III. Contact Information
Chris O. Yoder, Research Director
Midwest Biodiversity Institute (MBI)
4673 Northwest Parkway
Hilliard, OH 43026
(614) 457-6000 x1102 [Main]
(614) 403-9592 [Cell]
https://midwestbiodiversityinst.org/
Fed. Tax ID #31-1559845

Fish sampling in the Lower Kennebec River drainage by MBI has been conducted annually at seven (7) sites in the Lower Kennebec River mainstem since 2002 and at three (3) sites in the Lower Sebasticook River since 2008. MBI conducted the majority of this work as a grantee or contractor to U.S. EPA and the project was covered by 5-year ITPs issued under Section 7 of the ESA since 2010, the most recent of which expired in 2019. The respective Biological Opinions included annual take limits for Atlantic Sturgeon, Shortnose Sturgeon, and Atlantic Salmon and Terms and Conditions based on Reasonable and Prudent Measures for minimizing harm to individual fish and for reporting any incidental takes to NOAA. The history of incidental takes are included with the descriptions of each of the three ESA listed fish species that are known to occur in the Lower Kennebec River system.

IV. Species descriptions:
Three ESA listed fish species occur in an approximate 17.5 mile reach of the Lower Kennebec River between the Lockwood Dam and Hydropower Project (operated by Brookfield Inc.) in Waterville, ME to the former Edwards Dam site in Augusta, ME and a 3.5 mile reach of the Lower Sebasticook River downstream from the Benton Falls Dam and Hydropower Project (owned by Benton Falls Associates) to its confluence with the Kennebec River in Winslow, ME.

Atlantic Sturgeon (*Acipenser oxyrinchus*)¹

Atlantic sturgeon live in rivers and coastal waters from Canada to Florida. Hatched in the freshwater of rivers, Atlantic sturgeon head out to sea as juveniles, and return to their

¹ https://www.fisheries.noaa.gov/species/atlantic-sturgeon
Atlantic sturgeon were once found in great abundance, but their populations have declined greatly due to overfishing and habitat loss. Atlantic sturgeon were prized for their eggs, which were valued as high-quality caviar. During the late 1800s, people flocked to the Eastern United States in search of caviar riches from the sturgeon fishery, known as the “Black Gold Rush.” By the beginning of the 1900s, sturgeon populations had declined drastically. Close to 7 million pounds of sturgeon were reportedly caught in 1887, but by 1905 the catch declined to only 20,000 pounds, and by 1989 only 400 pounds of sturgeon were recorded. Today, all five U.S. Atlantic sturgeon distinct population segments are listed as endangered or threatened under the Endangered Species Act. The populations in Canada are not protected. The primary threats currently facing Atlantic sturgeon are entanglement in fishing gear, habitat degradation, habitat impediments such as dams and other barriers and vessel strikes.

Atlantic Sturgeon are known to occur in coastal river systems across New England (Figure 1; Appendix A) that include the Penobscot River, Kennebec River, Androscoggin River, Sheepscot River, Saco River, Presumpscot River, Piscataqua River, Merrimack River, Taunton River, Connecticut River, and Housatonic River. Historically, Atlantic Sturgeon were present in approximately 38 rivers in the United States from St. Croix, ME to the Saint Johns River, FL, of which 35 rivers have been confirmed to have had a historical spawning population. Atlantic sturgeon are present in 32 of these rivers with spawning occurring in at least 20.

In 2017, the National Oceanic and Atmospheric Administration (NOAA) increased the critical habitat range for Atlantic Sturgeon (*Acipenser oxyrinchus*). (DEPARTMENT OF COMMERCE, National Oceanic and Atmospheric Administration 50 CFR Part 226, [Docket No. 150818735-7452-02], RIN 0648-BF28: Endangered and Threatened Species; Designation of Critical Habitat for the Endangered New York Bight, Chesapeake Bay, Carolina and South Atlantic Distinct Population Segments of Atlantic Sturgeon and the Threatened Gulf of Maine Distinct Population Segment of Atlantic Sturgeon). The National Marine Fisheries Service (NMFS) and NOAA issued the final rule to designate critical habitat for the threatened Gulf of Maine DPS of Atlantic sturgeon, the endangered New York Bight DPS of Atlantic sturgeon, the endangered Chesapeake Bay DPS of Atlantic Sturgeon, the endangered Carolina DPS of Atlantic Sturgeon and the endangered South Atlantic DPS of Atlantic Sturgeon pursuant to the Endangered Species Act (ESA). Specific occupied areas designated as critical habitat for the Gulf of Maine DPS of Atlantic Sturgeon contain approximately 244 kilometers (km; 152 miles) of aquatic habitat in the following rivers of Maine, New Hampshire, and Massachusetts: Penobscot, Kennebec, Androscoggin, Piscataqua, Cocheco, Salmon Falls, and Merrimack. Specific occupied areas designated as critical habitat for the New York Bight DPS of Atlantic Sturgeon contain approximately 547 km (340 miles) of aquatic habitat in selected rivers in Connecticut,
Figure 1. Coastal rivers designated by NOAA as critical habitat for Atlantic Sturgeon for Distinct Population Segments (DPS) as shown. The Lower Kennebec River study area includes the Gulf of Maine DPS.
Massachusetts, New York, New Jersey, Pennsylvania, and Delaware: Connecticut, Housatonic, Hudson, and Delaware rivers. Specific occupied areas designated as critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon contain approximately 773 km (480 miles) of aquatic habitat in the following rivers of Maryland, Virginia, and the District of Columbia: Potomac, Rappahannock, York, Pamunkey, Mattaponi, James, Nanticoke, and the following other water body: Marshyhope Creek. Specific occupied areas designated as critical habitat for the Carolina DPS of Atlantic sturgeon contain approximately 1,939 km (1,205 miles) of aquatic habitat in the following rivers of North Carolina and South Carolina: Roanoke, Tar - Pamlico, Neuse, Cape Fear, Northeast Cape Fear, Waccamaw, Pee Dee, Black, Santee, North Santee, South Santee, and Cooper, and Bull Creek. Specific occupied areas designated as critical habitat for the South Atlantic DPS of Atlantic sturgeon contain approximately 2,883 km (1,791 miles) of aquatic habitat in the following rivers of South Carolina, Georgia, and Florida: Edisto, Combahee, Salkehatchie, Savannah, Ogeechee, Altamaha, Ocmulgee, Oconee, Satilla, and St. Marys Rivers.

Atlantic Sturgeon Encounters in the Lower Kennebec River 2002-19
Previous “encounters” of Atlantic Sturgeon during fish sampling conducted by MBI in the Lower Kennebec River during 2002-19 are listed in Table 1. The first encounter occurred in 2007 with a single adult that was “rolled” at Sevenmile Island (RM 4.0) in the Kennebec River. This individual vigorously escaped the immediate vicinity when the electric current was interrupted. Adults were not encountered in the Kennebec River until 2014 when two adults were observed, one below the Lockwood Dam (RM 17.4) in Waterville and the other at Augusta (RM 0.1), each under the Terms and Conditions of the first Section 7 ITP (NMFS 2011). The second encounter in 2014 required a re-initiation of consultation as the take limit of one fish was reached at the final site of the 2014 survey. The next encounters happened under the most recent Section 7 ITP (NMFS 2015) as single adults at Sevenmile Island (RM 4.0) in 2018 and at Sidney, ME (RM 9.0) in 2019. As with the first encounter in 2007, fish were observed to swim away vigorously when the electric current was interrupted. All reasonable and prudent measures specified by the ITP were observed by interrupting the electric current immediately, not netting any fish, ensuring that the fish were able to swim away under their own power, and not resuming sampling for a period of five (5) minutes. All of the Lower Kennebec locations were sampled twice each year during the late summer and early fall months. No Atlantic Sturgeon were encountered in the Lower Sebasticook River during 2008-19.

Shortnose Sturgeon (Acipenser brevirostrum)²
Shortnose Sturgeon occur in most major river systems along the U.S. eastern seaboard. In the northern portion of the range, Shortnose Sturgeon are found in the Chesapeake Bay system, Delaware River, and the Hudson River in New York and in New England coastal river systems (Figure 2; Appendix A) that include parts of the Housatonic River, Connecticut River, Farmington River, Merrimack River, Saco River, Presumpscot River, Androscoggin River, Kennebec River, and Penobscot River. In the southern portion of the range, they are found in the St. Johns River in Florida, Altamaha, Ogeechee, and Savannah Rivers in Georgia, and in South Carolina river

² https://www.fisheries.noaa.gov/species/shortnose-sturgeon
Table 1. Currently listed ESA species collected by electrofishing in the Lower Sebasticook and Lower Kennebec Rivers 2002-2019 showing the number encountered and estimated weights in grams based on visually estimated lengths. Some early collections were made prior to a species being ESA listed and or the Lower Kennebec being listed as a critical habitat.

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Figure 2. NMFS estimated inland range of Shortnose Sturgeon in New England and Mid-Atlantic coastal rivers that are accessible. No critical habitats have been identified. The Lower Kennebec River is number 6 on the map.
systems that empty into Winyah Bay and the Santee/ Cooper River complex that forms Lake Marion. Shortnose Sturgeon live in rivers and coastal waters from Canada to Florida. They hatch in the freshwater of rivers and spend most of their time in the estuaries of these rivers. Unlike Atlantic Sturgeon, Shortnose Sturgeon tend to spend relatively little time in the ocean. When they do enter marine waters, they generally stay close to shore. In the spring, adults move far upstream and away from saltwater, to spawn. After spawning, the adults move rapidly back downstream to the estuaries, where they feed, rest, and spend most of their time. Shortnose Sturgeon have five rows of bony plates known as scutes. This unique fish looks like it is covered in armor. Shortnose sturgeon are slow-growing and late-maturing, and they have been recorded to reach up to 4.5 feet in length and live 30 years or more.

Native American fishermen harvested Shortnose and Atlantic Sturgeon for their meat and eggs (roe) some 4,000 years ago, and sturgeon are credited as the primary food source that saved the Jamestown settlers in 1607. In the mid-1800s, Atlantic and Shortnose sturgeon began to support a thriving and profitable fishery for caviar, smoked meat, and oil. For the most part, historical landings records failed to differentiate between Shortnose sturgeon and the larger Atlantic sturgeon, making it difficult to determine historical trends in abundance for populations of either species difficult to determine. By the late-1800s, sturgeon were being over-exploited. In 1890, over 7 million pounds of sturgeon were caught in that year alone. In 1920, only 23,000 pounds of sturgeon were caught.

Although Shortnose Sturgeon are no longer fished, threats remain that continue to affect recovery efforts. Bycatch in commercial fisheries and increased industrial uses (e.g., hydropower, nuclear power, treated sewage disposal) of the nation’s large coastal rivers during the 20th century became the primary barriers to Shortnose Sturgeon recovery. Today, the Shortnose Sturgeon is in danger of extinction throughout its range and is listed as endangered under the Endangered Species Act. The primary threats to this species are habitat degradation, water pollution, dredging, water withdrawals, fisheries bycatch, and habitat impediments (e.g., dams).

**Shortnose Sturgeon Encounters in the Lower Kennebec River 2002-19**

Shortnose Sturgeon have been encountered at multiple sites in the lower Kennebec River study area during 2012-19 (Table 1). The first Shortnose Sturgeon encountered consisted of three (3) adults at Sidney, ME (RM 9.0) in 2012 under the first Section 7 ITP (NMFS 2011). The next encounters consisted of a single adult at Augusta (RM 0.1) in 2014, single adults at Sidney (RM 9.0) and Augusta (RM 0.1) in 2016, two single adults in 2017 during each of two sampling passes at Augusta (RM 0.1), a single adult at Petty’s Rips (RM 15.1) near Waterville in 2018, and five (5) adults at three sites in 2019 – a single adult at Petty’s Rips (RM 15.1) near Waterville, three (3) adults at Sidney (RM 9.0), and a single adult at Sevenmile Island (RM 4.0) all under the second ITP (NMFS 2015). The total of ten (10) individuals collected over 18 years is 0.11% of the 9436 individuals population estimate by Wippelhauser and Squire (2015) for 1998-2000 and over the entirety of the Lower Kennebec River including the tidal reach downstream from our study area. The recent trend has been for encounters at sites further upstream in the Lower Kennebec River study area which may well be the result of the almost two-fold increase in the
population since 1977-1981 (Wippelhauser and Squire 2015). As with the first encounter in 2012, all affected fish were observed to swim away under their own power. The reasonable and prudent measures specified by the Section 7 ITPs were observed by interrupting the electric current immediately, not netting any fish, ensuring that the fish were able to swim away under their own power, and not resuming sampling for a period of five (5) minutes. All of the Lower Kennebec locations were sampled twice each year during the late summer and early fall months. No Shortnose Sturgeon were encountered in the Lower Sebasticook River 2008-19.

**Atlantic Salmon** (*Salmo salar*)

Atlantic salmon, also known as the “King of Fish,” are anadromous, which means they can live in both fresh and saltwater. Atlantic salmon have a relatively complex life history that begins with spawning and juvenile rearing in rivers. They then migrate to saltwater to feed, grow, and mature before returning to freshwater to spawn. Atlantic salmon are vulnerable to many stressors and threats, including blocked access to spawning grounds, habitat degradation caused by dams and culverts, and poor marine survival. They are considered an indicator species or a “canary in the coal mine.” This means that the health of the species is directly affected by its ecosystem health. When a river ecosystem is clean and well-connected, its salmon population is typically healthy and robust. When a river ecosystem is not clean or well-connected, its salmon population will usually decline. Atlantic salmon in the United States were once native to almost every coastal river northeast of the Hudson River in New York. But commercial fishing in Atlantic salmon fisheries reduced their population size until the fisheries closed in 1948. Commercial and recreational fishing for wild sea run Atlantic salmon is still prohibited in the United States. All Atlantic salmon in the public market is cultured and commercially grown. Currently, the last wild populations of U.S. Atlantic salmon are found in at least eight rivers in Maine. These populations comprise the Gulf of Maine distinct population segment, which is listed as endangered under the Endangered Species Act. Some populations in southern Canada and Europe are also declining significantly, creating concern about the status of this species globally. In addition, the Gulf of Maine DPS is one of eight Species in the Spotlight. This means that NOAA Fisheries has made it a priority to focus recovery efforts on research to better understand the major threats and stabilize the Gulf of Maine DPS by improving access to quality habitat and thus, preventing its extinction.

The endangered Gulf of Maine DPS has declined significantly since the late 19th century. Historically, dams, overfishing, and pollution led to large declines in salmon abundance. Because of this, the commercial Atlantic salmon fishery closed in 1948. Improvements in water quality and stocking from hatcheries helped rebuild populations to nearly 5,000 adults by 1985. But more recently, scientists have discovered marine survival and populations have significantly decreased, resulting in annual returns to the United States of generally less than 1,000 adults. The rapid decline and dire status of the ESA-listed Gulf of Maine DPS makes it a priority for NOAA Fisheries and partners to prevent its extinction and promote its recovery.

3 https://www.fisheries.noaa.gov/species/atlantic-salmon-protected
Figure 3. NMFS estimated inland range of Gulf of Maine Distinct Population Segment Atlantic Salmon in Maine river and stream basins as of May 2014.
Atlantic Salmon Encounters in the Lower Kennebec River 2002-19

Atlantic salmon presently occur in most coastal river systems in Maine (Figure 3; Appendix A) including the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, Sheepscot, Cove Brook, Penobscot, Androscoggin, and Kennebec River basins. Atlantic Salmon encounters in the Lower Kennebec River 2002-19 consisted of adult fish that have occurred sporadically through that time period (Table 1). The first encounters occurred prior to Atlantic Salmon being ESA listed as endangered with three (3) adults and a single (1) juvenile being collected in 2002, 2003, 2004, and 2009 respectively in and just downstream from Waterville (RM 17.4, 16.5, and 15.1). The next encounters happened under the first Section 7 ITP (NMFS 2011) with four (4) adults in 2011, single (1) adults at Waterville (RM 16.5) and Sidney (RM 9.0) in the Kennebec River and two (2) adults in the Sebasticook River at Benton Falls (RM 5.3), and followed by a single (1) adult at Waterville (RM 17.4) in 2012. No Atlantic Salmon were encountered thereafter until 2019 when a single (1) adult was encountered at Waterville (RM 17.4). The trend since 2010 has been for a decreasing number of encounters and then only at the furthest upstream sites in the Lower Kennebec River. This annual pattern of occurrence in the Lower Kennebec River fish sampling is generally consistent with the number of fish appearing in the fish lift at the Lockwood Dam and Hydropower Project, which has generally been less than 10 fish annually. Exceptions were more than 30 and 60 fish at the lift in 2009 and 2011, respectively, the latter coinciding with four (4) adult encounters by MBI sampling in that same year. In all of the MBI encounters fish were observed to swim away and frequently doing so by vigorous leaping out of the water. All reasonable and prudent measures specified by the ITP were observed by interrupting the electric current immediately, not netting any fish, ensuring that the fish were able to swim away under their own power, and not resuming sampling for a period of five (5) minutes. All of the Lower Kennebec locations were sampled twice each year during the late summer and early fall of 2002-19.

V. Detailed description of proposed activity:

Overview: MBI proposes to continue what is currently an 18 year long (2002-19) systematic assessment of the fish assemblages at seven (7) sites in an approximate 17.5 mile reach of the Lower Kennebec River between the Lockwood Dam and Hydropower Project in Waterville, ME to the former Edwards Dam site in Augusta, ME and three (3) sites in a six (6) mile reach of the Sebasticook River (2008-19) between the Benton Falls Dam and Hydropower Project in Benton Falls, ME to the mouth at the Kennebec River in Winslow, ME (Figure 4). The Lower Kennebec River study area is a subset of a larger survey of the Kennebec River in 2002 that was sampled as part of a statewide assessment of Maine Rivers during 2002-2007 (MBI 2008) and a regional assessment of New England Large River fish assemblages in 2008-9 (MBI 2015). The rationale for the annual sampling conducted in 2002-19 was to assess the recovery of the formerly impounded habitat resulting from the Edwards Dam in Augusta and the open passage of fish allowed by its removal in 2000 followed by aggressive diadromous fish management efforts by federal (NOAA, U.S. FWS) and Maine state agencies (Maine DMR, Maine IF&W) that are ongoing. The diadromous species of interest include Alewife (*Alosa pseudoharengus*), Blueback Herring (*Alosa aestivalis*), American Shad (*Alosa sapidissima*), American Eel (*Anguilla rostrata*), and Striped Bass (*Morone saxatilis*) in addition to the three ESA listed species described previously. Documentation of native and introduced freshwater species is also a goal of the
Figure 4. The Lower Kennebec River study area (red ellipse) positioned within the larger Kennebec River study area in 2002 showing numbers and biomass of fish collected by electrofishing at riverine and impounded reaches in 2002. Maine IBI + Diadromous IBI rankings from 36 New England rivers during 2002-2009 (MBI 2015) are shown for comparison and to demonstrate the broad goals of the proposed fish assemblage assessment.
project. Introduced warmwater fish species such as Smallmouth Bass (*Micropterus dolomieu*), Largemouth Bass (*Micropterus salmoides*), Black crappie (*Pomoxis nigromaculatus*), Bluegill (*Lepomis macrochirus*), Green sunfish (*Lepomis cyanellus*), White catfish (*Ameiurus catus*), and Common Carp (*Cyprinus carpio*) are especially of interest as none are native to Gulf of Maine freshwater rivers, some have become established as naturalized populations, and others are only recently appearing. How the presence and establishment of these and other introduced fish species affect the recovery of native inland and diadromous fish species populations is a major focus of our research.

**Sampling Goals, Design, and Rationale**

The methodology proposed for use herein was first developed, tested, and piloted by Yoder et al. (2006) in Maine during 2001-3. It consists of a single-gear sampling approach that meets the following objectives of large scale bioassessments outlined by Karr et al. (1986):

- Monitor biotic integrity at specific sites, within river reaches, and between different sites, reaches, and rivers.
- Sample and screen large numbers of sites in order to identify those that require attention.
- Assess changes in key fish assemblage parameters and attributes over space and time.
- Interpret large amounts of data from complex fish assemblages where the objective is to assess biotic integrity.

Meeting these objectives requires a methodology that can be used to sample multiple sites during a day, tens of sites in a week, and hundreds of sites over a summer-early fall seasonal index period (e.g., mid-June to early October). The sampling equipment and platform need to be transportable enough to gain access at multiple points along the lengths of boatable and raftable rivers including comparatively remote reaches. Similar single-gear electrofishing approaches have been successfully tested and used in other parts of the U.S. and Canada to fulfill similar project objectives (Yoder and Kulik 2003). Based on our prior experiences in New England and other regions where similar approaches are used, this protocol has not only proven useful for Clean Water Act (CWA) bioassessment purposes, but also for other natural resource management objectives such as diadromous fish restoration and management. A more detailed treatment of the rationale for the design and methods proposed for use in the Lower Kennebec River study area are described in Yoder et al. (2015).

**Sampling Protocol, Logistics, and Methodology**

Boat electrofishing has been the primary method of choice based on its successful application as a single gear approach to rivers throughout the U.S. and Canada. For this project the selection of this methodology was based on a successful trial application in the Kennebec River in 2001 and full scale piloting in the Kennebec, Sebasticook, and Androscoggin Rivers in 2002-3. The design of the electrofishing boats used to date is similar to that originated by Gammon (1973, 1976) and widely used by Ohio EPA (1989a) and many other state and federal agencies since, including the U.S. EPA sponsored National Streams and Rivers Assessment (NRSA) in 2008-9, 2013-14, and 2018-19.
For the Maine and New England riverine methodology electric current is generated by a Smith-Root GPP 5.0 generator/pulsator combination and transmitted into the water as a pulsed D.C. waveform by an electrode array suspended from the bow of 16-18 foot long john boats or a 16 foot long inflatable Wing raft. The anodes (+ electrodes) are positioned approximately three (3) meters in front of the bow consisting of 2 gangs of umbrella spreaders from which 8-10 strands of 3/16” stainless steel woven cable are hung. The umbrella arrays are suspended from individual booms that can be raised or lowered to vary the depth of penetration of the anode array and which can be moved laterally to either expand or restrict the electric field. Cathodes consist of a curtain of 3/16” stainless steel woven cable that hang from the bow and from the sides of the bow (Figure 5). Wiring from the generator/pulsator to the electrodes is encased in plastic conduit to protect against shorts and electrical shock. A positive pressure foot pedal switch located on the bow platform is operated by a netter. Two emergency cutoff switches are located within easy reach of the boat driver, one mounted to the rear seat and one on the 5.0 GPP pulsator unit. The electrofishing boat is propelled by 15-25 h.p. outboard motors mounted on the transom. Electrofishing unit settings for the 5.0 GPP unit is typically governed by the relative conductivity of the ambient water. At low conductivities (15-40 µS/cm) the GPP unit settings are the high voltage range (500-1000 v) at 60-120 Hz and ≈50-100% of the voltage range to produce ≈2-4 A. At sites with higher relative conductivity (>40-100 µS/cm) the same settings at 60-100% of the low voltage range (0-500 v) produce ≈6-12 A. These have been determined to be the most effective unit settings based on visual observations of the comparative effectiveness in stunning all fish species. Lower pulse settings (30 Hz) were much less effective and were deemed unsuitable for meeting the fish assemblage survey objectives. Care is taken routinely to avoid fish mortality and/or injury and all captured fish are examined for visible signs of damage. The selected settings have produced very few, if any visible injuries during the Maine or New England surveys of 2002-19.

An electrofishing boat crew typically consists of three persons, two netters and a boat operator. The primary responsibility of a netter is to capture all fish sighted; the responsibility of a driver is to maneuver the boat or raft so as to provide the netter(s) the best opportunities to capture and land stunned fish (the driver may assist in netting stunned fish that appear near the stern of the boat or raft). The driver also operates the electrofishing unit including the selection of the most effective settings and overseeing safe operations. Each task requires levels of skill and training, but boat maneuvering requires the most experience to gain an adequate proficiency and to ensure safe and effective operation. This latter skill is particularly important in the faster flowing sections of riverine sampling sites. The boat driver also functions as the crew leader who is a skilled professional capable of carrying out and supervising all data collection activities that include fish identification and the accompanying habitat assessment. The netters are usually seasonal technicians with the physical ability to perform all crew member tasks. The netters are clad in chest waders and wear life jackets and rubber gloves; the driver is also clad in chest waders.

Sampling sites are located along the shoreline and in the river channel with the most diverse habitat features in accordance with established methods (Gammon 1973, 1976; Ohio EPA
1989a; Lyons et al. 2001; Yoder et al. 2005) and as applied in the New England Large Rivers project (Yoder et al. 2015). Sites measuring a lineal distance of 1.0 km are positioned to include all habitat subtypes including areas of faster current velocities consisting of swift chutes, runs, and rapids and all major cover types (e.g., large boulders, log cribs, deep runs, bedrock ledges) some of which are positioned away from the shoreline. Boat electrofishing sites are sampled at a fixed distance of 1.0 km as determined by the Maine rivers pilot testing (Yoder et al. 2006). Sites are sampled in a general downstream direction starting at the upstream beginning of a site and ending at the downstream terminus. The electrofishing boat is carefully and systematically maneuvered by motoring or, if necessary, wading and pushing. Riverine sites with a diversity of currents and flow patterns present different challenges than do slower moving impounded or low gradient riverine sites. The boat is maneuvered with, across, and against the current and through different habitats (pools, runs, ledges, woody debris, vegetation beds, etc.) to produce a thorough sampling of a site. Whereas distance is the standard unit of relative abundance (i.e., numbers or biomass per kilometer), the time sampled is an indicator of how thoroughly the sampling is executed and it is recorded by the pulsator unit. Adequately sampling a boat site requires frequent turning, backing, shifting (forward,

Figure 5. The 18’ electrofishing boat used by MBI to sample fish assemblages in the Lower Kennebec River showing the electrofishing booms with the umbrella anode dropper and bow cathode curtain arrays. Location is the midpoint of site KEN 6 at Sevenmile Island.
reverse), and changing speed in areas of moderate to extensive cover and varying current velocities. Sampling sites generally begin immediately upstream of a run habitat and proceed downstream through the local extent of this type of habitat. The boat is periodically and quickly turned into the current to position the netter to capture drifting fish, motoring back upstream with the current off, and re-sampling the same area a second and, if needed, a third time. Sampling along the shallows of a shoreline is also accomplished when returning upstream.

An example of a typical site configuration in the study area appears in Figure 6 which shows the sampling track of the electrofishing boat produced by a GPS unit in the Kennebec River at site KEN 3 at Petty’s Rips near Waterville, ME. Like other free-flowing riverine reaches, a part of each zone included faster flowing run-riffle habitat in addition to slower flowing pool habitat when the former is available. The fixed sampling distance at each site was determined with a GPS unit or laser range finder and is measured by determining the cumulative lineal distance of shoreline. Each site is designated with a unique alpha code (e.g., Kennebec River = “KEN”) and each site with a unique numeric descriptor (e.g., “KEN 1”) in addition to a five digit basin and stream code. A detailed rendering of the sampling track is also recorded on the habitat (QHEI) data sheet in addition to recording and saving the GPS track. This enables the accurate location of sites in the event repeat visits are made by different crews. If the sampling zone is delineated in disjunct subzones, additional demarcations are made. A detailed description of the sampling location should also include the proximity to fixed local landmarks such as a bridge, road, discharge outfall, railroad crossing, park, tributary, dam, etc. Sampling site locations are indexed to UTM coordinates at the beginning, mid-point, and end of each zone. Sites are also delineated by a river mile\(^4\) designation at the center point of a site. The delineation of river miles proceeds in an upstream direction with mile point zero at the head-of-tide for coastal rivers or the confluence with an inland river. Sites located in the tidal zone of a river are depicted as negative values starting at the head-of-tide and proceeding downstream towards the Atlantic Ocean.

Electrofishing is conducted only during “normal” summer-fall water flow and clarity conditions. What constitutes “normal” can vary considerably from region to region, but usually includes benchmarks such as daily median or 80\(^{th}\) percentile low flows as determined by USGS. Generally normal water conditions in the Lower Kennebec River are during below seasonal median river flows. Under these conditions the surface of the water generally has a placid appearance and visibility is >1-2 meters. Abnormally turbid conditions are avoided as are elevated water levels and abnormal current velocities which also raise safety prohibitions. Any of these conditions will adversely affect sampling efficiency and will rule out data applicability for bioassessment purposes. Since the ability of the netter to see and capture stunned fish is crucial, sampling takes place only during such periods of normal water clarity and flow.

Upon capture, fish are immediately placed in an aerated live well for later processing. Trout, salmon, and other comparatively fragile species that can be legally netted are placed in a

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\(^4\) River mileage is the distance in miles upstream from the head-of-tide for coastal rivers and from the mouth for inland tributary rivers tracking distance along the Thalweg of the defined mainstem channel.
separate aerated container and processed first to minimize their holding time. If necessary, fish can be anesthetized to minimize trauma and handling stress, although this practice has been rarely used. All captured fish are processed by enumerating and recording weights by species or by species age class (Yoder et al. 2015). Individual fish weighing less than 1000 grams are weighed to the nearest gram on a spring dial scale (1000 g x 2g) or a 1000 g hand held spring scale. Fish weighing more than 1000 grams are weighed to the nearest 25 grams on a 12 kg spring dial scale (12 kg x 50 g) or 20 kg hand held spring scales. Even larger fish are weighed using a 50 kg hand held spring scale. ESA listed Atlantic Salmon, Shortnose Sturgeon, and Atlantic Sturgeon are not netted, but are identified and their length estimated by sight. In accordance with the Reasonable and Prudent Measures of the applicable ITPs, the electric current is immediately interrupted and not resumed for a period of at least five (5) minutes. Fish weights are derived by estimated length and length/weight relationship data provided by the Maine DMR.

Species that are comprised of two or three distinct size classes of fish (e.g., y-o-y, juveniles, and adults) are processed separately for each class. Species that occur in very large numbers can be
subsampled with a minimum of 15 individuals for large adults and 50 individuals for smaller species and 1+ or 0+ life stages. Most species are distinguished as adults, 1+ (juveniles), or 0+ (young-of-year) in accordance with the criteria in Yoder et al. (2015). These are recorded on the field data sheet by appending an A (adult), B (1+ year), or Y (0+ or young-of-year) to the numeric species code. For example, if both adult and juvenile white suckers occur in the same sample the adult numbers and weights are recorded as family-species code 40-016A with juvenile numbers and weights recorded separately as 40-016B. Although each is listed separately on the fish data sheet they can be treated in the aggregate as a single sample of the same species in any subsequent data analyses or as distinct size class entities. The principal purpose of this differentiation was to increase the accuracy of extrapolations based on subsampling and for potential refinements of IBI guild classifications. The data management programs used by MBI are designed to calculate relative numbers and biomass data based on the input of weighted subsamples. Total lengths may be recorded for important commercial, recreational, and special interest species on an as needed or requested basis. Immature and post-larval fish measuring less than 15-20 mm in length are generally not included in the data recording as a matter of practice following the recommendations of Angermier and Karr (1986). However, specimens may be retained for other purposes. All fish that are weighed, whether done individually, in the aggregate, or as subsamples, are also examined for the presence of gross external anomalies. Light and heavy infestations are noted for certain types of anomalies and follow the guidance in Ohio EPA (1989a, 1996) and Sanders et al. (1999). DELT (deformities, erosions, lesions, and tumors) anomalies are a metric in the Maine IBI and are also used as a diagnostic indicator.

Field data are recorded on water resistant data sheets formatted in the manner that the data is entered into an electronic database (Appendix B). Each of the field crew members are recorded on the field sheet with crew duties listed (crew leader, boat driver, netters) along with site information including the alpha-numeric river-site code, a five digit basin-river code, UTM coordinates, river mile, and sampling date. The crew leader also maintains a field activities log noting all circumstances related to field sampling conduct and safety such as site access, weather, and other relevant observations. All field data sheets are retained indefinitely by MBI and the data are entered into an electronic database named Maine ECOS.

The majority of captured fish are identified to species in the field; however, any uncertainty about the field identification of individual fish requires the retention of voucher specimens for laboratory identification or a voucher photograph. Voucherized fish are preserved in a solution of borax buffered 10% formalin and labeled by date, river name, and site designation. Identification is made to the species level in all cases and follows the nomenclature of the American Fisheries Society (Nelson et al. 2004; Page et al. 2013). The same is true of new river or regional species distribution records. Fish are preserved for later identification in borax buffered 10% formalin and labeled by date, river or stream, and geographic identifier (e.g., river mile). Large specimens (>50-100 mm) usually require visceral incision (lower right abdominal) to permit proper preservation of internal tissues and organs. After an initial fixation period of at least 3-4 weeks, specimens are washed in plain water and then transferred to increasing dilutions of ethyl alcohol (non-denatured) and water (35%, 50%) and ultimately to a final
solution of 70% ethyl alcohol. This process takes approximately 4-5 weeks to complete. Identification is then performed to the species level at a minimum and it may be necessary to the sub-specific level in certain instances. Regional ichthyology keys are used and include the Inland Fishes of Massachusetts (Hartel et al. 2002), Fishes of the Gulf of Maine (Bigelow and Schroeder 1953; Collette and Klein-McPhee 2000), Freshwater Fishes of Canada (Scott and Crossman 1973), Fishes of Vermont (Langdon et al. 2006), and Inland Fishes of New York (Smith 1985). Assistance with the verification of voucher specimens was provided by Dr. David Halliwell, Maine DEP, Karsten Hartel of the Museum of Comparative Zoology, Cambridge, MA, and Marc Kibbey of The Ohio State University Museum of Biodiversity, Columbus, OH. Voucher photographs are also taken to record species occurrences, particularly larger species that are not feasibly preserved and stored. Photographs are maintained by MBI in an archived electronic file on the MBI data server.

A qualitative habitat assessment using an appropriate modification of the Qualitative Habitat Evaluation Index (QHEI; Ohio EPA 1989a; Rankin 1989, 1995; Ohio EPA 2006; Yoder et al. 2006) is completed by the crew leader at each electrofishing site. The QHEI is a physical habitat index designed to provide an empirical, qualitative evaluation of the lotic macrohabitat characteristics that are important to fish assemblages. Comprised of seven categories of aquatic habitat (Appendix B), the QHEI was developed as a rapid assessment tool and in recognition of the constraints associated with the practicalities of conducting a large-scale monitoring program, i.e., the need for a rapid assessment tool that yields meaningful information and which takes advantage of the knowledge and insights of experienced field biologists who are conducting the biological assessments. This index has been used widely outside of its Ohio origins and parallel habitat evaluation techniques that are in widespread existence throughout the U.S. The QHEI incorporates the types and quality substrate, the types and amounts of instream cover, several characteristics of channel morphology, riparian zone extent and quality, bank stability and condition, and pool-run-riffle quality and characteristics. Slope or gradient is also factored into the QHEI score. We followed the guidance and scoring procedures outlined in Ohio EPA (1989a, 2006) and Rankin (1989) with some modifications made during 2002 and 2003 in Maine (Yoder et al. 2006) and for the New England Large Rivers project (Yoder et al. 2015). The QHEI habitat assessment form is completed by the crew leader for each 1.0 km site.

Field chemical/physical measurements are taken in the field during fish sampling and include temperature (°C), dissolved oxygen (D.O., mg/L), relative conductivity (μS/cm), and pH (S.U.) with a YSI 556 meter. The meters are maintained and calibrated in accordance with the project QAPP (MBI 2008). These data are recorded on the fish field sheet (Appendix B).

**Data Management**

MBI developed the Maine ECOS data management system to store, retrieve, and analyze biological and habitat assessment data and information. Fish assemblage and qualitative habitat data are entered via an electronic data entry routine from the field sheets (Appendix B). All data entry codes follow those developed specifically for New England in conformance to the Maine ECOS data management system. Each entered data sheet contains the basin-river code,
date of entry, river mile, and date of sampling. Each entry is checked, initialed, and dated by the
data entry analyst; any subsequent changes that are made to the fish data sheets are also
initialed and dated. All entries are proofread by the data entry analyst and the crew leader for
accuracy. Any corrections or updates are noted and then made in the database. The initialed
and entered data sheets serve as the chain-of-custody for the data collection and management
process. The data sheets along with a data sheet log, site descriptions, QHEI field sheets, maps
of the sampling sites, and any site characterization forms are scanned and retained in
permanent electronic and paper storage files at MBI.

A. Activity dates:
The sampling protocol specifies that riverine fish sampling be conducted within a seasonal
index period of July 1-September 30. However, for the Lower Kennebec River study the end of
the seasonal index period has been extended into October to coincide with the peak of out
migrating river herring, i.e., Alewife and Blueback Herring especially. In most years the first
sampling pass has occurred between late August and mid-September and the second pass in
early to mid-October. Based on recent research and information provided by Dr. Gail
Wippelhauser, Maine DMR, (Wippelhauser et al. 2015; Wippelhauser and Squires 2015; Kynard
and Horgan 2002) sampling will be delayed until after mid-September to better avoid early life
stages and juveniles of Shortnose Sturgeon and also assure that water temperatures are below
the recommended maximum of 22°C for Atlantic Salmon. Each Lower Kennebec River sampling
pass requires 2-3 days to accomplish with up to four sites being sampled in a day. Sampling the
Sebasticook River adds another day to the schedule, but this has been precluded by recurrent
low flows since 2016. Efforts will be made to resume this survey in the future.

B. Location:
The location of the proposed sampling is the 17.5 mile reach of the Lower Kennebec River
between the Lockwood Dam and Hydropower Project in Waterville, ME to the former Edwards
Dam site in Augusta, ME and three (3) sites in a six (6) mile reach of the Sebasticook River
(2008-19) between the Benton Falls Dam and Hydropower Project in Benton Falls, ME to the
mouth at the Kennebec River in Winslow, ME (Table 2). This project has been coordinated with
the NOAA Bangor, ME office per the terms and condition of two Section 7 ITPs since 2011 which
requires advance notification of sampling and the immediate reporting of any takes and for
which MBI has performed accordingly. In addition, a freshwater collecting permit issued by the
Maine Inland Fisheries and Wildlife (IF&W) requires prior notification and coordination of
sampling. We have also coordinated closely with the Maine Department of Environmental
Protection (DEP) and the Maine Department of Marine Resources (DMR) as each agency derives
benefits from this project. We have furnished Maine DEP with fish for tissue analysis and
necropsy exams and Maine DMR receives the data and provides advice about different
diadromous species. Both agencies have supplied personnel to assist with sampling, the Maine
DMR being the most frequent participant in recent years. Non-governmental organizations such
as the Maine office of The Nature Conservancy and local Trout Unlimited chapters have gained
information for their purposes and have provided personnel to assist with the sampling.
Table 2. List of sampling locations in the Lower Kennebec River and Lower Sebasticook Rivers 2002-19 and proposed for 2020-29. Each site is sampled for fish twice during a late summer-early fall seasonal index period. The sites are georeferenced by river mile (distance upstream from the head of tide) and by UTM coordinates at the center of a 1.0 km sampling zone. A basin-stream code identifies the river and a site identification code is assigned to each site in addition to the river mile.

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Basin</th>
<th>Stream</th>
<th>RIVER</th>
<th>RM</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Location Description</th>
</tr>
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<tbody>
<tr>
<td>KEN 1</td>
<td>50</td>
<td>001</td>
<td>Kennebec</td>
<td>17.4</td>
<td>44.545190</td>
<td>-69.627667</td>
<td>Immediately dst. Lockwood Dam &amp; Hydro Project</td>
</tr>
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<td>001</td>
<td>Kennebec</td>
<td>16.7</td>
<td>44.533984</td>
<td>-69.637951</td>
<td>Dst. Sebasticook River</td>
</tr>
<tr>
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<td>001</td>
<td>Kennebec</td>
<td>15.1</td>
<td>44.522228</td>
<td>-69.659059</td>
<td>Petty’s Rips - dst. Waterville WWTP</td>
</tr>
<tr>
<td>KEN 4</td>
<td>50</td>
<td>001</td>
<td>Kennebec</td>
<td>11.0</td>
<td>44.468922</td>
<td>-69.684662</td>
<td>Sixmile Falls</td>
</tr>
<tr>
<td>KEN 5</td>
<td>50</td>
<td>001</td>
<td>Kennebec</td>
<td>9.0</td>
<td>44.442891</td>
<td>-69.697161</td>
<td>Upstream Sidney boat launch</td>
</tr>
<tr>
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<td>001</td>
<td>Kennebec</td>
<td>4.0</td>
<td>44.381757</td>
<td>-69.726756</td>
<td>Sevenmile Island</td>
</tr>
<tr>
<td>KEN 7</td>
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<td>001</td>
<td>Kennebec</td>
<td>0.1</td>
<td>44.324932</td>
<td>-69.768608</td>
<td>Brackets former Edwards Dam site - Augusta</td>
</tr>
<tr>
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<td>100</td>
<td>Sebasticook</td>
<td>5.3</td>
<td>44.574695</td>
<td>-69.558276</td>
<td>Ust. tip of island Dst. Benton Falls Dam</td>
</tr>
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<td>SEB FH2</td>
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<td>100</td>
<td>Sebasticook</td>
<td>3.7</td>
<td>44.557685</td>
<td>-69.574625</td>
<td>Middle site at twin islands</td>
</tr>
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<td>100</td>
<td>Sebasticook</td>
<td>1.8</td>
<td>44.538866</td>
<td>-69.616010</td>
<td>Ust. Fort Halifax Dam site</td>
</tr>
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Figure 7. The Lower Kennebec and Sebasticook River study area showing fish sampling sites with site codes and river miles (see Table 2), major highways, and other landmarks between Waterville and Augusta, ME.
C. Estimate of total level of activity:
The proposed fish sampling activity will take place at seven (7) 1.0 km long sites in 17.5 miles (28.2 km) of the Lower Kennebec River and three (3) 1.0 km long sites in six (6) miles (9.7 km) of the Lower Sebasticook River (Figure 7). With two sampling passes annually at each site this is a cumulative total of 20 km of sampling effort over 37.9 km of river. While this comprises 26.4% of the lineal distance of river, the exposure of the river and its fishes to electrofishing needs to take into account the time of exposure to electric current vs. the time of not being exposed within the range of dates between the first and second passes. This was calculated by taking the number of days between the beginning of the first and end of the second passes which for 2020 would be 26 days between September 15 and October 15 for a total of 21,600 hours. The sampling effort was determined by taking the average time that the electric current is active at a site (4000 seconds or 1.11 hours) times the 20 total km of cumulative sampling distance which is 22.0 total hours. This results in the fishes of the study area being potentially exposed 0.10% of the time. This analysis is inherently one-dimensional and does not take into account the fact that the electric field is only exposing a fraction of the three-dimensional width and depth of each river thus the exposure risk is actually much less than the preceding one-dimensional analysis. The Section 7 Biological Opinion (BiOp) for the 2011-15 and 2015-19 Lower Kennebec projects (NMFS 2011, 2015) in their assessment of the “Action Area” assumed that the electric field occupied an area of 3.5-4.5 meters in width and 2.5-3.5 meters in depth over a length of 1.0 km. The BiOps also concluded that the proposed activity of boat electrofishing would not have any direct or indirect effects to listed species outside of the 1.0 km long sampling sites.

VI. Conservation plan:
Herein we consider the potential impact of the collection method to the three ESA listed fish species that occur in the Lower Kennebec River and Lower Sebasticook River study area. In general, electrofishing can potentially result in mortality and/or injury to any fish species if proper precautions are not followed. A compendium of possible adverse effects of electrofishing was first produced by Snyder (2003). Harmful effects can include spinal injuries, bleeding at the gills or vent, internal hemorrhaging, and excessive physiological stress. However, Snyder (2003) also stated that injuries heal and seldom result in delayed mortality if electrofishing is properly conducted and in consideration of the susceptibility of a particular species to the electric current. Fish handling that is associated with the capture, holding, and processing of electrofishing samples poses a greater risk. Snyder (2003) noted that mortality attributed to electrofishing was caused mostly by asphyxiation which was the result of improper fish holding and handling. The aforementioned fish holding and handling procedures that MBI has followed in the 18 prior years of Lower Kennebec River surveys have resulted in no mortality to ESA listed species. While experimental data specific to the effects of electrofishing on Atlantic and Shortnose Sturgeon are not available, such data are available for other species of sturgeon. Electrofishing injury rates for Shovelnose Sturgeon (Scaphirhynchus platyrhynchus) were documented to be 0% according to Snyder (2003). MBI has previously encountered this species in prior electrofishing surveys of large rivers in the Midwestern U.S. and with no adverse effects observed including from fish handling (weighing, counting). Laboratory studies conducted on juvenile White Sturgeon (Acipenser transmontanus) showed higher injury rates
from pulsed D.C. compared to straight D.C. (68% vs. 10%) with no mortality observed (Holliman and Reynolds 2002). This study concluded that the tetanus response associated with the pulsed D.C. waveform likely resulted in tissue injuries from rapid muscle contractions under direct exposure. However, the authors also observed that such injuries will likely heal over time with the potential effect of diverting energy from other physiological functions such as growth. While the White Sturgeon study documented injury from the pulsed D.C. waveform, we also feel that the exposure to sturgeon in the field is more variable and less intensely sustained than under a controlled laboratory exposure. Add to this the steps already taken to shut down the electric field at a sighting and the risk of injury and latent consequences are further reduced. The other electrofishing waveforms are either unsafe (e.g., A.C.) or not effective for fish assemblage assessment purposes. While no specific electrofishing mortality data is available for Shortnose or Atlantic Sturgeon NOAA recommends that electrofishing not be used for targeted studies of either sturgeon species (Randall et al. 2010). Most targeted research utilizes gill nets to collect Shortnose Sturgeon. Gill net mortality rates for adult Shortnose Sturgeon have been reported to range from 0 to 1.2% (NMFS 2008). As mortality rates from gill nets are expected to be greater than from pulsed D.C. electrofishing for most species of fish, it is reasonable to expect that electrofishing mortality rates during the proposed study will be 0% especially considering that none of the ESA species are being targeted. Studies on other species have shown the mortality rate of electrofishing to be 1-3% for Salmonids (McMichael et al. 1998) with some risk of muscular and/or skeletal injury if conducted improperly.

As was concluded by two previous BiOps (NMFS 2011, 2015) for the same scope as the proposed activity, the conclusion was that while there was the potential for adverse effects to individual fish from electrofishing, it was not likely to jeopardize the continued existence of listed species nor have any adverse effects on their critical habitats. Based on a record of no mortalities in 18 years of systematic application of the electrofishing methodology and the exercise of precautionary measures, the risk of adverse effects has been effectively minimized such that no adverse effects to the respective populations are anticipated.

The trend in encounters has been sporadic for Atlantic Sturgeon and decreasing for Atlantic Salmon due to a declining number of returning adults to the Lower Kennebec River since 2011. The timing of sampling occurring in the late summer and early fall is after when most Atlantic Sturgeon have moved downstream into the Kennebec River estuary below Augusta and are mostly absent from the proposed study area (Wippelhauser et al. 2015, 2017). Still, the risk of future encounters for either species cannot be ruled out. The risk of encountering Shortnose Sturgeon seems to have increased with encounters taking place further upstream than in the earlier years of the 2002-2019 surveys. Still, the encounters have mostly been with single individuals at selected, but not all, locations. Regardless, the risk of encounters and subjecting individual fish to the electric field cannot be ruled out. Therefore, precautionary steps and practices are included in the conservation plan for approval by the NOAA Protected Resources Division.

**Reporting and Training Requirements**
The following reporting and training requirements are proposed:
1) NOAA will be notified at least one week prior to any planned sampling activities. The notification will include a general schedule and inclusive dates of sampling. This will be sent via email and/or phone to the individual contact(s) as specified in the ITP.

2) All MBI and accompanying non-MBI personnel conducting the sampling will have received appropriate training in electrofishing and in the identification of listed species. Each crew member will receive instruction about the procedures to follow when a listed species is encountered at the start of each sampling day.

3) A report of each encounter with an ESA listed species will be filed with NOAA using the ITP form and submittal by email to both the incental.take@noaa.gov and the attending NOAA biologist email addresses within 24 hours. While it is not anticipated to occur, the procedures for dealing with any incidences of mortality on the ITP report form will be followed. An annual report will be filed with NOAA within 90 days after the sampling season has ended and will include the raw fish assemblage data.

Minimization and Avoidance Measures
These are measures that are necessary and appropriate to minimize injury or mortality resulting from an incidental take of an ESA listed species. We believe the following measures are both necessary and appropriate to minimize and monitor impacts of incidental takes for Atlantic Salmon, Shortnose Sturgeon, and Atlantic Sturgeon in the Lower Kennebec River. As such, the following Minimization and Avoidance Measures are proposed for this project moving forward:

1) Sampling will be conducted between mid-September and mid-October to minimize any encounters with ELS or juvenile fish. MBI will also request any recent acoustic detections of ESA listed species in the study area and take steps to avoid any congregations of individual fish.

2) Only trained and qualified MBI crew leaders and either MBI or Maine agency technicians will be allowed to carry out the sampling activities. The MBI crew leader will review the ESA listed species minimization and avoidance with the sampling crew at the beginning of each sampling day. In addition Maine DMR procedures (Bruchs et al. 2016) for electrofishing will be included in the training and instruction.

3) The conduct of sampling and operation of the electrofishing gear will be done in a manner that minimizes the potential for injury or mortality of listed species. The pulse frequency will be reduced to 30-60Hz when sampling in areas of prior capture of ESA listed species to minimize the risk of injury. In areas where ESA listed species are highly unlikely the normal pulse frequency of 120 Hz will be used.

4) The electric current and the sampling activity will cease upon an encounter where a listed species is observed to be affected by the electric field. Affected fish, if immobilized and/or in apparent distress, may be netted or otherwise touched or
handled in order to ascertain any injury and to revive if necessary. Otherwise, affected fish that leave the electric field under their own power and appear to be uninjured will not be pursued and netted. In such cases the species identification and estimation of length will be made visually. For Atlantic Salmon, sampling will not be conducted when ambient water temperature is >22°C per Maine DMR specifications (Bruchs et al. 2016). Temperature will be routinely measured at the start of each electrofishing site, but will be more frequently monitored (every 2 hours) between 20-22°C.

5) In all cases sampling activities will be ceased and the electric current shut off for a period of five (5) minutes and/or until the individual fish are released and determined to have departed the area. Notation will be made about the physical condition of the individual(s) in terms of the reaction to the electric field and if it/they was/were able to leave the area under its/their own power. Photographs will be taken of each species and to document any evidence of injury.

B. Habitat impact:
The impact on critical habitat for ESA listed species will be negligible given the small size and shallow draft of the electrofishing boat/raft. Occasionally, sampling along the shoreline brings either the boat hull or the outboard propeller into contact with the substrate, but this too is negligible given the infrequency of that contact.

C. Impact mitigation:
Other than strictly observing the aforementioned Minimization and Avoidance Measures, no additional mitigation actions are needed to ensure that no adverse impacts occur to the populations of the three ESA listed species in the study area. The observance of the proposed Minimization and Avoidance Measures should be sufficient to avoid harm to ESA listed species.

D. Alternative actions:
Alternative means of sampling the breadth of the freshwater and diadromous fish species assemblages in the study area have long ago been considered as being too resource intensive and cost-ineffective compared to the single gear of boat-mounted pulsed D.C. electrofishing (Zajicek and Wolter 2018). Other active and passive gear types including seining, trap nets, gill nets, and trawling all pose different risks of injury and mortality to ESA listed species, some more so than electrofishing alone. All of the alternative methods of capture would require the direct handling of listed species and an increased risk of injury or mortality that electrofishing does not pose by comparison. The combination of that risk and the comparative inefficiency and ineffectiveness of alternate fish collecting gear types makes boat-mounted pulsed D.C. electrofishing as described herein and by Yoder et al. (2015) as the safest and most effective sampling method available.

Sampling during the late summer and early fall also avoids potential risks to early life stages and juveniles as these life stages of either sturgeon species are not present in the river during that time period. The risk to Atlantic Salmon early life stages is eliminated in that spawning and rearing occurs in tributaries well outside of the proposed study area. The necessity of the late
summer and early fall sampling is further undergirded by the more favorable and stable lower flow conditions that are generally present during this period and the need to sample during the peak of outmigrating river herring in order to better ascertain their relative abundance.

E. Information sources:
Our primary sources of current information for the three ESA listed species are the NOAA Bangor Field and Gloucester Regional Offices and the Maine DMR in Augusta, ME. For the sturgeon species our prior Section 7 NOAA contacts have been Max Tritt (NOAA Orono, ME) and more recently Zachary Jyllka (NOAA Gloucester, MA) each of whom can attest to MBI’s performance over the term of the prior Section 7 ITPs. For local information about both Kennebec River sturgeon species and Atlantic Salmon, DMR Biologists Gail Wippelhauser (Gail.Wippelhauser@maine.gov) and Jason Bartlett (Jason.Bartlett@maine.gov) have been the principal points of contact. Jason Bartlett and other Maine DMR personnel have been regular participants in the sampling and have provided for DMR sampling crew assistance since 2010.

F. Funding Sources
At present the project is funded by MBI research and development funds, but securing outside funding is a continual part of the MBI project process. The discontinuation of funding by U.S. EPA is due to recent budget reductions in that agency, not by a lack of interest in the project. This project at 18 consecutive years is one of the longest running biological monitoring projects in New England and the only sustained effort that focuses on large river fish assemblages that include both freshwater and diadromous species.

VII. MBI ITP Request:
MBI is requesting a 10-year term for an ITP to cover four (4) takes annually for Atlantic Salmon and four (4) takes for Atlantic Sturgeon. For Shortnose Sturgeon the request is for an annual take of five (5) individuals, which is based on our recent experiences in the study area. The recommended Reasonable and Prudent Measures and Terms and Conditions are similar to the most recent Section 7 ITP that applied to this same project because of their adequacy in preventing adverse impacts to the populations of the three ESA listed species. However, additional terms and conditions have been added as a result of the review of the initial application and comments provided by NOAA biologists.

VIII. References:


2016). Maine Department of Marine Resources, Division of Sea Run Fisheries and Habitat, Bangor, ME. 21 pp.


Everhart, W.H. 1966. Fishes of Maine. Maine Department of Inland Fisheries and Game. Augusta, ME.


Appendix A: GARFO Master ESA Tables for Atlantic Sturgeon, Shortnose Sturgeon, and Atlantic Salmon
**General distribution:** Atlantic Ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida; only subadult and adult lifestages occur in marine waters, where they are typically found in waters 5-50 meters in depth (Stein et al. 2004; ASMFC TC 2007); subadults and adults may travel long distances in marine waters, aggregate in both ocean and estuarine areas at certain times of the year, and exhibit seasonal coastal movements in the spring and fall; distribution in rivers and inshore bays typically occurs from the estuary or river mouth generally up to the first impassible barrier (e.g., a dam or falls); Atlantic sturgeon generally use the deepest habitats available to them in rivers, but they have also been collected over shallow (2.5 meters), tidally influenced flats and substrates ranging from mud to sand and mixed rubble and cobble (Savoy and Pacileo 2003)

**Disclaimer:** the best available information on Atlantic sturgeon presence within coastal rivers, estuaries, and bays of the Greater Atlantic Region is presented below; waterbodies highlighted below are ones where we have information specific to Atlantic sturgeon use of the area that would be helpful for action agencies reviewing proposed actions and their potential effects on Atlantic sturgeon; however, they may occur in other watersheds within this range for which we do not currently have specific information; note: individuals from any of the five listed DPSs (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic) may occur in any of the areas identified throughout the species’ range; a description of Atlantic sturgeon life history stages are included at the end of the table below

<table>
<thead>
<tr>
<th>Body of Water (State)</th>
<th>Distribution/Range in Watershed</th>
<th>Life Stages Present</th>
<th>Use of the Watershed</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cobscook Bay/St. Croix River (ME)</td>
<td>Up to the Milltown Dam at Calais, ME (RKM 16)</td>
<td>subadults and adults</td>
<td>Foraging - assumed to occur wherever suitable forage is present[1]</td>
<td>[1] Zydlewski (UMaine) pers. comm., September 21, 2015</td>
</tr>
<tr>
<td>Damariscotta River (ME)</td>
<td>Up to Damariscotta Lake Dam (RKM 30.3)</td>
<td>subadults and adults</td>
<td>Foraging - assumed to occur wherever suitable forage is present; tag detections indicate that usage of the river is for short periods during coastal migrations[1]</td>
<td>[1] Picard and Zydlewski 2014</td>
</tr>
<tr>
<td>Sheepscot River (ME)</td>
<td>Up to the head-of-tide dam (RKM 35)</td>
<td>subadults and adults</td>
<td>Foraging - assumed to occur wherever suitable forage is present; may occur in Montsweag Bay as shortnose sturgeon foraging has been documented there[1]; subadults have been captured in the river[2]</td>
<td>[1] Fried and McCleave 1973; [2] ASSRT 2007</td>
</tr>
<tr>
<td>Kennebec River (ME)</td>
<td>Up to the Lockwood Dam (RKM 102), also includes the entirety of the Back and Sasanoa Rivers</td>
<td>eggs, larvae, YOY, juveniles, subadults, and adults</td>
<td>Spawning - May-August[4]; documented via captures of spawning condition adults and larvae (RKM 52.8-76)[1][4]; potentially occurs as far upstream as the Lockwood Dam in the restored spawning habitat (RKM 87-102)[4] Rearing - ELS have been documented near the spawning grounds[4]; juveniles have also been documented in the river[3] Foraging - assumed to occur wherever suitable forage is present (documented from RKM 0-42)[4]; also documented in the Sasanoa and Back Rivers[2][3]</td>
<td>[1] Wippelhauser 2011; [2] Wippelhauser 2012; [3] Wippelhauser and Squiers 2015; [4] Wippelhauser et al. 2017</td>
</tr>
<tr>
<td>Location</td>
<td>Range in River</td>
<td>Age Classes</td>
<td>Spawning</td>
<td>Foraging</td>
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</table>
| Androscoggin River (ME)        | Up to Brunswick Dam (RKM 8.4) | eggs, larvae, YOY, juveniles, subadults, and adults | **Spawning** - May-August[2]; capture of a ripe male[2] in the summer below the Brunswick Dam (RKM 7.7-8.4)[1] indicates that spawning is likely occurring  
| Presumpscot River (ME)         | Up to Presumpscot Falls (RKM 3) | subadults and adults | **Foraging** - assumed to occur wherever suitable forage is present; an Atlantic sturgeon was caught below Presumpscot Falls[1] | | [1] Yoder et al. 2009 |
| Scarborough River (ME)         | Throughout the entire river | subadults and adults | **Foraging** - assumed to occur wherever suitable forage is present[1] | | [1] Wippelhauser et al. 2017 |
| Saco River (ME)                | Up to Cataract Dam (RKM 10) | juveniles, subadults, and adults | **Foraging** - assumed to occur wherever suitable forage is present[1] | | [1] Novak et al. 2017 |
| Piscataqua River Watershed     | Up to the confluence with the Salmon Falls and Cochecho Rivers (RKM 15) and including Great Bay; Salmon Falls River – up to the Route 4/South Brunswick Dam (RKM 7); Cochecho River – up to the Cochecho Falls Dam (RKM 6) | subadults and adults (eggs, larvae, YOY, and juveniles possible) | **Spawning** - potentially occurs in the Salmon Falls and Cochecho rivers based on the presence of features necessary to support reproduction and recruitment as well as the capture of an adult female Atlantic sturgeon in spawning condition in 1990[1][3]  
**Rearing** - data suggests it is used as a nursery area[3]  
**Foraging** - used seasonally for foraging and resting during spring and fall migrations; tagging data indicates that use by individual sturgeon is limited to days or weeks[2] | | [1] ASSRT 2007; [2] Kieffer and Trefry 2017 pers. comm.; [3] NMFS 2017 |
| Merrimack River (MA)           | Up to the Essex Dam (RKM 46); often found around the lower islands reach (RKM 3-12) and the mouth of the river | subadults and adults (potentially eggs, larvae, YOY, and juveniles) | **Spawning** - potentially occurs due to the presence of features necessary to support reproduction and recruitment[4]  
**Rearing** - data suggests it is used as a nursery area[3]  
<p>| Charles River (MA)             | Up to Charles River Locks (RKM 5.5) | subadults and adults | <strong>Foraging</strong> - assumed to occur wherever suitable forage is present[1] | | [1] Boston.com February 20, 2012 (<a href="http://archive.boston.com/news/science/articles/2012/02/20/from_depths_of_the_charles_an_ancient_species/">http://archive.boston.com/news/science/articles/2012/02/20/from_depths_of_the_charles_an_ancient_species/</a>) |
| North River (MA)               | Up to Dam #1 on the Indian Head Reservoir at Luddam's Ford (RKM 21) | subadults and adults | <strong>Foraging</strong> - assumed to occur wherever suitable forage is present; an adult was found in the North River, 4 miles from the mouth in 2012[1] | | [1] The Patriot Ledger June 1, 2012 (<a href="http://www.patriotledger.com/article/20120601/NEWS/306019786">http://www.patriotledger.com/article/20120601/NEWS/306019786</a>) |
| Narragansett Bay (RI)          | Throughout the bay | subadults and adults | <strong>Foraging</strong> - assumed to occur wherever suitable forage is present[1] | | [1] ASSRT 2007 |</p>
<table>
<thead>
<tr>
<th>Location</th>
<th>Habitat Description</th>
<th>Life Stages</th>
<th>Activities</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long Island Sound (NY/CT)</td>
<td>All of Long Island Sound</td>
<td>Subadults and adults</td>
<td>Foraging - where suitable forage is present; 85% of Atlantic sturgeon caught in Long Island Sound are over mud/transitional bottoms of 27-37 meters deep in the central basin[1]</td>
<td>[1] Savoy and Pacileo 2003</td>
</tr>
<tr>
<td>East River (NY)</td>
<td>Full length of the East River</td>
<td>Subadults and adults</td>
<td>Migration - subadults and adults have been documented using this waterbody to move between the Hudson River and western Long Island Sound[1][2] Foraging - assumed to occur wherever suitable forage is present, but forage is limited[1][2]</td>
<td>[1] Savoy and Pacileo 2003; [2] Tomichek et al. 2014</td>
</tr>
<tr>
<td>River</td>
<td>Habitat Description</td>
<td>Life Stage(s)</td>
<td>Details</td>
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<tr>
<td>Hudson River (NY/NJ)</td>
<td>Up to the Troy Dam (approximately RKM 246)</td>
<td>eggs, larvae, YOY, juveniles, subadults, and adults</td>
<td>Spawning - late April through August[1][6], notably around Hyde Park (RKM 129-135)[4] and Catskill (RKM 182)[2], as well as throughout RKM 113-184[4]; evidence strongly suggests that there is also spawning further upstream of RKM 193[6]; Rearing - larvae and YOY - RKM 60-148[1][3]; remain upstream of the salt wedge[2]; juveniles - RKM 63-140[1][3]; utilize the estuary up through Kingston (RKM 148)[1]; Newburgh and Haverstraw Bays (RKM 55-61) are areas of known juvenile concentrations[5]; Foraging - assumed to occur wherever suitable forage is present; Overwintering - juveniles - RKM 19-74 from fall through winter[1]; some juveniles were recorded in Esopus Meadows (RKM 134)[3]; Spawning - documented and/or potential spawning habitat in April through July from the Marcus Hook Bar to the fall line at Trenton, NJ (RKM 125-211)[2][3][5]; Rearing - YOY/juveniles - Deepwater to Roebling, NJ (RKM 105-199)[4] with most of the detections in the Marcus Hook Area (RKM 127-129)[7]; Foraging - where suitable forage and appropriate habitat conditions are present; Overwintering - juveniles - move between lower (RKM 100-150) and upper (RKM 185-199) tidal areas[8]; may overwinter in tidal fresh water[1];</td>
<td></td>
</tr>
<tr>
<td>Delaware River (NJ/DE/PA)</td>
<td>Up to the fall line near Trenton, NJ (RKM 211)</td>
<td>eggs, larvae, YOY, juveniles, subadults, and adults</td>
<td>Spawning - April-November for adults[5] and subadults[1]; year round for juveniles[2][3]; these lifestages wander among coastal and estuarine habitats[5]; Foraging - typically in areas where suitable forage and appropriate habitat conditions are present; typically tidally influenced flats and mud, sand and mixed cobble substrates[4];</td>
<td></td>
</tr>
<tr>
<td>C&amp;D Canal (DE/MD)</td>
<td>Used at least occasionally to move from Chesapeake Bay to the Delaware River</td>
<td>juveniles, subadults, and adults</td>
<td>Foraging - Assumed to occur in areas with suitable forage[1][2];</td>
<td></td>
</tr>
<tr>
<td>Chesapeake Bay (MD/VA)</td>
<td>Throughout the bay typically in spring through fall</td>
<td>juveniles, subadults, and adults</td>
<td>Migration - April-November for adults[5] and subadults[1]; year round for juveniles[2][3]; these lifestages wander among coastal and estuarine habitats[5]; Foraging - typically in areas where suitable forage and appropriate habitat conditions are present; typically tidally influenced flats and mud, sand and mixed cobble substrates[4];</td>
<td></td>
</tr>
<tr>
<td>Susquehanna River (MD)</td>
<td>Up to the Conowingo Dam (RKM 16)</td>
<td>subadults and adults (potentially eggs, larvae, YOY, and juveniles)</td>
<td>Foraging - where suitable forage and appropriate habitat conditions are present[1];</td>
<td></td>
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</tbody>
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<table>
<thead>
<tr>
<th>River</th>
<th>Range Information</th>
<th>Subadults and Adults (Potentially Eggs, Larvae, YOY, and Juveniles)</th>
<th>Foraging</th>
<th>Spawning</th>
<th>Rearing</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choptank River (MD)</td>
<td>Range not confirmed, but they have been documented in this river (likely up to the dam at RKM 102)</td>
<td>subadults and adults (potentially eggs, larvae, YOY, and juveniles)</td>
<td></td>
<td></td>
<td></td>
<td>[1] The Baltimore Sun June 13, 2007 (<a href="http://articles.baltimoresun.com/2007-06-13/news/0706130110_1_sturgeon-on-chesapeake-bay-university-of-maryland">http://articles.baltimoresun.com/2007-06-13/news/0706130110_1_sturgeon-on-chesapeake-bay-university-of-maryland</a>); [2] ASSRT 2007</td>
</tr>
<tr>
<td>Nanticoke River, including Marshyhope Creek and Broad Creek tributaries (MD)</td>
<td>Range not confirmed, but they have been documented in the Nanticoke River up to the mouth of Broad Creek; they have also been found up to Federalsburg, MD in Marshyhope Creek and up to Laurel, DE in Broad Creek[2]</td>
<td>subadults and adults (potentially eggs, larvae, YOY, and juveniles)</td>
<td>Foraging</td>
<td>Spawning - potential for spawning due to the presence of features necessary to support reproduction and recruitment in one of its tributaries (in Marshyhope Creek, spawn ready adults have been captured)[2]</td>
<td>Rearing</td>
<td>[1] ASSRT 2007; [2] Horne and Stence 2016</td>
</tr>
<tr>
<td>Pocomoke River (MD)</td>
<td>To the limit of tidal influence where Whiton Crossing Road crosses the river</td>
<td>subadults and adults</td>
<td></td>
<td></td>
<td></td>
<td>[1] Horne and Stence 2016</td>
</tr>
<tr>
<td>Rappahannock River (VA)</td>
<td>Range not confirmed, but they have been documented in this river (likely throughout the entire river)</td>
<td>subadults and adults (potentially eggs, larvae, YOY, and juveniles)</td>
<td>Spawning</td>
<td>potentially occurs due to the capture of a male sturgeon in spawning condition in September 2015 and the presence of features necessary to support reproduction and recruitment[1][3]</td>
<td>Rearing</td>
<td>[1] Bushnoe et al. 2005; [2] ASSRT 2007; [3] NMFS 2016</td>
</tr>
</tbody>
</table>

Notes:
- [1] Niklitschek and Secor 2005
<table>
<thead>
<tr>
<th>Location</th>
<th>Range</th>
<th>Egg, Larval, YOY, Juvenile, Subadult, and Adult</th>
<th>Spawning</th>
<th>Staging</th>
<th>Rearing</th>
<th>Foraging</th>
</tr>
</thead>
<tbody>
<tr>
<td>York River, including Mattaponi and Pamunkey River tributaries (VA)</td>
<td>York River - up to confluence with the Mattaponi and Pamunkey Rivers (RKM 55): Pamunkey River - up to RKM 150; Mattaponi River - up to RKM 120</td>
<td>eggs, larvae, YOY, juveniles, subadults, and adults</td>
<td>Spawning - potential for fall spawning due to the presence of features necessary to support reproduction in its tributaries (Mattaponi and Pamunkey Rivers) and recruitment in both the York River and its tributaries[1]; documented in the Pamunkey River through the capture of an adult female sturgeon in post-spawning condition in the fall and the presence of features necessary to support reproduction and recruitment[3]; may occur in the Pamunkey River as far upstream as RKM 150[4].</td>
<td>Staging - likely done by fall spawners, during summer and fall in brackish water before and after the fall spawn (RKM 22-107)[4].</td>
<td>Rearing - in freshwater reaches downstream of spawning sites; four age-0 Atlantic sturgeon were captured in the York River[2].</td>
<td>Foraging - where suitable forage and appropriate habitat conditions are present[1].</td>
</tr>
<tr>
<td>James River (VA)</td>
<td>Up to Boshers Dam (RKM 182.3)</td>
<td>eggs, larvae, YOY, juveniles, subadults, and adults</td>
<td>Spawning - both a spring (likely at RKM 90-95)[4] and fall spawning event (likely between RKM 105 and the fall line near Richmond, VA at RKM 155)[3].</td>
<td>Staging - likely done by fall spawners, during summer and fall in brackish water before and after the fall spawn (RKM 22-107)[4].</td>
<td>Rearing - freshwater reaches downstream of spawning locations[1][2].</td>
<td>Foraging - where suitable forage and appropriate habitat conditions are present[2].</td>
</tr>
<tr>
<td>Appomattox River (VA), tributary of the James River</td>
<td>Range not confirmed, but they have been documented in this river (likely up to Battersea Dam, RKM 21)</td>
<td>subadults and adults</td>
<td>Spawning - both a spring (likely at RKM 90-95)[4] and fall spawning event (likely between RKM 105 and the fall line near Richmond, VA at RKM 155)[3].</td>
<td>Staging - likely done by fall spawners, during summer and fall in brackish water before and after the fall spawn (RKM 22-107)[4].</td>
<td>Rearing - freshwater reaches downstream of spawning locations[1][2].</td>
<td>Foraging - where suitable forage and appropriate habitat conditions are present[2].</td>
</tr>
</tbody>
</table>

**Listing rules:** 77 FR 5880 and 77 FR 5914, February 6, 2012; **Recovery plan:** none published
**General distribution:** Atlantic Ocean waters and associated bays, estuaries, and coastal river systems from Minas Basin, Nova Scotia, Canada, to the St. Johns River, Florida; only adults occur in marine waters, with some adults making coastal migrations between river systems (e.g., Penobscot River to Merrimack River via the Gulf of Maine; Merrimack River to Connecticut River via the Gulf of Maine and Long Island Sound; Connecticut River to Hudson River via Long Island Sound and the East River); typically, distribution in rivers and inshore bays occurs from the estuary or river mouth up to the first impassible barrier (e.g., a dam or falls); comprehensive information on species biology and distribution is available in the Shortnose Sturgeon Status Review Team's Biological Assessment (SSSRT 2010; available at: http://www.nmfs.noaa.gov/pr/pdfs/species/shortnosesturgeon Biological Assessment 2010.pdf)

**Disclaimer:** the best available information on shortnose sturgeon presence within the Greater Atlantic Region is presented below; waterbodies included are ones where we have information specific to shortnose sturgeon use of the area that would be helpful for action agencies reviewing proposed actions and their potential effects on shortnose sturgeon; for waterbodies not listed below, we have no data on usage by shortnose sturgeon; however, we expect the species may be present in other coastal waters in the Gulf of Maine and along the U.S. Atlantic coast between the Merrimack and Hudson Rivers; bracketed footnotes are provided in the table to match up "Use of the Watershed" information to the specific reference(s) from which it came; a description of shortnose sturgeon life history stages are included at the end of the table below

<table>
<thead>
<tr>
<th>Body of Water (State)</th>
<th>Distribution/Range in Watershed</th>
<th>Life Stages Present</th>
<th>Use of the Watershed</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narraganset River (ME)</td>
<td>Up to Cherryfield Dam (RKM 10.6)</td>
<td>adults</td>
<td>Foraging - May be used for foraging; tag detections indicate that usage of the river is for short periods during coastal migrations[1]</td>
<td>[1] Dionne et al. 2013</td>
</tr>
<tr>
<td>St. George River (ME)</td>
<td>Up to RKM 39 in lower estuary</td>
<td>adults</td>
<td>Foraging - May be used for foraging; tag detections indicate that usage of the river is for short periods during coastal migrations[1][2]</td>
<td>[1] Zydlewski et al. 2011; [2] Dionne et al. 2013</td>
</tr>
<tr>
<td>Damariscota River (ME)</td>
<td>Up to Damariscotta Lake Dam (RKM 30.3)</td>
<td>adults</td>
<td>Foraging - May be used for foraging; tag detections indicate that usage of the river is for short periods during coastal migrations[1][2]</td>
<td>[1] Zydlewski et al. 2011; [2] Dionne et al. 2013</td>
</tr>
<tr>
<td>River</td>
<td>Reach Description</td>
<td>Life Stages Reported</td>
<td>Spawning</td>
<td>Rearing</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
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<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>Kennebec River (ME)</td>
<td>Up to Lockwood Dam (RKM 103), also includes Merrymeeting Bay, Sagadahoc Bay, and the entirety of the Back, Sasanoa, Eastern, and Cathance Rivers</td>
<td>eggs, larvae, YOY, juveniles, and adults</td>
<td>Occurs at two sites: below the former Edwards Dam[7] (RKM 58-74) and downstream of the Lockwood Dam[8] (RKM 87-103)</td>
<td>Throughout the lower estuary to the mouth of the river[4][5][8] (below RKM 70) with concentration areas near Bath[3][5][8] (RKM 16-29) including Sagadahoc Bay[6] and the Back and Sasanoa Rivers[1][5][8]</td>
</tr>
<tr>
<td>Androscoggin River (ME)</td>
<td>Up to Brunswick Dam (RKM 8.4)</td>
<td>eggs, larvae, YOY, juveniles, and adults</td>
<td>Occurs at two sites: below the former Edwards Dam[7] (RKM 58-74) and downstream of the Lockwood Dam[8] (RKM 87-103)</td>
<td>Throughout the lower estuary to the mouth of the river[4][5][8] (below RKM 70) with concentration areas near Bath[3][5][8] (RKM 16-29) including Sagadahoc Bay[6] and the Back and Sasanoa Rivers[1][5][8]</td>
</tr>
<tr>
<td>Presumpscot River (ME)</td>
<td>Up to Presumpscot Falls (RKM 4)</td>
<td>adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saco River (ME)</td>
<td>Up to Cataract Dam (RKM 10)</td>
<td>adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piscataqua River (NH)</td>
<td>Entirety of Piscataqua River including Cocheco River from its confluence with Piscataqua River upstream to Cocheco Falls Dam and waters of Salmon Falls River from its confluence with Piscataqua River upstream to the Route 4 Dam</td>
<td>adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Merrimack River (MA)</td>
<td>Up to Essex Dam (RKM 46)</td>
<td>eggs, larvae, YOY, juveniles, and adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Narragansett Bay (RI)</td>
<td>Throughout the bay</td>
<td>adults</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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1. Yoder et al. 2009

1. Little et al. 2013

1. Kieffer and Trefry, pers. comm., April 18, 2017

1. NMFS 1998
<table>
<thead>
<tr>
<th>Location</th>
<th>Range</th>
<th>Status</th>
<th>Foraging</th>
<th>Spawning</th>
<th>Rearing</th>
<th>Overwintering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thames River (CT)</td>
<td>Up to the Greenville Dam (RKM 28)</td>
<td>adults undocumented, but assumed based on documented occurrences of Atlantic sturgeon in the river</td>
<td>Foraging - Assumed to occur where suitable forage is present[1]</td>
<td>Spawning - Below Turners Falls Dam/Cabot Station at two locations depending on river conditions[3] (RKM 193-194); limited spawning may occasionally occur below Holyoke Dam[3] (RKM 139-140)</td>
<td>Rearing - Eggs and larvae spawned upstream documented up to 20 km downstream of the spawning site[3]; if spawning is successful downstream of Holyoke, early life stages would be present in downstream freshwater reaches[1][3] (RKM 13-194)</td>
<td>Overwintering - May be used as an overwintering area potential pre-spawning staging area for adults[1]</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Location</th>
<th>Range Description</th>
<th>Life Stages Present</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housatonic River (CT)</td>
<td>Up to Derby Dam (RKM 23.5)</td>
<td>adults</td>
<td><strong>Spawning</strong> - Historical spawning occurred above the Derby Dam, none known to occur currently[1]&lt;br&gt;<strong>Foraging</strong> - Potentially occurs where suitable forage is present[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[1] Savoy and Benway 2006 in SSSRT 2010</td>
</tr>
<tr>
<td>Long Island Sound (CT/NY)</td>
<td>Full length of Long Island Sound in nearshore coastal waters</td>
<td>adults</td>
<td><strong>Foraging</strong> - Potentially occurs where suitable forage is present[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[1] Savoy 2004 in SSSRT 2010</td>
</tr>
<tr>
<td>East River (NY)</td>
<td>Full length of the East River</td>
<td>transient adults undocumented, but assumed based on detections of Atlantic sturgeon and occasional movements of shortnose sturgeon from Hudson River to Connecticut River</td>
<td><strong>Foraging</strong> - Potentially occurs where suitable forage is present[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[1] Savoy 2004 in SSSRT 2010</td>
</tr>
<tr>
<td>Hudson River (NY/NJ)</td>
<td>Up to Troy Dam, NY (approximately RKM 246)</td>
<td>eggs, larvae, YOY, juveniles, and adults</td>
<td><strong>Spawning</strong> - Documented from late March to early May when water temperatures reach 10° -18°C[1] from Coxsackie to below the Federal Dam at Troy[1][3] (RKM 190-246)&lt;br&gt;<strong>Rearing</strong> - Eggs on the spawning grounds; larvae downstream to at least RKM 104; YOY downstream to at least RKM 64[1]&lt;br&gt;<strong>Foraging</strong> - Throughout the Hudson River[3] (RKM 38-166) with concentrations in Haverstraw Bay[1] (RKM 56-64)&lt;br&gt;<strong>Overwintering</strong> - Late fall to early spring[3]; largest area (mainly spawning adults) near Kingston[2] (RKM 137-149); smaller overwintering areas are located from Saugerties to Hyde Park[2] (RKM 123-170) and in the Croton-Haverstraw Bay area[2] (RKM 54-61); many juveniles overwinter in the lower river[1] (RKM 0-64)</td>
</tr>
<tr>
<td>Location</td>
<td>Spawning</td>
<td>Rearing</td>
<td>Foraging</td>
</tr>
<tr>
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</tr>
<tr>
<td>Delaware River and Bay (NJ/DE/PA)</td>
<td>Documented from late March through late May; water temperatures 6-18°C; between Trenton and Lambertville (RKM 214-238)</td>
<td>Eggs and larvae between Trenton and Lambertville (RKM 214-238); juveniles located upstream of the salt wedge from Wilmington to Philadelphia (RKM 114-148)</td>
<td>- Documented from late March through late May; water temperatures 6-18°C; between Trenton and Lambertville (RKM 214-238)</td>
</tr>
<tr>
<td>Schuylkill River (PA), tributary of the Delaware River</td>
<td>Up to Fairmount Dam (RKM 13.6)</td>
<td>juveniles and adults</td>
<td>Potentially occurs where suitable forage is present</td>
</tr>
<tr>
<td>C&amp;D Canal (DE/MD)</td>
<td>Used at least occasionally to move from Chesapeake Bay to the Delaware River</td>
<td>adults</td>
<td>Assumed to occur in areas with suitable forage</td>
</tr>
<tr>
<td>Chesapeake Bay (MD/VA)</td>
<td>Maryland waters of mainstem bay and tidal tributaries listed below; documented modern use of Virginia waters limited to one individual captured in 2016</td>
<td>adults documented; other life stages assumed but unknown</td>
<td>Assumed to occur in areas with suitable forage</td>
</tr>
<tr>
<td>Susquehanna River (MD)</td>
<td>Up to Conowingo Dam (RKM 16)</td>
<td>adults documented; other life stages assumed but unknown</td>
<td>Historically occurred; currently unknown as suitability of habitat is likely impacted by dam operations</td>
</tr>
</tbody>
</table>


[1] SSSRT 2010

<table>
<thead>
<tr>
<th>River</th>
<th>Location</th>
<th>Life Stages</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potomac River (MD/VA)</td>
<td>Up to Little Falls Dam (RKM 189)</td>
<td>Adult</td>
<td>Spawning - Historically occurred; current spawning not documented but assumed based on presence of pre-spawning females and suitable habitat at RKM 185-187[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other Stages</td>
<td>Rearing - Eggs expected at RKM 185-187, larvae would be present downstream in freshwater[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Foraging - Mainly in the deepwater channel from RKM 63-141[1][2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overwintering - Near Mattawoman Creek; saltwater/freshwater reach near Craney Island[1][2] (RKM 63-141)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rappahannock River (VA)</td>
<td>Range not confirmed, but they have been documented in this river (likely throughout the entire river)</td>
<td>Adult</td>
<td>Foraging - Potentially occurs where suitable forage is present; one was captured in May 1998[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>James River (VA)</td>
<td>Range not confirmed, but likely up to Boshers Dam (RKM 182.3)</td>
<td>Adult</td>
<td>Foraging - Potentially occurs where suitable forage is present; a sturgeon, possibly from the Potomac or Delaware River, was captured on March 13, 2016, in the freshwater portion at RKM 48[1]</td>
</tr>
</tbody>
</table>

**General distribution:** the Gulf of Maine (GOM) DPS of Atlantic salmon includes all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment; the marine range of the GOM DPS extends from the Gulf of Maine, throughout the Northwest Atlantic Ocean, to the coast of Greenland; included in the GOM DPS are all associated conservation hatchery populations used to supplement these natural populations; currently, such conservation hatchery populations are maintained at Green Lake National Fish Hatchery and Craig Brook National Fish Hatchery, both operated by the U.S. Fish and Wildlife Service; excluded from the GOM DPS are landlocked Atlantic salmon and those salmon raised in commercial hatcheries for the aquaculture industry.

**Disclaimer:** the best available information on GOM DPS Atlantic salmon presence within the Greater Atlantic Region is presented below; waterbodies included are ones where we have information specific to GOM DPS Atlantic salmon use of the area that would be helpful for action agencies reviewing proposed actions and their potential effects on Atlantic salmon; for waterbodies in the Gulf of Maine not listed below, we have no data on usage by GOM DPS Atlantic salmon; a description of Atlantic salmon life history stages are included at the end of the table below.

<table>
<thead>
<tr>
<th>Body of Water</th>
<th>Distribution/Range in Watershed</th>
<th>Life Stages Present</th>
<th>Use of the Watershed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narraguagus River</td>
<td>Marine/Estuarine Throughout</td>
<td>Smolts (Juveniles) and Adults</td>
<td>Foraging, Migration</td>
</tr>
<tr>
<td></td>
<td>Freshwater Throughout</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
<td>Spawning - Oct-Dec, Rearing - Year round, Overwintering - Dec-Mar</td>
</tr>
<tr>
<td>Ducktrap River</td>
<td>Marine/Estuarine Throughout</td>
<td>Smolts (Juveniles) and Adults</td>
<td>Foraging, Migration</td>
</tr>
<tr>
<td></td>
<td>Freshwater Up to Dickey Mill Dam (RKM 18) Year round</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
<td>Spawning - Oct-Dec, Rearing - Year round, Overwintering - Dec-Mar</td>
</tr>
<tr>
<td>Dennys River</td>
<td>Marine/Estuarine Throughout</td>
<td>Smolts (Juveniles) and Adults</td>
<td>Foraging, Migration</td>
</tr>
<tr>
<td></td>
<td>Freshwater Throughout</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
<td>Spawning - Oct-Dec, Rearing - Year round, Overwintering - Dec-Mar</td>
</tr>
<tr>
<td>Machias River</td>
<td>Marine/Estuarine Throughout</td>
<td>Smolts (Juveniles) and Adults</td>
<td>Foraging, Migration</td>
</tr>
<tr>
<td></td>
<td>Freshwater Throughout</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
<td>Spawning - Oct-Dec, Rearing - Year round, Overwintering - Dec-Mar</td>
</tr>
</tbody>
</table>
## GARFO Master ESA Species Table - Gulf of Maine DPS of Atlantic Salmon

<table>
<thead>
<tr>
<th>Location</th>
<th>Life Stage</th>
<th>Time Period</th>
<th>Habitat</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>East Machias River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>Throughout</td>
<td>Apr-Nov</td>
<td>Marine/Estuarine</td>
<td>Smolts (Juveniles) and Adults</td>
</tr>
<tr>
<td></td>
<td>Throughout</td>
<td>Year round</td>
<td>Freshwater</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
</tr>
<tr>
<td><strong>Penobscot River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>Up to Medway Dam on western branch; Up to Grand Lake Dam on eastern branch</td>
<td>Year round</td>
<td>Marine/Estuarine</td>
<td>Smolts (Juveniles) and Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Freshwater</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
</tr>
<tr>
<td><strong>St. George River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>Up to Trues Pond Dam</td>
<td>Year round</td>
<td>Marine/Estuarine</td>
<td>Smolts (Juveniles) and Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Freshwater</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
</tr>
<tr>
<td><strong>Medomak River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>Throughout</td>
<td>Apr-Nov</td>
<td>Marine/Estuarine</td>
<td>Smolts (Juveniles) and Adults</td>
</tr>
<tr>
<td></td>
<td>Throughout</td>
<td>Year round</td>
<td>Freshwater</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
</tr>
<tr>
<td><strong>Kennebec River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>Up to Anson Dam</td>
<td>Apr-Nov</td>
<td>Marine/Estuarine</td>
<td>Smolts (Juveniles) and Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Year round</td>
<td>Freshwater</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
</tr>
<tr>
<td><strong>Androscoggin River</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freshwater</td>
<td>Up to Lewiston Falls Dam (32 RKM upstream of Merrymeeting Bay)</td>
<td>Year round</td>
<td>Marine/Estuarine</td>
<td>Smolts (Juveniles) and Adults</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Freshwater</td>
<td>Eggs, Hatchlings (Alevin), Fry, Parr, Smolts (Juveniles), Adults</td>
</tr>
</tbody>
</table>

**Listing rule:** 74 FR 29344, June 19, 2009; **Recovery plan:** NMFS and USFWS 2005; **Additional references:** Fay et al. 2006; 74 FR 29300, June 19, 2009
Appendix B: MBI Field Data Sheets
### Fish Data Sheet

**Field Crew:**

- Crew Leader: 
- Boat Driver: 
- Netsmen: 

**Time of Day:**

**Location:**

**Site Code:**

**Convention: Weight Weighed Collected:**

<table>
<thead>
<tr>
<th>Species</th>
<th># Weighed</th>
<th># Counted</th>
<th>Individual or Batch Weights or Length/Weight</th>
<th>Anomalies</th>
<th>Lunker</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>10x</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>V</td>
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<tr>
<td>V</td>
<td>10x</td>
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</tr>
</tbody>
</table>

**Anomalies:**

- A- anchor worm
- B- black spot
- C- leeches
- D- deformed fins
- E- eroded fins
- F- fungus
- L- lesions
- M- multiple DELT anomalies
- N- blind
- P- parasites
- Y- popeye
- S- emaciated
- W- swirled scales
- T- tumors
- Z- other

**Voltage:**

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Volt. Range</th>
<th>D.O. %sat.</th>
<th>Lat/Long (Beg)</th>
<th>Lat/Long (Mid)</th>
<th>Lat/Long (End)</th>
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**Distance:**

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<tr>
<th>River Code</th>
<th>Sampler Type</th>
<th>Conductivity</th>
<th>Lat/Long (X-Loc)</th>
<th>Lat/Long (Beg)</th>
<th>Lat/Long (End)</th>
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**Temp:**

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<th>Voltage</th>
<th>Temp</th>
<th>Amperage</th>
<th>pH</th>
<th>Lat/Long (Beg)</th>
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**Distance:**

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<tr>
<th>RM</th>
<th>Secchi Depth</th>
<th>Diss. Oxy.</th>
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**Revised 5/2008**

**B-1**
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<tr>
<th>Species</th>
<th># Weighed</th>
<th># Counted</th>
<th>Individual or Batch Weights or Length/Weight</th>
<th>Anomalies</th>
<th>Lunker</th>
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**Qualitative Habitat Evaluation Index Field Sheet**

**QHEI Score:**

**River Code:**

**Site Code:**

**Stream:**

**Project Code:**

**Location:**

**Date:**

**Scorer:**

**Latitude:**

**Longitude:**

1. **SUBSTRATE** (Check ONLY Two Substrate TYPE BOXES; Estimate ¾ percent)
   - **TYPE**
     - **POOL**
       - BLDR/SLS [10]
       - Lg BOULD [10]
       - BOULDER [9]
       - COBBLE [8]
       - HARDPAN [4]
       - MUCK [2]
     - **RIFLE**
       - -GRavel [7]
       - -SAND [6]
       - -BEDROCK [5]
       - -DETRITUS [3]
       - -ARTICIAL [0]
       - -SILT [2]
   - **SUBSTRATE ORIGIN**
     - CHECK ONE (OR 2 & AVERAGE)
   - **SUBSTRATE QUALITY**
     - CHECK ONE (OR 2 & AVERAGE)
   - **NUMBER OF SUBSTRATE TYPES:**
     - 4 or More [2]
     - 3 or Less [0]
     - [High Quality Only, Score 5 or >]
     - -4 or Less [0]
     - -SHALE [-1]
     - -COAL FINES [-2]

2. **INSTREAM COVER** (Give each cover type a score of 0 to 3; see back for instructions)
   - **AMOUNT:**
     - (Check ONLY one or check 2 and AVERAGE)
   - **TYPE: Score All That Occur**
     - UNDERCUT BANKS [5]
     - OXBOCKS, BACKWATERS [2]
     - SHALLOW (IN SLOW WATER) [1]
     - ROOTMATS [1]

3. **CHANNEL MORPHOLOGY** (Check ONLY one PER Category OR check 2 and AVERAGE)
   - **SINUOSITY**
     - [Check 1 or 2 & AVERAGE]
   - **DEVELOPMENT**
     - [Check 1 or 2 & AVERAGE]
   - **CHANNELIZATION**
     - [Check 1 or 2 & AVERAGE]
   - **STABILITY**
     - [Check 1 or 2 & AVERAGE]
   - **MODIFICATIONS / OTHER**
     - [Check 1 or 2 & AVERAGE]

4. **RIPARIAN ZONE AND BANK EROSION** (check ONE box PER bank or check 2 and AVERAGE per bank)
   - **RIparian WIDTH**
   - **BANK EROSION**
   - **CURRENT VELOCITY**
     - (POOLS & RIFFLES)

5. **POOL / GLIDE AND RIFFLE / RUN QUALITY**
   - **MORPHOLOGY**(Check 1 or 2 & AVERAGE)
   - **CURRENT VELOCITY**(POOLS & RIFFLES)
   - **Riffle / Run**

6. **GRADIENT (ft / mi):**
   - **DRAINAGE AREA (sq.mi.):**
   - **% POOL:**
   - **% GLIDE:**
   - **% RIFFLE:**
   - **% RUN:**

---

*Best areas must be large enough to support a population of riffle-obligate species*

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**Check Score from Table 2 of Users Manual based on gradient and channel area.**

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**Max 8**

**Max 10**

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**B-3**