systematic effort was carried out in 2000 by local volunteers working with the National Park Service Rivers and Trails Program and the York Rivers Association. Their project focused on flow restrictions caused by road crossings in both the tidal and freshwater portions of the watershed.

FISH SPAWNING MOVEMENT AND FISH MIGRATION BARRIERS

The springtime volunteer visual survey yielded a number of observations of fish migration (Map 10). This was a challenging exercise, given the size of the watershed, and the fact that fish have many migratory paths from which to choose. This kind of effort is usually conducted in watersheds where all fish must pass by a single point, often a fish ladder constructed specifically to allow visual estimation of fish passage. In the case of the York River, we used local knowledge as best we could to identify likely spots to witness

migration of alewives, smelt and eels. The survey team noted human-made impediments to fish movement encountered during the visual survey and when mapping fish habitat along the 44 stream reaches within the freshwater drainage (Map 10). Brief descriptions of fish movement and fish passage barriers are provided below. Bear in mind that data presented in Map 10 is by no means a complete assessment of barriers to fish movement.

Dolly Gordon Brook

The **dam** in the fresh water reaches looks as if the landowner constructed it in order to create a body of water upstream. The dam is roughly 4' high and 12' long. There is a covered bridge just downstream. This could be one of the larger problems for fish because even though it may or may not act as a migration barrier, it does manipulate flow. The **mill dam** downstream from Dolly Gordon is an old grist mill of some sort and spans the entire width of the channel, approx 75' (see pic). The dam is roughly 4' high with two roughly 20' long openings, probably is not a migration barrier.

Not certain of the condition of the **trolley crossing**.

Spawning movement: alewives



Inlet to Dolly Gordon

Cider Hill Creek

The **mill dam** looks like an old field stone wall that crosses the entire span of the creek, approx 14', and is roughly 6-8' high (see pic). There is a bit of a gradient to the creek just below the dam. Anadromous fish may not travel this far up stream to spawn, but it might hinder freshwater species.

Spawning movement: elvers



Cider Hill Creek

Outflow of Boulter Pond

A definite migration barrier, smelt seen around there but not sure if they're there to spawn or just feed.

Spawning movement: smelt

Smelt Brook

Spawning movement: smelt and alewives

Rogers Brook

The dam is a small concrete box culvert (see pic) with a wooden flashboard on the upstream side. It is roughly 5' high and spans the length of the channel only about 4'.

Supposed to be replaced by the DOT.

Spawning movement: none, though habitat looks suitable (see pic)



Rogers Brook Dam



Rogers Brook Spawning Habitat

Upper Reaches of York River (above head of tide)

Mill Dam 1 is just above the head of tide. It looks like a pile of small field stones that is about 3' high and spans the length of the channel roughly 12' (see pic). Probably not a barrier to some species, might be to others (e.g. alewives can leap over some obstacles, not sure how capable smelt are to doing that).

Mill Dam 2 and 3 are very similar: they are on somewhat of a steep gradient and made of large stone blocks, anywhere from 5' to 8' high and resting on the entire length of the stream about 8'. They are some of the more intact mill dams with some pieces of metal equipment laying around. Anadromous fish may not travel this far up stream to spawn, but it might hinder freshwater species.

Mill Dam 4 is in a condition more similar to Mill Dam 1 (see pic), a pile of stones. It is roughly 4' high and spans the length of the channel roughly 10'. Anadromous fish may not travel this far up stream to spawn, but it might hinder freshwater species.



Mill Dam 1



Mill Dam 4

Mill Dam 5 is on the edge of the first large body of water that is encountered (see pic) and is a bit difficult to distinguish where it exactly begins and ends though the obvious opening is about 2' high and 3' wide. Anadromous fish may not travel this far up stream to spawn, but it might hinder freshwater species.



Mill Dam 5

Cutts Ridge Brook

Trolley Crossing is not necessarily a fish migration barrier though is worth noting. It is roughly 4' high, 6' wide, and runs for a length of about 15-20' (see pic).



Cutts Ridge Brook

THE BEAUTY OF BUFFERS

Our watercourses are subject not only to contaminated inputs from obvious sources such as discharge pipes, but also to surface water runoff from precipitation or snowmelt. These diffuse, indirect, hard to measure inputs are referred to collectively as non-point source (NPS) pollution. All water within the York River watershed has the potential to become contaminated by materials present due to human alterations of the watershed landscape. Some types of NPS pollution include sediment from roadsides, fertilizers from lawns and gardens, nutrients from discharge pipes, petroleum products from vehicles, bacteria from livestock, or debris such as trash.

Vegetation within natural landscapes has a large capacity to protect water resources: the forest canopy, subcanopy and shrub layer intercepts raindrops, breaking them into smaller droplets that flow along leaves, needles, branches and trunks before reaching the forest floor. The leaf litter on the forest floor provides further protection for fragile forest soils, allowing water to seep downward, preventing compaction, erosion, and surface water runoff during heavy rains. The deep, well-developed root systems of woody plants also stabilize forest soils and help them retain moisture and pollutants/nutrients that would

otherwise seep into the ground water. Natural vegetation allows rainwater to soak into the ground, filter through the substrate, and recharge the watershed's subsurface water supply.

As the landscape is developed, it typically becomes progressively hardened or "impervious", preventing rainwater from seeping through soils. Rain that falls upon rooftops, pavement, manicured lawns, etc. rapidly runs off, carrying hydrocarbons from cars as well as herbicides, pesticides and nutrients from fertilizers into the nearest watercourse, often via a network of informal drainage ditches. Here the runoff and any contaminants create high flows downstream to the estuary. Freshwater that could have re-entered the groundwater instead goes out to sea. As impervious surface increases above 10% of the land area within the watershed, the force and volume of the flow erodes stream banks and destroys habitat. Eventually, the once meandering and fish-filled streams become eroded gullies devoid of fish, subject to flash flooding and requiring frequent stabilization due to washouts.

CONSERVATION BIOLOGY AND LANDSCAPE ECOLOGY: THE SCIENCE BEHIND CONSERVATION

Over the past two decades, ecological scientists have become increasingly aware of the pervasive influence of human activity on ecosystem elements and processes. This emerging awareness gave rise to the fields of conservation biology and landscape ecology. Ecologists working in this realm apply the methods of ecological research to questions regarding the protection and management of the natural landscape, the ecological functions of the landscape, and the flora and fauna that depend on these functions. From the larger, landscape scale perspective, it has become clear that the viability of local populations of many species are threatened by human-mediated habitat loss, fragmentation and alteration. This applies both to terrestrial and aquatic habitats, and the quality and quantity of water upon which these habitats and their species depend.

In this part of Maine, the integrity of our stream and forest ecosystems, now intact across large areas, will not withstand the current pattern of landscape development for long. More attention needs to be paid to the ecological consequences of human development,

and the location, site plans and design of homes, driveways, roads, businesses and parking lots. The same amount of growth can follow a mindful course that minimizes the impact on the landscape. Alternatively, development without a landscape scale vision can be devastating not only to the ecology of our region, but to our own regional identity, which is intimately linked to the landscape we live in. A few important lessons we have learned from conservation biology and landscape ecology include:

- 🌲 Roads and deforestation dramatically alter ecological communities and processes.
- 🌲 Aquatic habitats depend on wide buffers of forest, shrubland, or grassland (not lawn).
- 🌲 Many species of birds and mammals require large blocks of contiguous habitat to sustain their populations.
- 🌲 The impacts of habitat fragmentation can be lessened through the use of effective landscape corridors.
- 🌲 Watersheds (i.e. the land area drained by a particular river or lake system) are natural landscape units. Watersheds are defined by the contours of the land. Every drop of rain that falls upon the land becomes part of a watershed.
- 🌲 Natural shoreland areas are important pathways for wildlife movement within watersheds.
- 🌲 Natural shoreland areas are essential buffers that protect aquatic habitats from human-mediated landscape change.

WATERSHED ECOLOGY: LANDSCAPE ECOLOGY WITHIN A WATERSHED FOOTPRINT




The Clean Water Act of 1972 has done a remarkable job in controlling pollution such as "point source" discharges from sewage treatment plant and industrial effluent pipes. Nonetheless, many waters (about 40% of those surveyed by the USEPA in 1996) still do not meet the Act's "fishable and swimmable" standards. How can this be? Our watercourses are subject not only to inputs from obvious sources such as discharge pipes, but also to surface water runoff. These diffuse, hard to measure inputs are referred to collectively as non-point source (NPS) pollution. All water within the York River







watershed has the potential to become contaminated by materials present due to human alterations of the watershed landscape. Vegetation within natural landscapes have a large capacity to protect water resources: the forest canopy, subcanopy and shrub layer intercepts raindrops, breaking them into smaller droplets that flow along leaves, needles, branches and trunks before reaching the forest floor. The leaf litter on the forest floor provides further protection for fragile forest soils, allowing water to seep downward, preventing compaction and erosion and surface water runoff during heavy rains. The deep, well developed root systems of woody plants also stabilize forest soils and help them retain moisture, allowing aquifer recharge, and taking up pollutants/nutrients from the ground water. Natural vegetation allows rainwater to soak into the ground, filter through the substrate, and recharge the watershed's subsurface water supply.

As the landscape is developed, it typically becomes progressively hardened or "impervious", preventing rainwater from seeping through soils. Rain that falls upon increasing amounts of rooftops, pavement, manicured lawns, etc. rapidly runs off, carrying hydrocarbons, herbicides, pesticides and nutrients from fertilizers into the nearest watercourse, often via a network of informal drainage ditches. Here the runoff and any contaminants create high flows downstream to the estuary. Freshwater that could have re-entered the groundwater instead goes out to sea. As impervious surface increases above 10% of the land area within the watershed, the force and volume of the flow erodes stream banks and destroys habitat, eventually turning once meandering and fish-filled streams into eroded gullies subject to flash flooding and requiring stabilization.

WORKING WITH THE WATERSHED LANDSCAPE

As the York watershed continues to be developed, the following guidelines should be considered to help maintain the ecological integrity of the watershed and its landscape.

-  Minimize the amount of land clearing at building sites.
-  Use native trees, saplings, shrubs and tall grasses for landscaping.
-  Keep the lawn footprint to a minimum.

-  Minimize lawn mowing to reduce evaporation and the need for watering.
-  Avoid herbicides, pesticides and fertilizers.
-  Orient roads, drives and parking areas(both paved and unpaved) to minimize runoff into nearby surface waters. Drives oriented downslope and perpendicular to a nearby shoreline should be avoided.
-  Construct drainage swales to receive runoff from large areas of pavement or unpaved fill.
-  Maintain a minimum 100 foot buffer of trees, shrubs and/or dense, tall grasses along surface water shorelines.
-  Buffers of 250 feet can provide an 80% reduction in sediment and pollutant removal, as well as fair to good wildlife and avian habitat value (see Desbonnet et al. 1994).

CONTACT US

Please contact Tin Smith or Kristen Whiting-Grant for a copy of this report, or other information regarding the watershed, the survey, or the watershed management planning process.

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Glossary

Algae – small, simple plants that naturally live in water. High algae populations impair water clarity and dissolved oxygen levels and indicate high concentrations of phosphorous in fresh water, or nitrogen in estuarine and marine waters.

Anadromous fish – migrating from salt water to spawn in fresh water.

Bank erosion – Streambank erosion is the direct removal soil material of banks and beds by flowing water.

Culverts – a conduit through which surface water can flow under or across roads and driveways. Culverts are usually a pipe and can be made of metal, wood, plastic, or concrete.

Ecosystem – a system formed by the interactions of communities of organisms within their physical, chemical and biological environment.

Estuary – a semienclosed coastal water area, often at the mouth of a river, having a high input of freshwater and great fluctuation in salinity.

Fecal coliform – bacteria that lives in the intestinal tracts of warm-blooded animals such as birds and mammals, including humans. The presence of fecal coliform bacteria in a water sample can be an indicator of pollution of human sewage, farm animal waste, or wildlife scat.

Flow restrictions – when the natural flow of a body of water is inhibited by human impact such as bridges and culverts.

Ground water - water beneath the earth's surface that can be collected with wells, tunnels, or drainage galleries, or that flows naturally to the surface via seeps or springs. Groundwater is the water that is pumped by wells and flows out through springs.

Hydrocarbons – any of a class of aliphatic, cyclic, or aromatic compounds containing only hydrogen and carbon such as methane and benzene.

Livestock – animals such as cattle, horses, pigs and other animals kept or raised on a farm.

Leach fields – the part of a septic system where the effluent from the septic tank disperses into the soil.

Nutrients – essential chemicals needed by plants and animals for growth. Enriched nutrient load from point sources such as treated sewage, and non-point sources from land runoff or atmospheric deposition. These inputs can result in excessive growth of algae and lead to degradation of water quality.

Non-point source pollution – Non-point source (NPS) pollution is contamination indirectly discharged or carried into a water body by runoff or snowmelt, and having a negative impact on water quality.

Outwash plains – large areas of glacial sediment that has been moved and redeposited by meltwater.

Pipe Discharge – a point source of contamination that can contribute pollutants such as nutrients, bacteria, and toxins into a water body.

Riparian zone – the land along rivers, streams and lakes. These areas of transition between aquatic and upland ecosystems comprise a small portion of the total landscape, yet they are among the most diverse biological systems on earth.

Rip rap – large angular stones used to build or strengthen riverbanks and structures such as dikes, levee and spits.

Road Runoff – material originating from roadways including sediment, vehicle fluids and road salt that is carried into the river system by water flowing across the land.

Runoff – water or snowmelt that drains or flows over the surface of the land into a receiving waterbody. This runoff often carries with it eroded soil, nutrients and/or toxins that in sufficient amounts can be detrimental to natural aquatic systems.

Salt Marsh Accretion – an increase in the salt marsh surface by natural growth and addition of sediment deposits over a period of time.

Sedimentation – accumulation of mineral and organic soil material transported into the river from surface and road runoff.

Shoreland Zone – the area of land from the water line stretching inland for a defined distance. The definitions of this distance may vary by county zoning and state standards. In Maine this distance equals 250 ft from the water's edge.

Surface Water – open water bodies within the landscape such as lakes, streams, rivers and estuaries.

Turbidity – a measure of the lack of water clarity. Turbidity rises with the amount of suspended material that scatters light in the water column.

Vegetated Buffer – areas of vegetation, left undisturbed or planted between a developed area, agricultural area or residence and a water body that functions to capture pollutants from surface water and groundwater. Buffer vegetation can include trees, shrubs and ground cover plants.

Watershed – the geographic region within which water drains to a particular river, stream, or body of water. A watershed includes hills, lowlands and the body of water into which the land drains. The land ridges separate watersheds, defining the watershed boundaries.

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Also

National Park Service Rivers and Trails Program River Resource Library

This collection, provided by the Rivers and Trails Program of the National Park Service, contains numerous relevant titles.

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 Map 4. W.E.T. sites in Little River Estuary
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 Map 6. Inset 1 MBLR watershed shoreland survey site types

APPENDIX 1

Fish Species Occurring in the York River Watershed

FISH SPECIES LIST YORK RIVER

<u>SCIENTIFIC NAME</u>	<u>Common Name</u>	<u>Text</u>
Anguillidae		
<i>Anguilla rostrata</i>	American Eel	x
Clupeidea		
<i>Alosa pseudoharengus</i>	Alewife	x
<i>Clupea harengus</i>	Atlantic Herring	x
Salmonidae		
<i>Salvelinus fontinalis</i>	Brook Trout	x
<i>Salmo trutta</i>	Brown Trout	
Osmeridae		
<i>Osmerus mordax</i>	Rainbow Smelt	x
Cyprinodontidae		
<i>Fundulus heteroclitus</i>	Common Mummichog	x
<i>Fundulus diaphanus</i>	Banded Killifish	x
Atherinidae		
<i>Menidia menidia</i>	Atlantic Silverside	x
Gasterosteidae		
<i>Apeltes quadracus</i>	Fourspine Stickleback	x
<i>Gasterosteus aculeatus</i>	Threespine Stickleback	x
<i>Pungitius pungitius</i>	Ninespine Stickleback	x
Percichthyidae		
<i>Morone saxatilis</i>	Striped Bass	x
<i>Morone americana</i>	White Perch	x
Pomatomidae		
<i>Pomatomus saltatrix</i>	Bluefish	x
Mugilidae		
<i>Mugil cephalus</i>	Mullet	
Pleuronectidae		
<i>Pseudopleuronectes americanus</i>	Winter Flounder	x
Triglidae		
<i>Prionotus carolinus</i>	Northern Sea Robin	x

Cyclopteridae		
<i>Cyclopterus lumpus</i>	Lumpfish	x
Pholidae		
<i>Pholis gunnellus</i>	Rock Gunnel	x
Labridae		
<i>Tautoglabrus adspersus</i>	Cunner	x
Freshwater Fish		
Esocidae		
<i>Esox niger</i>	Chain Pickerel	
Centrarchidae		
<i>Micropterus salmoides</i>	Largemouth Bass	
Ictaluridae		
<i>Ictalurus nebulosus</i>	Brown Bullhead	
Cyprinidae		
<i>Notemigonus crysoleucas</i>	Golden Shiner	
Catostomidae		
<i>Catostomus commersoni</i>	White Sucker	
Crustacea		
<i>Carcinus maenas</i>	Green Crab	
<i>Xanthidae sp.</i>	Mud Crab	
<i>Homarus americanus</i>	American Lobster	
<i>Crangon sp.</i>	Sand Shrimp	
<i>Mysidae sp.</i>	Mysid Shrimp	

APPENDIX 3

Summary of Selected Studies applicable to the York River Watershed

Cartwright, Merrie A. (1997) Dietary Habits of Benthic-Feeding Fishes in a Southern Maine Salt Marsh: Evaluation of Prey Availability and Feeding Selectivity. Ph.D. Dissertation in Zoology, University of Maine.

This observational study explores benthic organisms and fishes which prey on them in the main creek channel of the Little River salt marsh in Wells, Maine, testing the hypothesis of “threshold” feeding behavior and classical optimal foraging theory. The report is divided into three chapters, the first describing the benthic community and its composition as prey relative to abiotic factors; the second discussing the fish distribution patterns; and the third detailing the diets of benthic-feeding fishes.

In chapter one, the author outlines the spatial and temporal variability of benthic organisms. The benthic community was sampled during the summers of 1994 and 1995. In both years, an upper estuary and lower estuary site were sampled on three occasions during the summer, representing early summer, mid summer and late summer. Statistical analyses using a MANOVA model looked for patterns by year, location, and period of season. A spatial difference in the benthic community was found, with bivalves and spionids being more abundant in the lower estuary and nereids and gastropods being most abundant in the upper estuary. Seasonal variation was the strongest factor in determining benthic community structure. Results were compared to those from Great Bay Estuary in New Hampshire.

Chapter two discusses the fish sampling undertaken in the summers of 1994 and 1995. In 1994, gill nets and large-mesh fyke nets were used to capture large fish, but the small number of fish caught resulted in minnow traps, seines, a cast net, small mesh fyke nets and angling being used in 1995. Species richness, dominance, and diversity were calculated using various indices. Other independent and location-dependent variables were also examined: date, distance from estuary mouth, time at mid-tide, direction of tidal flow, temperature, salinity, and dissolved oxygen. ANOVA modeling was also conducted. Total abundance was found highest in the middle section of the estuary, and in

early summer. Species richness and evenness were highest in the lower estuary. Estuarine residents were numerically dominant, with diadromous fishes and “estuary spawner” juveniles also present. No marine-spawned “nursery” fishes were found.

The final chapter on benthic-feeding fish diets is based on analysis of stomach contents of fish caught in 1995. Numerical abundance was the primary factor examined, along with size of prey for fishes with high sample size. Prey preference was calculated by an estimation of Chesson’s index for each prey type, which was then entered into a MANOVA model for each fish species. Most but not all fishes studied broadened their diets during prey scarcity, lending mixed support for classical optimal foraging theory. Predator size was not found to significantly determine prey-size selectivity. Broad and/or flexible diets of most fishes indicated that the “trophic generalism” hypothesis was valid for this estuary.

Holden, W.F. (1997) Fresh Water, Suspended Sediment and Nutrient Influx, Ph.D. Dissertation in Geology, Boston University, Boston, Massachusetts. 261 pp.

Development in coastal watersheds increases nutrient loading and eutrophication. A study of nutrient budgets is important in efforts to improve water quality. In this report, the Little River and Webhannet River watersheds are compared in terms of their nutrient budgets. These two watersheds are appealing because they are both back barrier beach systems and are adjacent; however, they have different attributes, such as surface geology, degrees of man made modifications and land use. This makes it easier to study how these differences affect their nutrient balances. The Webhannet River estuary is extensively developed, mostly in the area adjacent to the estuary along Route 1. The Little River estuary, on the other hand, is mostly in the Wells National Estuarine Research Reserve, and is the only example of an undeveloped barrier beach/salt marsh in southern Maine with a tidal inlet. The remainder of the Little River watershed is also relatively undeveloped.

Nutrient concentrations (including ammonium, orthophosphate, nitrate plus nitrite and silica) were measured in these two watersheds in 1994-95. Findings from this study determined that the overall nutrient/total suspended solids (TSS) concentrations in estuarine water in the Webhannet and Little Rivers are comparable to other Maine estuaries. The study also determined that the influx of freshwater from the rivers is not the main source of ammonium, orthophosphate and silica to the estuaries. However, the influx from the rivers is the main source of nitrate plus nitrite and TSS to the estuaries. Ammonium, nitrate plus nitrite and silica concentrations were higher in the upper Webhannet River estuary than the lower portion, which may be the result of flux from smaller streams or groundwater entering the upper estuary. “Higher nitrate plus nitrite concentrations in the Branch Brook may reflect a greater percentage of agricultural land use in its watershed.” Seasonal variations in nutrient concentrations were measured and nitrate concentrations were found to decrease in summer, however ammonium and orthophosphate concentrations increased. The presence of ammonium usually signifies an anthropogenic source; therefore this increase in summer may be a result of an increase in the local population at this time.

Median concentrations of nutrients from 1991-92 were compared to those from 1994-95 in both the Webhannet and Little River watersheds. Nutrient median concentrations generally increased in the rivers, indicating an increased anthropogenic impact on the watersheds over this period of time. The author states that “the estuaries are also being impacted, the Webhannet River estuary more than the Little River estuary.”

The two watersheds were also compared to seven other Maine coastal watersheds within 135 km of Wells. Concentrations of ammonium, nitrate plus nitrite and orthophosphate were compared. Overall, twenty different nutrient measurements were made within the seven coastal watersheds. Findings determined that river concentrations in the Webhannet/Little River watersheds were higher ten out of twenty times, and estuarine concentrations seven out of twenty. The author concluded from this information that “while relatively clean, the Webhannet and Little River estuaries may be receiving some impact.”

Orringer, S., Reid, S. and Sullivan, N. (1995) A Survey of Migratory Fishes In the Little River Estuary and its Watershed; Wells National Estuarine Research Reserve, Wells, Maine. Draft final data report, submitted to the Institute of Museum Services, Silver Spring, MD. 34 pp.

The Little River watershed consists of the Branch Brook and Merriland River. These relatively small rivers are not often cited in historical literature; however, they are part of an important river system in southern Maine that was once used as spawning area for many anadromous fish. Historical records indicate the disappearance of anadromous fish from many southern Maine rivers as early as the 18th century. Oral history has mentioned that alewife in the Merriland River and Branch Brook disappeared by 1943. In the Merriland River, there were no brook trout by 1953. Several factors over the years have impaired the ability of anadromous fish to spawn in the Little River watershed. One major reason for their decline in these rivers was the building of dams. These became obstacles, destroyed habitat where some fish would lay eggs, and also affected water quality. Deforestation, impassible culverts, and pollution from discarded trash and human activity are also contributors to this habitat loss.

The purpose of this study was to describe the populations of migratory fish species utilizing the Little River watershed. The methods of this study included the use of a fish weir, or live fish trap, in the Little River estuary. This trap allows for both upstream and downstream migrants to enter a live box to later be sampled. Fish were also sampled at five sites along each river by electroshocking.

In the preliminary results, five migratory fish species were discussed. This included Atlantic salmon, brook trout, rainbow smelt, and alewife. Four of these fish species were observed in the weir. Although alewife were seen in large numbers, the remaining species of brook trout, rainbow smelt, and Atlantic salmon occurred in much smaller numbers. Included in this report is a table with the entire list of juvenile and adult fishes found in the weir. Only two migratory fish species, brook trout and brown trout, were observed

from the electroshocking method in the rivers. The Merriland River had small numbers of these migratory fish. Twenty-four brook trout were observed in the Branch Brook and no brown trout were seen in this river. A table is also included with the entire list of species observed using electroshocking. Several areas of possible spawning substrates for these migratory fish were observed in the two rivers; however, because of fish barriers, these spawning sites are currently unusable.