UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
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MAR 17 2008

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RE: ESA Section 7 Formal Consultation for USGS Sea Run Brook Trout Research in Cove Brook, Maine

Dear Dr. Zydlewski:

Enclosed is NOAA's National Marine Fisheries Service (NMFS) biological opinion (Opinion), issued under Section 7(a)(2) of the Endangered Species Act (ESA), concerning research to be carried out by the U.S. Geological Survey (USGS) on sea run brook trout populations in Cove Brook, Maine. This Opinion is based on the USGS's November 21, 2007 Biological Assessment (BA), correspondence between USGS and NMFS, and other sources of information. The Opinion concludes that the proposed sea run brook trout research project in Cove Brook may adversely affect, but is not likely to jeopardize the continued existence of the endangered Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon (*Salmo salar*).

As required by Section 7(b)(4) of the ESA, an incidental take statement (ITS) prepared by NMFS is provided with the Opinion. The ITS exempts the incidental taking of 22 juvenile Atlantic salmon annually (no more than one of which may be lethal) from interactions with the proposed research, while specifying reasonable and prudent measures and implementing terms and conditions necessary to minimize the impact of these activities on Atlantic salmon. This level of take accounts for Atlantic salmon captured, injured or killed during research activities in Cove Brook. This take level was estimated based on the likelihood of the presence of Atlantic salmon in the action area during the time period proposed for the research activities. Monitoring that is required by the ITS will continue to supply information on the level of take resulting from the proposed action. No take of any adult Atlantic salmon is exempted by the ITS.

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. To further reduce adverse effects of the proposed project, NMFS does provide a conservation recommendation for endangered Atlantic salmon. While this recommendation is discretionary, NFMS strongly urges the USGS to carry out this program.

This Opinion concludes consultation for USGS's proposed research project in Cove Brook. Reinitiation of this consultation is required if: (1) the amount of taking specified in the ITS is exceeded; (2) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) project activities are subsequently modified in a manner that causes an effect to the listed species that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified actions.

We look forward to continuing to work cooperatively with your agency to conserve NOAA trust resources in Maine. Please contact Jeff Murphy of my staff at (207) 866-7379 or by e-mail (Jeff.Murphy@noaa.gov) for any questions involving this consultation.

Sincerely,

Patricia A. Kurkul
Regional Administrator

Cc: Collins – GCNE
Colligan, Pruden – F/NER3
Scott - F/NER4
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Dube - MASC

File Code: Sec 7 USGS Research on Brook Trout in Cove Brook, ME
F/NER/2007/07645

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency:	US Geological Survey, Maine Cooperative Fish and Wildlife Research Unit
Activity Considered:	Research on brook trout in Cove Brook, Maine **F/NER/2007/07645**
Conducted by:	National Marine Fisheries Service Northeast Region
Date Issued:	MARCH 17, 2008
Approved by:	

INTRODUCTION

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) on the effects of research proposed by the US Geological Survey (USGS), Maine Cooperative Fish and Wildlife Research Unit, on anadromous brook trout populations in Cove Brook, Maine on threatened and endangered species in accordance with Section 7 of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 et seq.). Cove Brook, which is a tributary of the lower Penobscot River, occurs within the geographic range of the Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon (*Salmo salar*). This Opinion is based on information provided in the USGS' November 21, 2007 consultation initiation package and additional information provided by the USGS. A complete administrative record of this consultation will be kept at the NMFS Northeast Regional Office. Formal consultation was initiated on December 20, 2007.

CONSULTATION HISTORY

October 11, 2007 – USGS initiated informal consultation with NMFS concerning plans to conduct research on brook trout in Cove Brook. NMFS advised USGS that a formal consultation under Section 7 of the ESA would be needed to assess the effects of the project on listed Atlantic salmon.

November 21, 2007 - NMFS received a letter from USGS requesting initiation of formal Section 7 consultation for the proposed brook trout research project in Cove Brook. The November 21, 2007 letter contained a Biological Assessment prepared by USGS concerning the effects of the research project on listed Atlantic salmon. As the submission from USGS contained all of the information necessary to conduct Section 7 consultation, the date that the letter was received

(November 26, 2007) serves as the date of initiation of consultation.

December 20, 2007 – NMFS files a letter with USGS acknowledging that all information required to initiate form Section 7 consultation has been received and formal consultation will be concluded by April 4, 2008.

January 28, 2007 – In an electronic message to NMFS, USGS clarifies that the study period for Cove Brook will be approximately 25 years.

DESCRIPTION OF THE PROPOSED ACTION

USGS proposes a long-term study (~25 years) of anadromous brook trout (*Salvelinus fontinalis*) populations in Cove Brook, a tributary to the lower Penobscot River. Historically, many coastal Maine streams supported anadromous runs of brook trout. Anadromous populations of brook trout appear to have declined precipitously throughout their historic range in Maine. However, the presence or absence of anadromous brook trout is largely unknown for most Maine waters. Cove Brook is known to have historically supported anadromous brook trout. USGS proposes to conduct research in Cove Brook to collect data on anadromous brook trout populations including: presence/absence; abundance; survival rates; recruitment; and movement characteristics.

According to USGS, a number of factors make Cove Brook an ideal study area for the proposed anadromous brook trout study. First, Cove Brook has historically supported anadromous brook trout and current data suggest populations remain today. Secondly, site logistics support the selection of Cove Brook for the study including: 1) proximity to the University of Maine; 2) a manageable size that allows the full width of the system to be monitored with single PIT antennas; 3) cooperative land owners where the proposed PIT installation sites will be located; 4) existing mapping and habitat surveys; and 5) the ability to coordinate with Maine Department of Marine Resources, Bureau of Sea-Run Fisheries and Habitat (MDMR) electrofishing surveys. Lastly, an active watershed council supports the work and has offered to provide volunteers.

Approach
To collect data concerning anadromous brook trout populations in Cove Brook, USGS proposes the following specific activities for the study period:

- Conduct annual basin-wide electrofishing surveys in Cove Brook during spring (March-May) and late-summer (August-September) to collect data on brook trout populations;
- Installation and maintenance of stationary Passive Integrated Transponders (PIT) arrays; and,
- PIT pack surveys at one month intervals annually to track brook trout movements.

Basin-Wide Electrofishing Surveys
Multiple pass electrofishing surveys will be completed throughout the entirety of Cove Brook twice yearly, March-May and August-September. This is estimated to require the activity of three to five individuals wading in the brook using electrofishing equipment to collect brook

trout. Block nets will be set up at 40 m intervals. These areas will be electrofished at least once (but up to three times) to assess fish density. Electrofishing will be applied to maintain power densities sufficient to generate electrotaxis in targeted fish. Minimum settings will be estimated by measuring water conductivity and evaluating behavioral responses of fish prior to changing settings. Efforts to adjust settings will favor low frequency and pulse width. During sampling the anode and cathode will be held as far apart as practical to generate a more diffuse field in order to minimize the risk of injury to fish. Stunned fish will be captured using hand held nets and removed from the field as rapidly as possible. All brook trout captured during electrofishing surveys will be aesthesized, measured (total length), weighed, tagged with a Passive Integrated Transponder (PIT) tag, and released alive. USGS will incorporate appropriate disinfection protocols for all gear that comes in contact with Cove Brook consistent with MDMR guidelines to prevent disease transmission. USGS will also follow MDMR electrofishing and handling protocols to minimize harm to fish.

Passive Integrated Transponders (PIT) Telemetry

Fisheries biologists use various marking techniques to investigate movement patterns, fish growth, and other life history characteristics (Parker et al. 1990). Most of these techniques (e.g., fin clips, freeze branding, coded wire tagging, and paint marks) lack the important feature of individual identification or have a limited longevity (e.g., radio and acoustic tags). PIT tags overcome these obstacles. PIT tags are individually coded, have infinite life, are relatively inexpensive, are easily applied, are well retained and have minimal effects on growth and survival (Gries and Letcher 2002; Zydlewski et al. 2003).

PIT tags consist of a coil of wire wrapped around a ferrite core which generates electricity as it passes through the electromagnetic (EM) field of a matched antenna; this EM field is the power source for the tag. A microchip in the tag is programmed with a unique alphanumeric identification code. Once in the EM field of an antenna, the tag disrupts the field to transmit the code to the transceiver. The code can then be logged to a computer with the time and date of detection. PIT tags to be used in the brook trout study will most likely be Destron-Fearing 134.2 kHz FDX tags.

Field applications of PIT tags have generally relied on physically recapturing tagged fish and placing the fish(tag) next to a hand-held antenna. A tag must be close, typically within 1 m (Gibbons and Andrews 2004, Hill et al. 2005), to an antenna for decoding. Many innovative laboratory (e.g., Obedzinski and Letcher 2004; Zydlewski et al. 2005; Sigourney et al. 2005) and field (Hilderbrand and Kershner 2000; Bell et al. 2001; Letcher et al. 2002) studies have benefited from this technology.

Successes using PIT tags in semi-natural systems have been achieved despite the restriction of tag and antenna proximity. For example, fish passage has been monitored at hydro-electric facilities where fish can be directed through small orifices equipped with antennas (e.g., Castro-Santos et al. 1996; Giorgi et al. 1997, Prentice et al. 1990 a&b). Because constrictions and orifices are known to alter natural behavior (Gowans et al. 1999) similarly-sized constrictions in fully natural systems may limit a biologist's ability to characterize natural movements. There are a few examples of successful field applications of continuous PIT tag monitoring (e.g., Zydlewski et al. 2001; Ibbotson et al. 2004; Zydlewski et al., submitted). Use of a PIT pack (mobile detector; Hill et al., 2006) is an effective method to locate tagged fish within a stream. This equipment, used much like an electrofisher (but without shocking the fish.) has been developed to monitor locations of individual fish within a stream.

USGS proposes to install stationary PIT antenna arrays at up to four sites in Cove Brook, with one being installed low in the system (but above tidal influence) and the rest at upstream locations. Installation of multiple antennas (serially) provides information on whether a detected fish is moving upstream or downstream. The antennas will be constructed as open coil inductor loops with PVC-coated multi-strand wire strung through PVC pipe. Each antenna is connected to a Destron-Fearing reader that emits a 134.2 kHz electromagnetic energizing signal through the antenna. Readers are powered by 12-V deep cycle marine batteries which are replaced with fresh batteries on a weekly basis (or directly powered if available). The readers and batteries are contained within a weather-proof box located outside of the immediate flood zone of the creek.

Pass through antennas will be installed so that the bottom of the antennas are flush with the substrate and therefore do not negatively impact fish passage. Alternatively, antennas can be installed as "pass-by", where the loop is installed flat on the substrate without obstructing fish passage. Either installation will require the activity of several individuals in the stream for less than 1 day to install the antennas. Movement of substrate and walking in the stream represent the extent of disturbance during this process. Maintenance and testing of the antennas will also require walking into the stream on regular intervals (at least weekly).

PIT Pack Surveys

PIT pack surveys will be conducted at one month intervals throughout the year (as conditions allow). This will involve one to two people walking through the entirely of the stream carrying a backpack unit to detect PIT tagged brook trout. Efforts will be taken to minimize disturbance of fish (a necessity of the process) and habitat.

Action Area

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The Action Area for this consultation encompasses the entirely of Cove Brook, from its confluence with the Penobscot River to its head waters. This represents approximately 12 river kilometers.

STATUS OF AFFECTED SPECIES

The Status of the Species section presents biological information relevant to formulating this opinion and documents the effects of all past human and natural activities that have led to the current status of the species throughout its range.

Federally-listed species known to occur in Cove Brook include the GOM DPS of Atlantic salmon. While listed shortnose sturgeon (*Acipenser brevirostrum*) are known to occur in the Penobscot River, due to the lack of suitable habitat in Cove Brook they are not expected to occur in the action area. Therefore, shortnose sturgeon will not be considered further in this consultation.

Gulf of Maine DPS of Atlantic salmon

The GOM DPS of anadromous Atlantic salmon was listed by the USFWS and NMFS (collectively, the Services) as an endangered species on November 17, 2000 (65 FR 69459). The GOM DPS encompasses all naturally reproducing remnant populations of Atlantic salmon downstream of the former Edwards Dam site on the Kennebec River northward to the mouth of the St. Croix River. To date, the Services have determined that these populations are found in the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers, Kenduskeag Stream, and Cove Brook. The GOM DPS includes naturally reproducing Atlantic salmon in the Penobscot River downstream of the former Bangor Dam. The USFWS' GOM DPS river-specific hatchery-reared fish are also included as part of the listed entity. Critical habitat has not been designated for this species.

In the final rule listing the GOM DPS of Atlantic salmon, the Services deferred a determination of inclusion of fish that inhabit the main stem and tributaries of the Penobscot River above the site of the former Bangor Dam (65 FR 69464). The deferred decision reflected a need for further analysis of scientific information, including a detailed genetic characterization of the Penobscot population. In June, 2006, a new status review of additional Atlantic salmon populations, including the upper Penobscot River population, was completed by a Biological Review Team led by NMFS (Faye et al. 2006). Although the 2000 listing of Atlantic salmon did not include populations in the Penobscot River above the former site of the Bangor Dam, the recently completed status review of additional Atlantic salmon populations indicates that the mainstem Penobscot River population of Atlantic salmon are closely related to the GOM DPS (Fay et al. 2006). The BRT also concluded that Atlantic salmon populations in the Kennebec River upstream of the former Edwards Dam and Androscoggin River are also closely related to the GOM DPS. NMFS is currently considering the information presented in the new Status Review and excepts that a proposed rule concerning Atlantic salmon originating from above the former Bangor Dam will be published in the summer of 2008. If ESA protections are proposed for these populations of Atlantic salmon, then USGS may need to reinitiate Section 7 consultation with NMFS.

Atlantic Salmon Life History

The Atlantic salmon is an anadromous fish species that spends most of its adult life in the ocean but returns to freshwater to reproduce. The Atlantic salmon is native to the basin of the North Atlantic Ocean, from the Arctic Circle to Portugal in the eastern Atlantic, from Iceland and southern Greenland, and from the Ungava region of northern Quebec south to the Connecticut River (Scott and Crossman 1973). In the United States, Atlantic salmon historically ranged from Maine south to Long Island Sound. However, the Central New England and Long Island Sound DPSs have been extirpated (65 FR 69459, Nov. 17, 2000).

Adult Atlantic salmon ascend the rivers of New England beginning in the spring and continuing into the fall, with the peak occurring in June. Once an adult salmon enters a river, rising river temperatures and water flows stimulate upstream migration. When a salmon returns to its home river after two years at sea (referred to as 2-sea-winter or 2SW fish), it is approximately 75 cm long and weighs approximately 4.5 kg. A minority (10-20%) of Maine salmon return as smaller fish, or grilse, after only one winter at sea (1SW) and still fewer return as larger 3-sea-winter (3SW) fish. A spawning run of salmon with representation of several age groups ensures some level of genetic exchange among generations. Once in freshwater, adult salmon cease to feed during their up-river migration. Spawning occurs in late October through November.

Approximately 20% of Maine Atlantic salmon return to the sea immediately after spawning, but the majority overwinter in the river until the following spring before leaving (Baum 1997). Upon returning to salt water, the spawned salmon or kelt resumes feeding. If the salmon survives another one or two years at sea, it will return to its home river as a repeat spawner.

The salmon's preferred spawning habitat is coarse gravel or rubble substrate (up to 8.5 cm in diameter) with adequate water circulation to keep the buried eggs well oxygenated (Peterson 1978). Water depth at spawning sites is typically between 30 and 61 cm, and water velocity averages 60 cm per second (Beland 1984). Spawning sites are often located at the downstream end of riffles where water percolates through the gravel or where upwellings of groundwater occur (Danie et al. 1984). Redds, the depressions where eggs are deposited, average 2.4 m long and 1.4 m wide (Baum 1997). An average of 240 eggs is deposited per 100 m^2, or one unit of habitat (Baum 1997). Beland (1984) reported that the total original Atlantic salmon spawning and nursery habitat in Maine rivers was 398,466 units.

In late March or April, the eggs hatch into larval alevins or sac fry. Alevins remain in the redd for about six weeks and are nourished by their yolk sac. Alevins emerge from the gravel about mid-May, generally at night, and begin actively feeding. The survival rate of these fry is affected by stream gradient, overwintering temperatures and water flows, and the level of predation and competition (Bley and Moring 1988).

Within days, the free-swimming fry enter the parr stage. Parr prefer areas with adequate cover (rocks, aquatic vegetation, overhanging streambanks, and woody debris), water depths ranging from approximately 10 to 60 cm, velocities between 30 and 92 cm per second, and temperature near 16°C (Beland 1984). Parr actively defend territories (Allen 1940; Danie et al. 1984; Kalleberg 1958; Mills 1964). Some male parr become sexually mature and can successfully spawn with sea-run adult females. Water temperature (Elliot 1991), parr density (Randall 1982), photoperiod (Lundqvist 1980), the level of competition and predation (Fausch 1988; Hearn 1987), and the food supply, all influence the growth rate of parr. Maine Atlantic salmon produce from five to ten parr per unit of habitat (Baum 1997). Parr feed on larvae of mayflies and stoneflies, chironomids, caddisflies and blackflies, aquatic annelids and mollusks, as well as numerous terrestrial invertebrates that fall into the river (Scott and Crossman 1973).

In a parr's second or third spring, when it has grown to 12.5-15 cm in length, physiological, morphological and behavioral changes occur (Schaffer and Elsòn 1975). This process, called smoltification, prepares the parr for migration to the ocean and life in salt water. In Maine, the majority of parr (80%) remain in fresh water for two years, while the balance remains for three years (Baum 1997). The biochemical and physiological modifications that occur during smoltification prepare the fish for the dramatic change in osmoregulatory needs that comes with the transition from a freshwater to a saltwater habitat (Bley 1987; Farmer et al. 1977; Hoar 1976; Ruggles 1980; USFWS 1989). As smolts migrate from the rivers between April and June, they tend to travel near the water surface, where they must contend with changes in water temperature, pH, dissolved oxygen, pollution levels, and predation. Most smolts in New England rivers enter the sea during May and June to begin their ocean migration. It is estimated that Maine salmon rivers produce 19 fry per unit of habitat, resulting in five to ten parr per unit and ultimately three smolts per unit (Baum 1997).

Atlantic salmon of U.S. origin are highly migratory, undertaking long marine migrations from the mouths of U.S. rivers into the northwest Atlantic Ocean, where they are distributed seasonally over much of the region (Reddin 1985). The marine phase starts with smoltification and subsequent migration through the estuary of the natal river. Upon completion of the physiological transition to salt water, the post-smolt grows rapidly and has been documented to move in small schools loosely aggregated close to the surface (Dutil and Coutu 1988). After entering the nearshore waters of Canada, the U.S. post-smolts become part of a mixture of stocks of Atlantic salmon from various North American streams. Upon entry into the marine environment, post-smolts appear to feed opportunistically, primarily in the neuston (near the surface). Their diet includes invertebrates, amphipods, euphausiids, and fish (Fraser 1987; Hislop and Shelton 1993; Hislop and Youngson 1984; Jutila and Toivonen 1985).

Most of the GOM DPS-origin salmon spend two winters in the ocean before returning to Maine streams for spawning. Aggregations of Atlantic salmon may still occur after the first winter at sea, but most evidence indicates that they travel individually (Reddin 1985). At this stage, Atlantic salmon primarily eat fish, feeding upon capelin, herring, and sand lance (Hansen and Pethon 1985; Reddin 1985; Hislop and Shelton 1993).

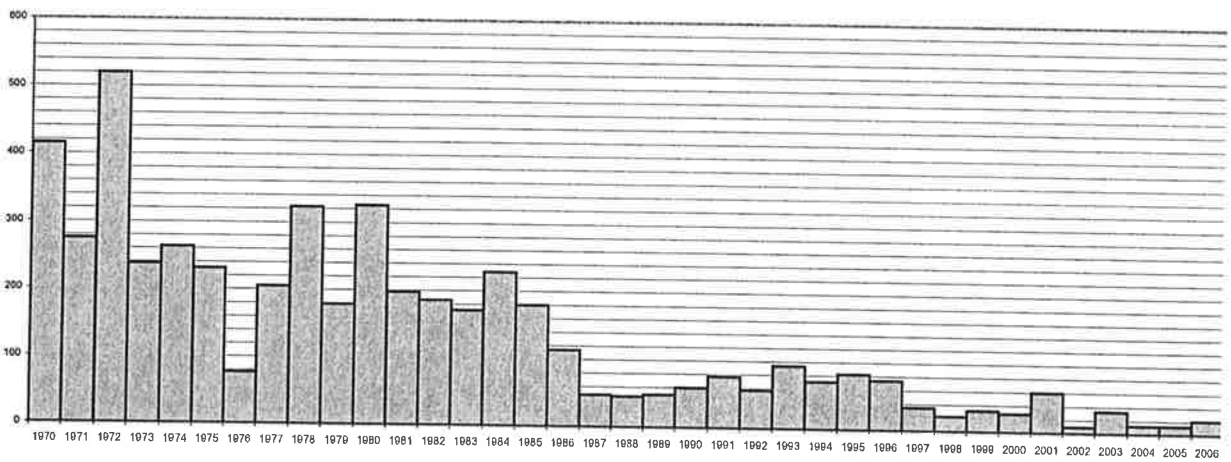
Status and Trends of Atlantic Salmon Rangewide

Anadromous Atlantic salmon were native to nearly every major coastal river north of the Hudson River in New York (Atkins 1874; Kendall 1935). The annual historic Atlantic salmon adult population returning to U.S. rivers has been estimated to be between 300,000 (Stolte 1981) and 500,000 (Beland 1984). The largest historical salmon runs in New England were likely in the Connecticut, Merrimack, Androscoggin, Kennebec, and Penobscot Rivers.

By the early 1800s, Atlantic salmon runs in New England had been severely depleted due to the construction of dams, over fishing, and water pollution, all of which greatly reduced the species' distribution in the southern half of its range. Restoration efforts were initiated in the mid-1800s, but there was little success due to the presence of dams and the inefficiency of early fishways (Stolte 1981). There was a brief period in the late nineteenth century when limited runs were reestablished in the Merrimack and Connecticut Rivers by artificial propagation, but these runs were extirpated by the end of the century (USFWS 1989). By the end of the nineteenth century, three of the five largest salmon populations in New England (in the Connecticut, Merrimack, and Androscoggin Rivers) had been eliminated. As with most anadromous species, Atlantic salmon can exhibit temporal changes in abundance. Angler catch and trapping data from 1970 to 1998 provide the best available composite index of recent adult Atlantic salmon population trends within the GOM DPS rivers. These indices indicate that there was a dramatic decline in the mid-1980s, and that populations have remained at low levels ever since. Figure 4 below demonstrates this trend.

Total documented natural (wild and conservation hatchery) GOM DPS spawner returns for 1995 through 2006 are as follows: 1995 (85); 1996 (82); 1997 (38); 1998 (23); 1999 (32); 2000 (28); 2001 (60); 2002 (16); 2003 (33); 2004 (13); 2005 (13); and 2006 (21) (USASAC 2007). These counts (as well as the counts shown in Figure 1) represent minimal estimates of the wild adult returns, because not all GOM DPS rivers have trapping facilities (e.g., weirs) to document spawner returns in all years. The counts of redds conducted annually by the MDMR demonstrate that salmon do return to those rivers for which no adult counts are possible. Since 2001, scientists have estimated the total number of salmon returning to the GOM DPS with a linear regression model. This estimate is calculated using capture data on GOM DPS rivers with trapping facilities (Dennys, Pleasant, and Narraguagus Rivers), combined with redd count data from the other five GOM DPS rivers. Total return estimates based on these redd counts and trap data are 99 adults in 2001, 33 adults in 2002, 72 adults in 2003, and 82 adults in 2004, 71 adults in 2005, and 79 adults in 2006 (at 90% probability).

Figure 1. Total documented natural (wild and conservation hatchery) spawner returns from USASAC (2005) data (minimal estimates) for the GOM DPS 1970-2004.



Densities of young-of-the-year salmon (0+) and parr (1+ and 2+) generally remain low relative to potential carrying capacity. This depressed juvenile abundance is a direct result of low adult returns in recent years. Survival from the parr to the smolt stage has previously been estimated to range from 35-55% (Baum 1997). Research in the Narraguagus River, however, demonstrated at the 99% probability level that survival was less than 30% (Kocik et al. 1999). Survival from fry to smolt, based on results from hatchery fry stocking, is reported by Bley and Moring (1988) to range from about 1-12%; and survival from egg to smolt stage is reported by Baum (1997) to be approximately 1.25%.

In summary, naturally-producing Atlantic salmon populations in the GOM DPS are at extremely low levels of abundance. This conclusion is based principally on the fact that: 1) spawner abundance is below 10% of the number required to maximize juvenile production; 2) juvenile abundance indices are lower than historical counts; and 3) smolt production is less than one-third of what would be expected based on the amount of habitat available. Counts of adults and redds in all rivers continue to show a downward trend from these already low abundance levels. Given recent estimates of spawner-recruitment dynamics, some researchers suggest that adult populations may not be able to replace themselves, and that populations would be expected to decline further (Beland and Friedland 1997).

Threats to Atlantic Salmon Recovery

The Services listed the GOM DPS as endangered because of the danger of extinction created by inadequate regulation of agricultural water withdrawals, disease, aquaculture, and low marine survival (65 FR 69476, Nov. 17, 2000). At this time, the Services consider the Atlantic salmon an endangered species that is faced with a variety of threats including acidified water and associated aluminum toxicity, Atlantic salmon aquaculture off the coast of Maine, poaching of adults in DPS rivers, incidental capture of adults and parr by recreational fishermen, predation, sedimentation of habitat, depletion of diadromous fish communities, and water withdrawals. The 2006 status review of Atlantic salmon populations in Maine identified obstructed fish passage and degraded habitats caused by dams as one of the greatest impediments to self-sustaining Atlantic salmon populations in Maine (Fay et al. 2006). No single factor can be pinpointed as the cause of the continuing decline of the DPS. Rather, all threats that were key factors in the listing determination, in combination with other recently identified threats, have the potential to adversely affect Atlantic salmon and their habitat. Continued research and assessment is needed to understand the impacts of and interactions among all the threats faced by the DPS. Not all threats are pervasive throughout the DPS rivers, and not all threats would be expected to adversely affect the DPS if populations were stable (e.g., predation and competition). Despite a wide variety of conservation activities already completed or currently in progress, the GOM DPS has not shown any recent signs of population recovery.

GOM DPS of Atlantic salmon in the Action Area

At the time the GOM DPS was listed, the Services determined that Cove Brook supported a population of naturally reproducing Atlantic salmon. Cove Brook is a small tributary to the Penobscot River estuary located approximately 13 miles below the Veazie Dam (head of tide). Cove Brook flows approximately 16.5 km from its headwaters and drains an area approximately 24.6 square km. Based on a habitat surveys conducted by MDMR, Cove Brook contains 166.0 units (one unit = 100 square meters) of juvenile rearing habitat and 7.0 units of adult spawning habitat. Tributaries to Cove Brook have not been extensively mapped by MDMR; however, tributaries are expected to contribute little additional suitable spawning or rearing habitat to the Cove Brook watershed. No active river-specific conservation hatchery program exists for this river; thus, no hatchery Atlantic salmon are stocked in the watershed.

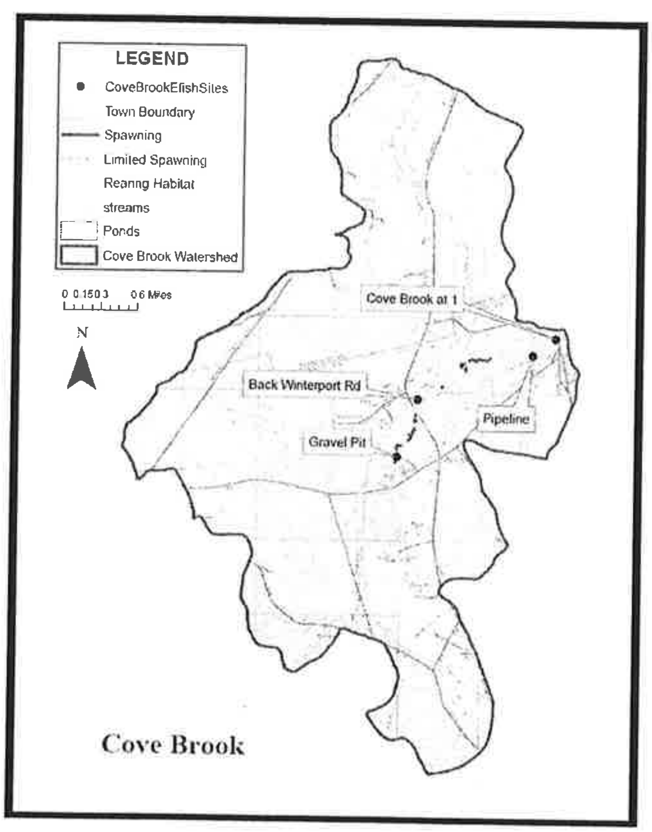
MDMR has conducted baseline monitoring of Atlantic salmon populations in Cove Brook since 1996 (MDMR unpublished data). Currently, the MDMR annually monitors three index sites in July through October on Cove Brook for the presence or absence of Atlantic salmon parr (Figure 2). Table 1 presents a summary of captured Atlantic salmon in Cove Brook during annual electrofishing surveys conducted by the MDMR. Because of the extremely low numbers over the last ten years (Table 1), neither catch-per-unit-effort (CPUE) or densities have been assessed for parr.

Table 1. Summary of captured Atlantic salmon parr in Cove Brook during annual MDMR electrofishing surveys (1997-2006). MDMR unpublished data.

Year	No. Parr Captured
1996	20
1997	20
1998	14
1999	0
2000	0
2001	0
2002	0
2003	0
2004	0
2005	2†
2006	1*
Total	57

†Hatchery-origin salmon * Young-of-year salmon

Figure 2. Map of Cove Brook indicating Atlantic salmon spawning and rearing habitat and index sites annually surveyed by the MDMR.



While at least 57 juvenile salmon have been captured in Cove Brook since 1996, only three have been captured since 2001 (two 1^+parr in 2005, one young-of-year in 2006). For the two fish captured in 2005, one was identified by fin clip marking as being a Penobscot fall parr stocked by the USFWS' Craig Brook National Fish Hatchery (CBNFH) upstream of the former Bangor Dam and both were identifiable as CBNFH hatchery-origin via scale sample analysis (Peter Ruksznis, DMR, personal communication). Because no scale samples were taken from the young-of-year captured in 2006, no conclusion as to origin can be drawn. Based on the available parental broodstock genotypes, genetic parentage was not identified to sea-run Penobscot broodstock spawned at CBNFH for the three juveniles found in Cove Brook in 2005 and 2006. However, genotypes were not available for all sea-run broodstock individuals spawned at CBNFH, so the possibility that these juveniles may have originated from the sea-run Penobscot broodstock could not be completely excluded (Meredith Bartron and Jeff Kalie, USFWS, Northeast Fishery Center, unpublished data). It is also important to note, however, that all three of these captures in 2005 and 2006 were within 100m of the confluence of Cove Brook and the Penobscot River. It is therefore reasonable to hypothesize that these all of these fish were of Penobscot origin since no spawning has been documented in the brook since 2002. Nevertheless, as the origin of the young-of-year fish captured in 2006 can not be conclusively determined, NMFS assumes for purposes of this Opinion that it was a wild, GOM DPS Atlantic salmon.

MDMR also conducts annual redd surveys in Cove Brook. Due to its small size, MDMR redd surveys of the brook provide comprehensive data concerning Atlantic salmon spawning activities. From 1996-2001, MDMR documented low numbers of spawning Atlantic salmon in Cove Brook (less than 1 redd per year). No Atlantic salmon spawning redds have been documented in the brook since 2002.

ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this biological opinion includes the effects of several activities that may affect the survival and recovery of the endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: water quality, scientific research, and fisheries, and recovery activities associated with reducing those impacts.

Effects of Federal Actions that have Undergone Formal or Early Section 7 Consultation

No formal or early consultations have been completed on actions occurring in the action area for this consultation.

Other Potential Sources of Impacts in the Action Area

Non-Federally Regulated Fishery Operations

Unauthorized take of Atlantic salmon is prohibited by the ESA. However, if present, Atlantic salmon juveniles may be taken incidentally in brook trout fisheries by recreational anglers. Cove

Brook falls under general regulations for Maine Department of Inland Fish and Wildlife fishing regulations. Due to a lack of reporting, no information on the number of Atlantic salmon caught and released or killed in recreational fisheries in Cove Brook is available.

Contaminants and Water Quality

Point source and non-point source discharges (i.e., wastewater, agricultural or erosion) could potentially contribute to diminished water quality and sedimentation that impacts Atlantic salmon habitat in Cove Brook. Loss of riparian habitat in the brook from private and commercial development is also likely degrading water quality and habitat in Cove Brook through sedimentation and thermal warming.

Habitat Fragmentation

Improperly designed or maintained road crossings fragment habitat used by Atlantic salmon. Habitat fragmentation prevents Atlantic salmon from accessing necessary habitat for various life stages of the species. While the extent of habitat fragmentation by road crossings in Cove Brook is presently unknown, road crossing surveys conducted in a nearby watershed (Kenduskeag Stream) indicate the problem may be significant (Fay et al. 2006).

Scientific Studies

MDMR has conducted baseline monitoring of Atlantic salmon populations in Cove Brook since 1996 (MDMR unpublished data). Due to its small size, MDMR surveys the brook using a comprehensive electrofishing approach for juveniles. Redd surveys have also been conducted from 1996-2001 which could potentially disturb spawning fish. MDRM is authorized under the USFWS' endangered species blanket permit (No. 697823) to sample listed Atlantics salmon in the GOM DPS. Under blanket permit No. 697823, MDMR is authorized to take up to 2% of any given lifestage of Atlantic salmon during scientific research and recovery efforts (except for adults of which less than 1% can be taken).

Summary and Synthesis of the Status of the Species and Environmental Baseline

Impacts from actions occurring in the Environmental Baseline have the potential to impact Atlantic salmon. Atlantic salmon face multiple threats in Cove Brook including water quality issues, incidental capture by recreational anglers, and habitat fragmentation due to improperly designed or maintained road crossings. The number of listed GOM DPS Atlantic salmon in Cove Brook is very small. Data collected by the MDMR indicates that few if any listed adult Atlantic salmon are returning to Cove Brook. In addition, very few juvenile Atlantic salmon or spawning redds have been documented in the brook since 2002.

Considering Atlantic salmon in Maine typically complete their life cycle in four years, some researchers have suggested that the population of Atlantic salmon in Cove Brook is functionally extinct. At the very least, numbers of Atlantic salmon in Cove Brook are too small to reasonably quantify. Although upper Penobscot River-origin Atlantic salmon originating above the former Bangor Dam occur in the action area for this consultation, the effects of this action on these non-listed Atlantic salmon are not considered within the context of this Opinion (as these fish are not listed under the ESA).

EFFECTS OF THE ACTION

This section of a biological opinion assesses the direct and indirect effects of the proposed action on threatened or endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. This biological opinion examines the likely effects (direct and indirect) of the proposed action on the GOM DPS of Atlantic salmon and its habitat within the context of the species' current status and the environmental baseline.

Electrofishing for anadromous brook trout in Cove Brook could result in the unintentional capture of listed Atlantic salmon. It is likely that non-listed Penobscot-origin Atlantic salmon juveniles will be encountered in the lower part of the brook. It is also probable that wild, Cove Brook origin (i.e., GOM DPS) Atlantic salmon could also be captured during the proposed study. Electrofishing can cause mortality or injury to fish. Handling and anesthesia associated with electrofishing surveys can also cause harm to fish. Snyder (2004), in a review of the effects of electrofishing on fish, notes that electrofishing mortalities are related to asphyxiation are often the result of poor handling. Snyder (2004) also states that injuries heal and seldom result in delayed mortality if electrofishing is conducted carefully.

USGS proposes to perform electrofishing surveys in Cove Brook pursuant to protocols developed specifically by the MASC to minimize injury and mortality to Atlantic salmon. Mortality rates during electrofishing surveys by MDMR in the GOM DPS of Atlantic salmon have annually remained below 1% (MDMR unpublished data). Documented electrofishing mortality of large parr during MASC electrofishing surveys in the Narraguagus has been less than 0.1%. As USGS proposes to implement electrofishing protocols developed by MDMR during electrofishing surveys in Cove Brook, NMFS expected mortality of juvenile Atlantic salmon to be less than 1% of all fish captured. Electrofishing will be done in coordination and cooperation with MDMR so as to eliminate the need for duplicative efforts and to preserve the continuity and quality of Atlantic salmon data being collected.

Based upon Atlantic salmon population surveys conducted in Cove Brook since 1996, few wild Atlantic salmon are expected to be captured by USGS during electrofishing surveys for anadromous brook trout. Since 1999, only one juvenile Atlantic salmon of potentially wild-origin has been documented in the brook. Several Penobscot River-origin salmon parr have been collected in Cove Brook since 1999, however, these salmon are not presently included in the GOM DPS of Atlantic salmon. In 2006, MDMR sampled approximately 15 units of rearing habitat to capture 1 Atlantic salmon young-of-year of possible wild-origin. Using data collected in 2006 to estimate the number of Atlantic salmon likely to be captured during the USGS study, NMFS estimates that up to 11 listed Atlantic salmon could be captured if all units (166) of Cove Brook were sampled by USGS (160 units of habitat could yield 11 juvenile salmon based upon 1 parr/15 units of habitat). As USGS proposes to sample Cove Brook twice annually, NMFS anticipates that not more than 22 juvenile Atlantic salmon would be captured by USGS. Of these fish, no more than 1 fish is expected to be killed during sampling and handling (based upon 1% mortality rate explained above).

As no redds have been observed in Cove Brook since 2002, it is extremely unlikely that any adult Atlantic salmon will be encountered or captured during USGS electrofishing surveys in Cove Brook. However, even if adult Atlantic salmon were present during the surveys, because of their size and the general activities occurring within an area during electrofishing, it is highly unlikely that an adult salmon would be approached closely enough to be shocked by the electrofishing equipment. The only possible effect on adult salmon would be that they would avoid the area being fished. This avoidance behavior is expected to be temporary. As adult salmon are likely to avoid the area being fished, no adult Atlantic salmon are likely to be taken during electrofishing.

The installation of PIT antennas and associated PIT packing surveys are not expected to harm any listed Atlantic salmon in Cove Brook. The installation of PIT antennas will not require any heavy equipment in the brook and actual stream disturbance is expected to be small and short-lived. PIT surveys will require wading in the stream; however, wading activates are also not expected to harm any salmon. The installation of antennas and the PIT packing surveys will have an insignificant effect on salmon.

CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.

Future state and private activities in the action area that are reasonably certain to occur during project operations are recreational fisheries, pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation. Atlantic salmon are also vulnerable to direct and indirect effects from these types of activities.

Impacts to Atlantic salmon from non-federal activities are largely unknown in this river. It is possible that occasional recreational fishing for other fish species may result in incidental takes. There have been no documented takes in the action area, however, there is always the potential for this to occur when fisheries are known to operate in the presence of Atlantic salmon.

In December 1999, the State of Maine adopted regulations prohibiting all angling for sea-run salmon statewide. A limited catch-and-release fall fishery (September 15 to October 15) for Atlantic salmon in the Penobscot River was recently authorized by the MASC for 2006 and 2007. Angling is limited to 150 feet downstream of the Veazie Dam to the Bangor Dam. Considering the low numbers of GOM DPS origin Atlantic salmon in this area of the Penobscot, this fishery is not expected to significantly affect listed Atlantic salmon. Despite strict state and federal regulations, both juvenile and Atlantic salmon remain vulnerable to injury and mortality due to incidental capture by recreational anglers and as bycatch in commercial fisheries. The best available information indicates that Atlantic salmon are still incidentally caught by recreational anglers. Evidence suggests that Atlantic salmon are also targeted by poachers (NMFS 2005). Commercial fisheries for elvers (juvenile eels) and alewives may also capture Atlantic salmon as bycatch. No estimate of the numbers of Atlantic salmon caught incidentally in recreational or commercial fisheries exists.

Atlantic salmon are also vulnerable to impacts from pollution and are also likely to continue to be impacted by water quality impairments

INTEGRATION AND SYNTHESIS OF EFFECTS

Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are still confronted with a variety of threats. Numbers of endangered adult Atlantic salmon returning to the GOM DPS are extremely low, with only 79 adults in 2006, with less than 20 returning annually to the Penobscot system. Based upon the best available scientific information, NMFS has determined that the proposed study will result in the capture of up to 22 juvenile Atlantic salmon annually. Based upon assumptions outlined in this Opinion, the incidental mortality of no more than 1 juvenile Atlantic salmon annually is likely. No adult Atlantic salmon are expected to be injured or killed as a result of the proposed USGS study in Cove Brook.

NMFS believes that the authorization of the proposed action would not reduce the reproduction or distribution of Atlantic salmon in Cove Brook. This action is not likely to reduce reproduction because it is not likely to affect spawning activity and the action will not affect suitable spawning habitat or prevent Atlantic salmon from attempting or completing spawning. It is not likely to reduce distribution because the action will not impede Atlantic salmon from accessing foraging, overwintering or spawning grounds in Cove Brook or the Penobscot River. Nor is it expected that the action would reduce the distribution of Atlantic salmon throughout the GOM DPS.

While the loss of 1 juvenile Atlantic salmon annually for a period of 25 years will have a small effect on the number of Atlantic salmon in Cove Brook, it is not likely that this effect will be detectable at a GOM DPS population level (which includes wild and conservation hatchery juveniles). As described above, an Atlantic salon parr or young-of-the-year has a very low chance of surviving to return to its natal river to spawn. The low amount of mortality resulting from the action considered in this Opinion, combined with the high natural mortality rate experienced by juvenile Atlantic salmon in general, leads to the conclusion that the loss of 1 juvenile Atlantic salmon annually will not have a detectable effect on the species as a whole in terms of survival or recovery.

For these reasons, NMFS believes that there is not likely to be an appreciable reduction in reproduction and distribution and only a small and likely undetectable decrease in the numbers of listed Atlantic salmon in the lower Penobscot River tributaries and the GOM DPS as a whole. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of lower Penobscot River populations or the species as a whole.

CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, it is NMFS' biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon. No critical habitat has been designated for this species, therefore, none will be affected. As explained above, no effects to listed shortnose sturgeon are likely to result from the proposed action.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. NMFS interprets the term "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (50 CFR §222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Amount or Extent of Incidental Take

The proposed research project has the potential to directly affect Atlantic salmon by causing individuals to be captured during electrofishing surveys. Based upon Atlantic salmon abundance data collected by the MDMR in Cove Brook since 1996, NMFS anticipates that up to 22 juvenile Atlantic salmon are likely to be captured annually during this research project and no more than 1 of those annual captures is likely to die a result of capture and handling.

NMFS believes this level of incidental take is reasonable given the seasonal distribution and abundance of Atlantic salmon in the action area. In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to monitor and minimize the unlikely impacts of incidental take of Atlantic salmon:

(1) Personnel electrofishing must have appropriate training in this capture method and be trained in the handling and identification of Atlantic salmon;
(2) Researchers must contact NMFS within 24 hours of any interactions with a listed Atlantic salmon;
(3) Researchers must sufficiently monitor the take of Atlantic salmon;
(4) Encounter of an adult salmon (or redd) in Cove Brook will result in the immediate cessation of activity in the vicinity of the fish.

To implement these reasonable and prudent measures, Terms and Conditions outlining monitoring and reporting requirements are given below. The RPMs, with their implementing terms and conditions, are designed to minimize and monitor incidental take resulting from the research survey.

Terms and Conditions

In order to be exempt from prohibitions of section 9 of the ESA, the researchers must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

(1) To implement RPM #1, personnel shall be trained in Atlantic salmon biology and MDMR electrofishing and handling protocols (Attachment A).

(2) To implement RPM #2, researchers must contact NMFS within 24 hours of any interactions with listed Atlantic salmon, including non-lethal and lethal takes (Jeff Murphy: by email (Jeff.Murphy@noaa.gov) or phone 207-866-7379 or the Endangered Species Coordinator by phone 978-281-9208 or fax 978-281-9394). For purposes of distinguishing listed Atlantic salmon from upper Penobscot River-origin fish (non-listed), endangered fish are identified as bearing no marks (fin clips, PIT tags, VIE marks, etc), have no dorsal erosion, and subsequent genetic testing indicate GOM DPS origin.

(3) To implement RPM #2, a scale(s) sample, weight, and length shall be collected from any Atlantic salmon captured during electrofishing. Salmon scale samples should be retained for subsequent age and genetic analysis to be performed by USGS.

(4) To implement RPM #3, in the event of any lethal take of Atlantic salmon, any dead specimens or body parts must be photographed, and immediately preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS.

(5) To implement RPM #3, annual reports summarizing the results of the project and any takes of listed species must be submitted to NMFS by February 1 of each year by mail (to the attention of the Endangered Species Coordinator, NMFS Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930).

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. Researchers must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS has determined that the research to be funded and carried out by USGS regarding a study on anadromous brook trout populations in Cove Brook is not likely to jeopardize the continued existence of the GOM DPS of Atlantic Salmon. NMFS recommends that the following conservation recommendations be implemented:

(1) If any lethal take occurs, contaminant analysis of the specimen should be conducted. If this recommendation is to be implemented, the fish should be immediately frozen an NMFS should be contacted within 24 hours to provide instructions on shipping and preparation.

REINITIATION OF CONSULTATION

This concludes formal consultation on the research to be funded and carried out by USGS regarding a long-term study on anadromous brook trout in Cove Brook. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

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Attachment A

Maine Atlantic Salmon Commission

Standard Operating Procedure for

Juvenile Atlantic Salmon Sampling by Electrofishing in Wadeable Streams

July 21, 2005

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Introduction

The Maine Atlantic Salmon Commission (MASC) uses electrofishing as its primary tool to capture juvenile Atlantic salmon in their riffle and run habitat in rivers and streams throughout Maine. This protocol is the compilation of MASC biologists' input and support from peer reviewed literature to provide a reference of the specific methods employed by the agency for electrofishing in wadeable streams.

1. Safety

Electrofishing is the use of electricity to capture or control fish (Kolz et al 1998). This process of pulsing electricity through water entails obvious potential risks of injury or death to personnel and animals in the area of sampling. This danger requires that the crew participating in electrofishing events be trained and adequately equipped. Safety for the crew is the primary responsibility of the **crew leader** during any MASC electrofishing sampling event. The entire crew should understand hazards associated with electrofishing before the sampling begins. These hazards include but are not limited to: electrocution, drowning, punctures wounds, electric burns, bone fractures, sprained ligaments, cuts, and scrapes. Crew leaders will be responsible for minimizing the possibility for injuries by ensuring the following[1]:

- Assure that **All** electrofishing team members have read and are familiar with the contents of this SOP.
- Survey crews will consist of a minimum of **2** personnel (preferably 3 or 4).
- At least **one** person on each survey crew will have passed an electrofishing techniques course from the US Fish and Wildlife Service or equivalent. This includes current CPR and AED certification.
- An electrofishing unit safety inspection and maintenance inspection is completed each year prior to any electrofishing event.
- A visual electrofishing unit safety inspection is completed prior to each day's use.
- Assure that crew members are aware of unit operation to avoid contact with water or electrodes during use.
- Assure that crew members alert unit operators of falling or slipping crew so operators can turn off the power to the anode.
- Assure that All crew members understand to yell clearly and loudly "**OFF!!**" to signal the backpack operator to turn off the power to the anode for any reason.
- Stopping electrofishing activities if equipment such as gloves or boots begins to leak until the equipment is replaced or repaired.
- Knowing crewmembers health as it pertains to the ability to participate in electrofishing activities.
- The electrofishing unit power supply is only connected immediately prior to sampling and disconnected immediately after sampling.
- No sampling occurs during heavy rain, extremely high air temperatures, snow, or lightning.

[1]Taken in part from: *SOP For the Sampling of fish in Wadeable Stream Through the Use of Electrofishing*, The Office of Environmental Measurement and Evaluation, EPA New England Region 1.

In addition, Chapter 12 of USFWS *Principles and Techniques of Electrofishing* and Chapter 8.5.1 of *Fisheries Techniques* contain detailed discussions of electrofishing safety and serve as good sources of references for electrofishing safety. MASC staff are encouraged to periodically review these sources to remind the importance of crew safety in the field.

2. Equipment

The following is a list of equipment for MASC electrofishing surveys:

- ☐ Backpack shocking unit outfitted with safety kill switch and quick release frame
- ☐ Anode wand and cathode tail in good working order
- ☐ 2 fully charged batteries for the shocking unit
- ☐ Blocking seines for top and bottom of site (if necessary)
- ☐ GPS set to NAD 1983 with extra batteries
- ☐ Waterproof data sheets
- ☐ Pencils
- ☐ Metric measuring tape
- ☐ Live car and/or sampling buckets
- ☐ Fish measuring board with 1mm precision
- ☐ Electric balance with 0.1g precision
- ☐ Thermometer
- ☐ Calibrated conductivity meter with 1μS precision
- ☐ First Aid kit with bandages, CPR mask, gloves, etc
- ☐ "Other species" taxonomic key
- ☐ Sample jars with 10% Formalin solution for preservation of unknown species
- ☐ Fin clippers or punches (if necessary)
- ☐ Genetic vials with 95% EtOH (if necessary)
- ☐ Insect repellant (keep off hands when handling fish)

Equipment **REQUIRED**for **ALL** crewmembers (should have extras in truck)

- ☐ Rubber gloves
- ☐ Dip net
- ☐ Polarized glasses
- ☐ Hip boots or waders
- ☐ Personal floatation device if sampling deeper water

Equipment Notes: Crews will use backpack type or equivalent electrofishing units maintained per manufacturers instructions. Each crew member will have a dip net constructed with non-conductive handles such as fiberglass with 1/8" - 3/8"mesh bags that are free of rips or tears. The net handles should be long enough to prevent hands from touching the water. All crewmembers will wear rubber hip boots or neoprene waders that are free of leaks and have slip-resistant soles (felt or equivalent). Sampling gear will be disinfected prior to sampling according to the following current MASC protocol:

Field equipment:

All field equipment must be disinfected before use between river systems. Disinfection for most equipment is accomplished with a 2oz. Nolvasan/gallon water solution in the large trashcan. A chlorine bleach solution of 250 ppm may also be used. Equipment that comes in constant contact with stream water, such as waders, dip nets, seines, gloves, live cars, shocker wand and tail, fish boards, etc., should be allowed to set in solution for 10 minutes then rinsed thoroughly. Delicate equipment, such as electronic scales, conductivity meters, thermometers, etc., should be sprayed with alcohol and allowed to air dry. <u>Again, be sure all equipment is rinsed thoroughly</u>! (Dunham 2001)

3. Sampling Procedure

3.1 Pre-Sampling

Before any electrofishing sampling begins, all crewmembers should read and understand the MASC electrofishing protocol. The crew leader should ensure all equipment has been checked per safety guidelines outlined in this document. In addition, the crew leader will determine and clearly outline to the crew the sample objective of the trip. Current MASC electrofishing sampling objectives include juvenile population estimates, broodstock collection, and investigative sampling. Each objective has assumptions and techniques that accompany it and will determine how the data is collected and later analyzed. Trips that violate the necessary conditions for a given objective should be clearly documented on the datasheet for correct data entry and analysis (i.e. botched population estimates due to poor catchability or equipment failure). Once at the site the crew leader will evaluate the safety factors outlined above by:

-Determining if the river flows are safe for the crew and do not limit the ability to complete the sample objective.

- Determining if the weather conditions are safe for the crew and do not limit the ability to complete the sample objective.

- Determining if the crew and equipment are sufficient to follow and complete the sample objective.

- Determining if the water temperature is within the limits accepted by MASC protocols for sampling. (See below)

-Adjusting electrofishing unit settings to allow adequate capture of fish without significant injury or death. (See below)

Temperature limits:

MASC crews will not conduct electrofishing surveys or perform biological sampling of salmon in water temperatures greater than **23°C**. In addition surveys will not be conducted in temperature less than **6°C**. (Unpublished MASC data, MASC staff communication) The temperatures should be used as guidelines set to minimize temperature related handling stress with the final decision of sampling decided by the crew leader

Unit settings:

Crew leaders should adjust settings of the electrofishing unit before each sampling to maximize the capture effectiveness but minimize fish injury or mortality. Typically the MASC samples streams with the backpack Smith –Root Model 12 units set to 400-600V or power and pulse width of 60 Hz. These settings should only be used as guidelines and adjusted as needed according to water conductivity, water temperature, and fish behavior, size, and health. Once appropriate settings are made they should not change during the run or for subsequent runs in order to maintain sampling consistency (unless fish health issues are observed).

3.2 Population Estimate Sampling

Depletion Sampling:

The majority of MASC electrofishing is performed for the purpose of estimating juvenile Atlantic salmon populations in a section of river through multi-run removals. This method assumes:

1. **Changes in population size occur only through capture.** (Carl and Strub 1978)
2. **The probability of capture is equal for all individuals in a population during the removal sequence.** (Carl and Strub 1978)

Assumption 1 maybe addressed by the use of well-anchored blocking seines or major physical habitat barriers (i.e. ledge drop, etc) at up and downstream ends of the site. (Kolz et al 1998) Assumption 2 is more complex to address in electrofishing and involves many factors of fish behavior and sampling procedures. Sites should be rested for 1 hour between runs to reduce avoidance behavior effects (Peterson and Cederholm 1984).) Other areas for consistency would be consistent crew size, sampling pattern, sampling unit, unit operator, and unit settings among runs for a given sample. (Reynolds 1996)

Electrofishing samples will be conducted by sweeping across the current from shoreline to shoreline beginning at the downstream end of the site and moving upstream. Each pass or sweep is parallel to the next with a slight overlap. Passes are made throughout the section until the upper site limit is reached. The complete down to up sampling will be described as a "run". The primary objective of the sampling is age 2+, 1+, and 0+ Atlantic salmon. When targeted fish are collected they should be quickly removed from the site and placed in live cars or buckets with sufficient river water and shade. After the pass is complete all lifestage(s) or species should be enumerated and recorded to determine the necessity of a subsequent run. For juvenile Atlantic salmon population estimates any catch > 2 individuals will warrant a second run. The same procedure should be continued after resting the site for 1 hour. The necessity for subsequent runs is determined by the crew leader based on the counts of targeted species for prior runs. If the run 2 catch for the target lifestage is less than 25% of the first run, the estimate is valid with only two runs. If - additional runs are needed for a valid estimate, the catches of those runs should be less than 50% of the previous run.

Mark-recapture Sampling:

Juvenile salmon population estimates may also be conducted with a mark and recapture method. This method is done by sampling a site and marking all targeted individuals caught, usually with either a fin clip or fin punch. Then the same section is resurveyed (usually a day later) to capture both marked and unmarked individuals. The population estimate is calculated using the proportion of marked to unmarked fish.

Conditions for the use of this method are (from Ricker 1975):

1. The marked fish suffer the same natural mortality as the unmarked
2. The marked fish are as vulnerable to the fishing being carried on as are the unmarked ones.
3. The marked fish do not loose their mark.
4. The marked fish become randomly mixed with unmarked; or the distribution of fishing effort (in subsequent sampling) is proportional to the number of fish present in different parts of the body of water.
5. All marks are recognized and reported on recovery.
6. There is only a negligible amount of recruitment to the catchable population during the time the recoveries are being made.

3.3 Broodstock Collection (Parrathons):

The term "Parrathon" is used to describe the use of electrofishing for the collection of Atlantic salmon parr broodstock. This implies that a given reach was not shocked in its entirety but instead was quickly sampled targeting Atlantic salmon parr. The catches resulting from broodstock collection will not be used in population estimates, unless otherwise noted. The need for biological sampling should be predetermined prior to broodstock collection.

3.4 Investigative Sampling:

Investigative electrofishing or "poke" refers to sampling for the general presence or absence of Atlantic salmon juveniles and/or other species. These trips should have more detail given to physical habitat characteristics as well as total species composition. These trips are usually 1 run, and area sampled is measured or estimated. Data is typically not used for population estimates.

4. Biological Data:

At the completion of all electrofishing runs, fish should be sampled as necessary for the sample objective. Fish should be measured and weighed under anesthetization of clove oil (5% Clove oil in 70% ethanol; currently acquired via MIFW Fish Health Laboratory, Augusta, Maine contact: Dr. Russell Danner.) to reduce handling associated stress (Iversen et al 2003). Clove oil in a 3ml to 1 gal water concentration is generally acceptable for quick anesthetizing and minimum recovery time. Atlantic salmon have been found to react slower to clove oil in colder water temperatures (Hoskonen and Pirhonen 2004, MASC staff communication). Water temperature influences the efficiency of clove oil where cooler temperatures require slightly higher dosages of clove oil. Based on the model presented by Hoskonen and Pirhonen (2004); 3ml/gal at 15-22°C, 4ml/gal at 10-14°C, and 5ml/gal at <10°C induce fish to "workable" levels of anesthesia in 2-3 minutes with a 6-10 minute recovery time. Mortality has been documented for salmonids exposed to clove oil for extended periods (~1 hour) in the above dosages. Care should be taken to minimize the amount of fish handling and time kept in anesthetic. At the conclusion of sampling individuals should be allowed to recover to normal swimming prior to being released back into to the study site.

The following is a list of fields collected as part of each MASC electrofishing event with a brief description of methods and uses. Field names (in bold) are found on the MASC electrofishing datasheet (Appendix A).

Trip Data:

Sample Objective: objective of electrofishing trip, declared in order to validate use of data such as for population estimates. Categories are: Population Estimate, Parrathon, Poke (see definitions above).
Date (or Recapture date): Month/Day/Year of trip for purposes of temporal comparisons of data.
Drainage: "Maine Salmon" accepted name of drainage to spatially group data in analysis.
Stream Name: "Maine Salmon" accepted name to spatially group data in analysis.
Site Name and/or Code: "Maine Salmon" accepted name to spatially group data in analysis and allow for correct entry into geo-referenced database.
UTM Northing and Easting in North American Datum 1983 (NAD 83): GPS point taken at the most downstream point of sampling. Used to order to spatially group data in analysis and allow for correct entry into geo-referenced database.
Crew: Crew members participating in sampling event
Equipment Used: Equipment used for sampling such as: Backpack, 2 backpacks, or boat.
Backpack type: Type of backpack unit used (i.e. Smith Root Model 12)
Voltage: Voltage as recorded from unit settings.
Cycles: Cycles as recorded from unit settings.
Other Setting: Other settings used by different unit models (i.e. percentage)
Run Times (seconds): Number of seconds per run as recorded from unit. Used to quantify sampling effort between runs and/or for Catch per Unit Effort estimates.
Section Length: Total length taken in meters (0.1m accuracy) from the bottom of the section to the top. Used in area calculations and to confirm index site dimensions.
Section Widths: Stream wetted widths are taken in meters (0.1m accuracy) at least at the top and bottom of the site but also intermediately in the site to better describe the average area of the site. Used in area calculations.
Conductivity: Taken with calibrated, handheld conductivity meter. Used for estimating unit settings (higher conductivity may require lower voltage vice versa)
Water Temperature Start: Taken in °C with hand held thermometer. Used to determine risk to fish health due to electrofishing (see temperature guidelines above).
Water Temperature End: Taken in °C with hand held thermometer. Used to determine risk to fish health due to biological sampling (see temperature guidelines above).
Run catches: Total number of fish caught by life stage **on each run.**
 # Scale samples: Total number of samples taken during trip, used for record keeping /reporting.
 # Broodstock taken: Total number of broodstock taken as a result of trip, used for record

keeping/reporting.
 # DOA: Total number of individuals killed as a result of sampling, enumerated by lifestage. Used for record keeping /reporting.
 # Genetics: Total number of genetic samples taken for trip, used for record keeping /reporting.
Trip comments: Brief narrative used to describe: data and/or sampling anomalies, site characteristics, substrate, lifestage suitability, visibility, weather, and other data useful for subsequent sampling events at the site.

Fish Data:

Salmon Data * (for each individual segregated by lifestage)

Fork Length: Taken from anterior most point of individual to the caudal fork and recorded in millimeters.
Weight / Batch weight: Taken with as little water weight as possible and measured to 0.1 grams.
Scales: Taken from the fish's right side between the dorsal fin and lateral line.
Genetics: Sample clipped or punched from a fin and stored in 95%EtOH.
Marks/Tags: Record all fin clips, punches, and/or tag details observed or applied for each individual.
Disposition: Record if not released to river (i.e. DOA or Broodstock).

Other Species Data***

Species Name: MaineSalmon code or full name of species being enumerated.
Count (run 1 and multiple): Count of other species; run 1 counts for all species for relative abundance, and counts by run for Trout, Bass, and Pickerel.**
Length/weight: ** Taken in same precision and methods as salmon data. Required only for Trout, Bass, and Pickerel.
Scales: **Taken in same precision and methods as salmon data. Required only for Trout, Bass, and Pickerel.

*** Salmon will only be sampled in accordance with specific study designs.**
**** Other species Counts, and biological data will be collected in accordance with specific study designs.**
*** See Appendix B for partial other species key

Crew leaders will verify that <u>ALL</u> data fields are correctly filled out prior to leaving the site!!!!

5. Data Responsibilities and Timelines:

Data sheets will be filed in the respective field offices as soon as possible after the sampling event.

Data will be entered and sheet by sheet audited to verify the integrity of the entry by **trained** personnel in accordance with MASC Electrofishing Database Manual by December 1 each field season.

Audited data will be forwarded to the Electrofishing Database Steward by: December 1 each field season.

Literature Cited:

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Seber, G.A.F., and E.D. LeCren. 1967. Estimating population parameters from catches large relative to the population. Journal of Animal Ecology 36: 631-643.

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Appendix A: Sample ASC Field Data sheet (side 1)

Maine Atlantic Salmon Commission Electrofishing Data

Date:		Drainage		Site Name	
Date 2:		Stream		UTM North	
Crew		Site Code		UTM East	19

Sample Obj: Pop. Est - Parrathon - Poke - Petersen

BGEST: YES / NO

Equipment: Backpack - 2 Backpacks - Boat

Take UTM's in NAD 1983

Section Length:		Backpack type		Conductivity (uS)		# Runs	
Top Width:		Voltage		Water Temperature °C		# Gen.	
Mid Width:		Cycles		Start		# Scales	
Bottom Width:		Other Settings		End		# BS	

Catches	Time	ATS YOY	ATS Parr	Other Species								
Run 1												
Run 2												
Run 3												
Run 4												
Run 5												
DOA												

ATS YOY Data

Fish #	Scales	DOA?	F. Length	Weight	Vial #	Fish #	Scales	DOA?	F. Length	Weight	Vial #	Fish #	Scales	DOA?	F. Length	Weight	Vial #
1						11						21					
2						12						22					
3						13						23					
4						14						24					
5						15						25					
6						16						26					
7						17						27					
8						18						28					
9						19						29					
10						20						30					
Batch WT.						Batch WT:						Batch WT:					

ATS Parr Data

Fish #	Scales	DOA?	F. Length	Weight	Vial #	Fish #	Scales	DOA?	F. Length	Weight	Vial #	Fish #	Scales	DOA?	F. Length	Weight	Vial #
1						11						21					
2						12						22					
3						13						23					
4						14						24					
5						15						25					
6						16						26					
7						17						27					
8						18						28					
9						19						29					
10						20						30					

Trip Comments (may continue on back):

Other species data on back

FILL OUT ALL FIELDS BEFORE LEAVING!!!!!

Appendix A: Sample ASC Field Data sheet (side 2)

Other Species Data

Fish #	Species	Scales	Length (mm)	Weight (g)	Comments: (DOA?)

Fish #	Species	Scales

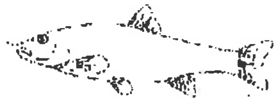
Additional Trip Comments:

Appendix B: Example for Field Other Species Key (Everhart 1976)

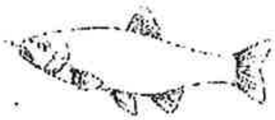
MINNOW FAMILY (Cyprinidae)

Key to the various members of the minnow family, found in Maine

1 Upper lip connected with the skin of snout by a bridge of tissue across which the premaxillary groove does not pass 4



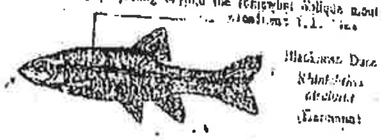
Upper lip separated from skin of snout by the deep premaxillary groove continuous across the midline 3



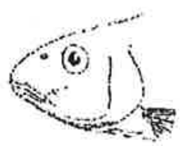
2 Snout projecting far beyond the horizontal mouth

Longnose Dace
Rhinichthys cataractae (Valenciennes)

Snout scarcely projecting beyond the somewhat oblique mouth



3 Maxillary with a barbel; the barbel is small and often hidden in the groove above the upper jaw. Care must be taken if the barbel is to be observed, and it may be necessary to pull out the upper jaw a little 4



Maxillary without a barbel . . . .

4 Barbel slender and at, or near, the end of the maxillary

Lake Chub
Hybopsis plumbea (Agassiz)

Barbel often flaplike and inconspicuous and located on the lower edge of the maxillary well in advance of the posterior end, usually concealed in the groove between the maxillary and premaxillary 5

5. Dorsal fin beginning over base of ventral fins; scales large, 45 in lateral line; silvery

Fallfish
Semotilus corporalis (Mitchill)

Dorsal fin beginning just behind base of ventral fins; scales smaller, about 56 in lateral line 6

6. Black spot on dorsal fin near front of base, indistinct in young; mouth large, upper jaw extending at least to below front of eye; sides not mottled by specialized dark scales; scales in lateral line fewer than 60

Creek Chub
Semotilus atromaculatus (Mitchill)

No black spot on dorsal fin; mouth small, upper jaw not extending to below front of eye; sides mottled by specialized dark scales; scales in lateral line about 65 to 75

Pearl Dace
Semotilus margarita (Cope)

7. Lateral line scales more than 60 8
Lateral line scales less than 60 10

8. Lateral line incomplete; more than 80 scales in lateral line

Finescale Dace
Chrosomus neogaeus (Cope)

Lateral line complete; scales fewer than 80 in lateral line . . . 9

9 Body with a single dusky lateral band; intestine short with a single main loop, and less than twice as long as the body

Pearl Dace
Semotilus margarita (Cope)

Body with two black lateral bands; intestine elongate, with two crosswise coils in addition to the primary loop, and more than twice as long as the body

Northern Redbelly Dace
Chrosomus eos (Cope)

61

Lateral line much decurved; anal fin curved like a sickle; abdomen behind ventral fins with a scaleless fleshy keel

Golden Shiner
Notemigonus crysoleucas (Mitchill)

Lateral line not greatly decurved; anal fin not sickle shaped; abdomen behind ventral fins rounded and scaled . . . 11

11 First dorsal ray more or less thickened, separated by membrane from first well-developed ray, and with a thicker coating of adipose tissue; a dark spot, faint in young and some females, at front of dorsal fin near, but not at, base; head bluish (these characters conspicuous only in adults)

Fathead Minnow
Pimephales promelas Rafinesque

First dorsal ray a thin splint closely attached to first well developed ray, and with a thinner covering of adipose tissue; no dark spot at front of dorsal near base; back flat, flattened . . 12

12 Anal rays 9 to 12, rarely 8

Common Shiner
Notropis cornutus (Mitchill)

Anal rays 7 or 8, rarely 9 13

13. Anal rays typically 8; fins smaller; length of depressed dorsal about 1.5 in distance from occiput to dorsal; dorsal usually inserted nearer base of caudal than tip of snout, and distinctly behind the ventral insertion; predorsal scales rather irregularly arranged and from 13 to 22 in number

Blacknose Shiner
Notropis heterolepis Eigenmann and Eigenmann

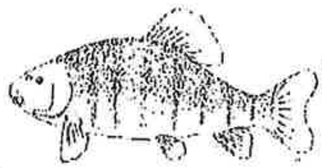
Anal rays typically 7; fins larger; length of depressed dorsal about 1.7 in distance from occiput to dorsal; dorsal usually inserted nearer tip of snout than base of caudal, and distinctly over or before ventral insertion; predorsal scales rather regularly arranged and usually 14 or 15 in number

Bridled Shiner
Notropis bifrenatus (Cope)

Appendix B *Continued:*

In the three members of the sucker family found in Maine:

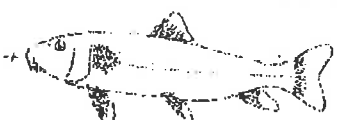
1 Lateral line absent; body oblong; mouth subinferior; color pattern of dusky, narrow vertical bars in adult



Creek Chubsucker
Erimyzon oblongus
(Mitchill)
p. 53

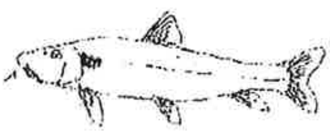
Lateral line present; body round; mouth inferior and definitely ventral; dusky, narrow vertical bars absent 2

Scales large less than 80 in the lateral line; snout not pointed



White Sucker
Catostomus commersoni
(Lacépède)
p. 59

Scales small, more than 80 in the lateral line, snout pointed, extending considerably beyond the mouth



Longnose Sucker
Catostomus catostomus
(Forster)
p. 60

SUNFISH FAMILY (Centrarchidae)

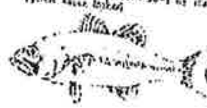
[illegible]

[illegible] . . . 3

[illegible]

Smallmouth Bass
Micropterus dolomieui
Lacépède
p. 81

[illegible]



Largemouth Bass
Micropterus salmoides
Lacépède
p. 83

[illegible]

Black Crappie
Pomoxis nigromaculatus
(Lesueur)
p. [illegible]

[illegible]

5. [illegible]

Redbreast Sunfish
Lepomis auritus
(Linnaeus)
p. [illegible]

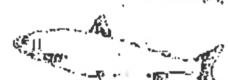
[illegible]

Pumpkinseed
Lepomis gibbosus
(Linnaeus)
p. [illegible]

WHITEFISH FAMILY (Coregonidae)

[illegible]

1 [illegible]



Round Whitefish
Prosopium cylindraceum
(Pallas)
p. [illegible]

[illegible]

Lake Whitefish
Coregonus clupeaformis
(Mitchill)

Appendix C: MSAD Sheet Emergency and First Aid information for chemicals used in electrofishing biological sampling. (Complete sheets on file at each ASC office). Sheets downloaded from: https://fscimage.fishersci.com/msds/ via http://hazard.com/msds/index.php (search engine).

Material Safety Data Sheet
Clove Oil

ACC# 05214

Section 1 - Chemical Product and Company Identification

MSDS Name Clove Oil
Catalog Numbers: S79970, S79961
Synonyms: Oil of clove
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call 703-527-3887

EMERGENCY OVERVIEW

Appearance: colorless to light yellow liquid
Caution! May cause eye and skin irritation. May cause respiratory and digestive tract irritation.
Target Organs: None.

Potential Health Effects
Eye: May cause eye irritation
Skin: May cause skin irritation.
Ingestion: May cause irritation of the digestive tract.
Inhalation: May cause respiratory tract irritation.
Chronic: No information found.

Section 4 - First Aid Measures

Eyes. Flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids Get medical aid
Skin: Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes Get medical aid if irritation develops or persists
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person Get medical aid
Inhalation: Remove from exposure and move to fresh air immediately Get medical aid if cough or other symptoms appear
Notes to Physician: Treat symptomatically and supportively.
Antidote: None reported.

Material Safety Data Sheet
Ethyl Alcohol, 70%

ACC# 91791

Section 1 - Chemical Product and Company Identification

MSDS Name: Ethyl Alcohol, 70%
Catalog Numbers: S75119, S75120, S556CA4
Synonyms: Ethyl Alcohol; Ethyl Hydrate, Ethyl Hydroxide, Fermentation Alcohol; Grain Alcohol. Methylcarbinol. Molasses Alcohol, Spirits of Wine
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
64-17-5	Ethyl alcohol	70	200-578-6
7732-18-5	Water	30	231-791-2

Hazard Symbols: F
Risk Phrases: 11

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: colorless clear liquid. Flash Point: 16.6 deg C. **Flammable liquid and vapor.** May cause central nervous system depression. Causes severe eye irritation Causes respiratory tract irritation. Causes moderate skin irritation. This substance has caused adverse reproductive and fetal effects in humans. **Warning!** May cause liver, kidney and heart damage.
Target Organs: Kidneys, heart, central nervous system, liver.

Potential Health Effects
Eye: Causes severe eye irritation. May cause painful sensitization to light May cause chemical conjunctivitis and corneal damage
Skin: Causes moderate skin irritation May cause cyanosis of the extremities.
Ingestion: May cause gastrointestinal irritation with nausea, vomiting and diarrhea May cause systemic toxicity with acidosis May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure.
Inhalation: Inhalation of high concentrations may cause central nervous system effects characterized by nausea, headache, dizziness, unconsciousness and coma Causes respiratory tract irritation. May cause narcotic effects in high concentration. Vapors may cause dizziness or suffocation
Chronic: May cause reproductive and fetal effects. Laboratory experiments have resulted in mutagenic effects. Animal studies have reported the development of tumors. Prolonged exposure may cause liver, kidney, and heart damage.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids Get medical aid. Gently lift eyelids and flush continuously with water.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes Wash clothing before reuse. Flush skin with plenty of soap and water.
Ingestion: Do NOT induce vomiting. If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid.
Inhalation: Remove from exposure and move to fresh air immediately If not breathing, give artificial respiration If breathing is difficult, give oxygen. Get medical aid. Do NOT use mouth-to-mouth resuscitation.
Notes to Physician: Treat symptomatically and supportively Persons with skin or eye disorders or liver, kidney, chronic respiratory diseases, or central and peripheral nervous sytem diseases may be at increased risk from exposure to this substance
Antidote: Replace fluid and electrolytes.

Material Safety Data Sheet
Formalin 10% aqueous solution

ACC# 90909

Section 1 - Chemical Product and Company Identification

MSDS Name: Formalin 10% aqueous solution
Catalog Numbers: S800182, S80018
Synonyms: 10% of a solution with 37% formaldehyde
Company Identification:
Fisher Scientific
1 Reagent Lane
Fair Lawn, NJ 07410
For information, call: 201-796-7100
Emergency Number: 201-796-7100
For CHEMTREC assistance, call: 800-424-9300
For International CHEMTREC assistance, call: 703-527-3887

Section 2 - Composition, Information on Ingredients

CAS#	Chemical Name	Percent	EINECS/ELINCS
7732-18-5	Water	95.1	231-791-2
50-00-0	Formaldehyde	3.7	200-001-8
67-56-1	Methyl alcohol	1.2	200-659-6

Section 3 - Hazards Identification

EMERGENCY OVERVIEW

Appearance: clear, colorless liquid
Warning! Harmful if absorbed through the skin. Contains formaldehyde which can cause cancer. May be fatal or cause blindness if swallowed. Harmful if inhaled. May cause allergic respiratory and skin reaction. May cause eye, skin, and respiratory tract irritation. May cause central nervous system depression. May cause kidney damage.
Target Organs: Kidneys, central nervous system, respiratory system, eyes, skin

Potential Health Effects
Eye: May cause eye irritation. May cause painful sensitization to light. Vapors cause eye irritation.
Skin: May cause skin irritation. Harmful if absorbed through the skin. May cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure to this material.
Ingestion: May be fatal or cause blindness if swallowed. May cause irritation of the digestive tract. May cause kidney damage. May cause systemic toxicity with acidosis. May cause central nervous system depression, characterized by excitement, followed by headache, dizziness, drowsiness, and nausea. Advanced stages may cause collapse, unconsciousness, coma and possible death due to respiratory failure.
Inhalation: May cause allergic respiratory reaction. May cause respiratory tract irritation.
Chronic: Contains formaldehyde which can cause cancer in humans. There is sufficient evidence that formaldehyde causes nasopharyngeal cancer in humans, a rare cancer in developed countries. There is limited evidence that formaldehyde causes cancer of the nasal cavity and paranasal sinuses and strong but not sufficient evidence for leukemia.

Section 4 - First Aid Measures

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes, occasionally lifting the upper and lower eyelids. Get medical aid imme diately.
Skin: Get medical aid. Flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes.
Ingestion: If victim is conscious and alert, give 2-4 cupfuls of milk or water. Never give anything by mouth to an unconscious person. Get medical aid immediately.
Inhalation: Remove from exposure and move to fresh air immediately. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical aid.
Notes to Physician: Treat symptomatically and supportively

Appendix C *continued:*

NOLVASAN(R) DISINFECTANT SOLUTION- FORT DODGE LAB/FORT DODGE, IA 50501

=========== 1. Product Identification ==========

Product ID:NOLVASAN(R) DISINFECTANT SOLUTION
MSDS Date:01/01/1987
Tech Review:03/23/1987
FSC:6840
NIIN:LIIN:00F004638
Submitter:F BT
MFN:01
=== Responsible Party ===
Company Name:FORT DODGE LAB/FORT DODGE, IA 50501
ZIP:00000
Emergency Phone Num:(515) 955-4600
Review Ind:Y
Published:Y
CAGE:64529
=== Contractor Identification ===
Company Name:FORT DODGE ANIMAL HEALTH INC (WAS FT DODGE LABORATORIES INC)
Address:800 5TH ST NW
Box:518
City:FORT DODGE
State:IA
ZIP:50501-7425
Country:US
Phone:515-955-4600
CAGE:64529
=== Item Description Information ===
Item Name:NASCO 97 10505

=========== 2. Composition/Information on Ingredients ===========
Ingred Name:CHLORHEXIDINE DIACETATE
CAS:56-95-1
RTECS #:DU1930000
Fraction by Wt: 2%
Ozone Depleting Chemical:Ingred Name:INERT

Fraction by Wt 98%
Ozone Depleting Chemical:
=========== 3. Hazards Identification ===========
=Routes of Entry=
=Reports of Carcinogenicity=
Effects of Overexposure:IRRITATING TO EYES OR MUCOUS MEMBRANES
=========== 4. First Aid Measures ===========
First Aid:IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH PLENTY OF WATER. GET MEDICAL ATTENTION IF IRRITATION PERSISTS. EYES: FLUSH WITH WATER. SKIN: WASH WITH SOAP AND WATER. INGESTION: MAY BE HARMFUL - GET M EDICAL ATTENTION
=========== 5. Fire Fighting Measures ===========
Flash Point:Flash Point Text:NONE
Extinguishing Media:WILL NOT BURN
Unusual Fire/Explosion Hazard:WILL NOT BURN - NO EXPLOSION HAZARDS.
=========== 6. Accidental Release Measures ===========
Spill Release Procedures:FLUSH TO DRAIN WITH EXCESS WATER
=========== 7 Handling and Storage ===========
Handling and Storage Precautions:DON'T CONTAMINATE WATER, FOOD, OR FEED BY STORAGE OR DISPOSAL. KEEP OUT OF REACH OF CHILDREN
Other Precautions:IT IS A VIOLATION OF FEDERAL LAW TO USE THIS PRODUCT IN A MANNER INCONSISTENT WITH ITS LABELING.
=========== 8. Exposure Controls/Personal Protection ===========
Respiratory Protection:NOT NEEDED
Protective Gloves:NOT NEEDED.
Eye Protection:RECOMMENDED
Other Protective Equipment:NONE
Supplemental Safety and Health
MSDS DATE: 28 MAY 86.

Appendix to ASC Electro-fishing Protocols Manuel
June 2006

Catch Per Unit Effort Sampling [CPUE]:

The CPUE method, in conjunction with **Population Estimate Sampling,** is used to develop an index of juvenile production. This method assumes:

1. **Each site has uniform habitat type.**
2. **Standardized electrofishing methods.**
3. **Uniform effort (wand time).**

The first assumption is addressed when sites are selected and before sampling begins. Assumption two and three are addressed in the SOP for the method and include consistent crew size, sampling pattern, sampling unit, unit operator, and unit settings within a given sample. (Reynolds 1996)

Sites should be selected based on the assessment plan for the watershed. Sites should be identified before the sampling trip to avoid selecting the "best" habitat (bias). Habitat types (riffle, run, glide, falls…) can be selected at random (see Random Generation of Electrofishing Sites for Dennys River BGEST [RandonGe.Doc] for guidance) based on available habitat survey data, or a location can be selected based on access, with a starting point chosen at random up or down from the access. Only one contiguous habitat type (natural unit) shall be sampled per trip (do not sample across habitat transitions either longitudinally or laterally). This method does not use blocking nets.

Definitions:
Pass = act of working across the stream
Sweep = act of moving the wand through a section of water

A three-person team, each carrying a scap net, will conduct CPUE electrofishing. The person carrying the unit and operating the wand (the "shocker") will make passes across the current from shoreline to shoreline beginning at the downstream end of the site and moving upstream. Each pass is parallel to the next at a distance that allows a slight overlap of sweeps conducted on successive passes (Figure 1). The "shocker" moves (sweeps) the wand from upstream to downstream, at approximately the speed of the current, with the scap netters ready downstream. Upon completion of each sweep of the wand, the shocker takes a step forward (perpendicular to streamflow) and repeats the process. The wand should sweep over an area only once. Do not perform multiple wand sweeps in the same spot. Passes are made successively upstream throughout the sampling section until wand time reaches 5 minutes (300 sec). The primary objective of the sampling is age 2+, 1+, and 0+ Atlantic salmon. When targeted fish are collected they should be placed in live cars or buckets with sufficient river water and shade. After the pass is complete all lifestage(s) or species should be enumerated and recorded (Figure 2 - data sheet). Applicable protocols to protect 0+ parr should be used (i.e. don't dig them out of the rocks with nets). The crew leader will determine appropriate strategies for a site, keeping in mind that the CPUE method seeks to get relative abundance and proportions of the ages of salmon present in the habitat.

Step by Step:

Identify sample site and discuss pass pattern.

Record trip information (Figure 2).

Prepare backpack unit for use. (Connect the batteries, anode and cathode, and select settings based on conductivity and flow conditions).

Test settings outside sample area. Once sampling begins settings should not be adjusted.

Set wand timer to zero or record seconds at start of sampling.

Begin electrofishing and start the stopwatch. Move upstream in standard pattern (Figure 1), removing as many of the stunned salmonids as possible to a bucket of water using a dip net. Priority is given to catching salmon (YOY and parr); however, other species captured in nets should be retained. Each member of the team should count the number of missed salmon by age class (YOY and parr).

After 5 minutes wand time, switch off the backpack and stopwatch and move the caught fish to the bank to be examined.

Record wand time and stopwatch "real time".
Record number of YOY and parr caught and observed marks or tags.
Discuss and record numbers of YOY and parr missed. (Consensus based on three independent counts)

At every third site within a stream (1, 4, 7, 10, 13...):

- Record length and weight of salmon
- [Scale and genetics samples as dictated by ongoing studies in drainage]
- Record counts of other species caught.
- Record length and weight for potential competitors and predators (BKT, PKL, SMB, LMB, ...)

Efficiency
This technique relies heavily on the experience and capabilities of the team. It is also affected by conditions i.e. water flow and habitat. A simple method of assessing the efficiency is based on the team member counts of salmon not caught but seen. The average number, by age class is used to work out the efficiency as a percentage.

eg 15 YOY caught + 5 YOY missed = 20 YOY

5/20 x 100 = 25% missed

Therefore, YOY fishing was 75% efficient.

If the efficiency drops below 60% the fishing results are invalid. This is usually due to high water flow and the site may be re-sampled in more suitable conditions depending on the assessment plan.

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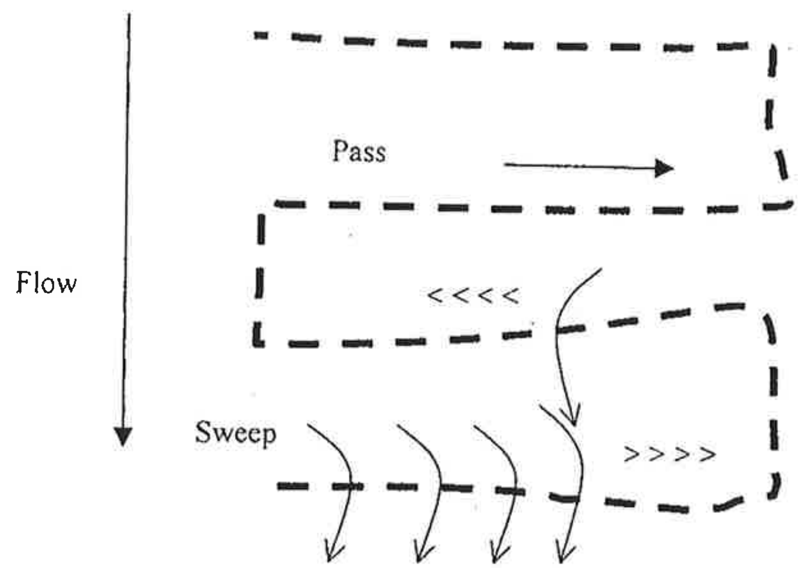

Figure 1. Stylized Pass and sweep patterns for CPUE sampling.