ENDANGERED SPECIES ACT SECTION 7 CONSULTATION

BIOLOGICAL OPINION

Agency:	Department of the Army, New England District, Corps of Engineers
Activity:	Proposed modification of existing ACOE permits authorizing the installation and maintenance of aquaculture fish pens within the State of Maine
Conducted by:	National Marine Fisheries Service, Protected Resources Division, Northeast Region (F/NER/2002/00932 and the U.S. Fish and Wildlife Service, New England Field Office [MEFO 02-001(F)] GARFO-2002-00001
Date Issued:	Nov. 19, 2003
Approved by:	

Patricia A. Kurkul
Regional Administrator
Northeast Region
National Marine Fisheries Service

INTRODUCTION

This constitutes the biological opinion (opinion) of the National Marine Fisheries Service (NOAA Fisheries) and the U.S. Fish and Wildlife Service (USFWS) (collectively referred to as the Services) on the continuation and proposed modification of existing U.S. Army Corps of Engineers (ACOE) permits previously issued under Section 10 of the Rivers and Harbors Act of 1899 (RHA Section 10) (33 U.S.C. §403), following the Services' listing of the Gulf of Maine (GOM) Distinct Population Segment (DPS) of Atlantic salmon (*Salmo salar*) as an endangered species on November 17, 2000. These existing ACOE permits have authorized the installation and maintenance of fish pens within the State of Maine. While the Services agree that the proposed modifications to the existing permits will reduce the impact of the aquaculture industry on the listed Atlantic salmon, these modifications do not eliminate the impacts to listed salmon. Since adverse effects to the listed salmon are still anticipated after implementation of the proposed permit amendments, the Endangered Species Act (ESA) requires formal consultation to: 1) ensure that the action is not likely to jeopardize the continued existence of the listed salmon in the wild; and 2) provide exemptions to the take prohibitions of Section 9 for take that may occur incidentally. This opinion is based on the following: (1) information provided in the ACOE's August 9, 2001 initiation letter and attachments in support of formal consultation under the ESA; (2) previous consultations among the Services and the Environmental Protection

Agency (EPA) on the National Pollution Discharge Elimination System (NPDES) program, including all documents and discussions that served as the basis for that consultation (USFWS/NOAA Fisheries 2001); (3) "Final Endangered Status for a Distinct Population Segment (DPS) of Anadromous Atlantic Salmon (*Salmo salar*) in the Gulf of Maine" (65 FR 69459, Nov. 17, 2000); (4) "Review of the Status of Anadromous Atlantic Salmon under the U.S. Endangered Species Act" [Anadromous Atlantic Salmon Biological Review Team (AASBRT) 1999]; (5) field investigations; (6) comments received on the September 25, 2002 draft of this opinion; and (7) other sources of information. A complete administrative record of this consultation will be maintained by the NOAA Fisheries office in Gloucester, Massachusetts. The NOAA Fisheries national Section 7 tracking number is F/NER/2002/00936, and the USFWS log number is MEFO 02-001(F).

BACKGROUND

The salmon aquaculture industry in Maine has been operating since the 1980s and currently is comprised of 42 marine sites, located primarily in the downeast region of the Gulf of Maine, and operated by several different companies. Section 10 of the Rivers and Harbors Act of 1899 authorizes the ACOE to regulate structures and work within navigable waters of the U.S.; and as such, marine aquaculture sites in Maine are required to obtain RHA Section 10 permits from the ACOE. The sites in this opinion currently operate under previously issued RHA Section 10 permits. Concern over the effect of the salmon aquaculture industry on wild salmon populations has existed since the industry first began in Maine. The Services discussed these concerns with the ACOE and the industry prior to the listing of the GOM DPS in November 2000. Intensive discussions have continued since the listing. The proposed permit modifications are the result of these joint discussions. Both the Services and the ACOE agreed that operation of the industry authorized by the ACOE was likely adversely affecting the listed salmon population. Accordingly, in order to attain compliance with the ESA, the ACOE transmitted a letter to the Services requesting initiation of Section 7 consultation on August 9, 2001. The following section is a record of important meetings and correspondence that took place prior to and during this Section 7 consultation. The record clearly demonstrates extensive efforts on the part of the agencies and the industry to achieve consensus on permit conditions that: 1) protect the GOM DPS, and 2) maintain the economic viability of the aquaculture industry.

CONSULTATION HISTORY

November 16, 1999 - Services give presentation at a Federal Agency Mid-Level Managers meeting to brief ACOE officials on the proposed listing of the Atlantic salmon as a federally-endangered species. Issues related to existing Atlantic salmon aquaculture facilities in Maine and associated adverse impacts on wild salmon are discussed.

April 20, 2000 - Letter from Elizabeth Butler of Pierce Atwood, Attorneys at Law, representing the Maine Aquaculture Association (MAA) and its member salmon companies to the ACOE regarding a proposed meeting in Maine.

May 15, 2000 - Meeting hosted by the ACOE with the aquaculture industry and the Services to discuss the proposed listing of the Atlantic salmon as an endangered species and the possible consequences for existing ACOE permits authorizing finfish aquaculture facilities. The Services provided a list of recommended permit conditions to provide protection for wild Atlantic salmon.

July 12, 2000 - Letter from the ACOE to the Services posing a number of questions related to the Services' May 15, 2000 recommendation for permit conditions. Included with the ACOE letter is a June 2, 2000 letter from the MAA commenting on the Services' May 15, 2000 recommendations.

September 11, 2000 - Letter from the Services to the ACOE responding to their July 12, 2000 letter.

October 18, 2000 - Letter from the ACOE to the MAA attaching the Services' September 11, 2000 letter and requesting that discussions continue related to the modification of existing aquaculture permits.

November 2, 2000 - Meeting hosted by the ACOE with the aquaculture industry and the Services to continue discussions related to the proposed listing of the Atlantic salmon and the possible consequences for existing ACOE permits authorizing finfish aquaculture facilities.

November 17, 2000 - The Services publish public notice of listing of the GOM DPS of Atlantic salmon as an endangered species, effective December 18, 2000.

January 12, 2001 - The Services issue a final non-jeopardy opinion to the EPA on the delegation of NPDES program to the State of Maine and its effects on the endangered Atlantic salmon.

March 12, 2001 - Letter from the Services to the ACOE requesting that the ACOE initiate formal Section 7 consultation for all existing permits authorizing finfish aquaculture facilities in Maine.

March 16, 2001 - The ACOE requests information from permittees in support of Section 7 consultation.

March 28 and 29, 2001 - The ACOE hosts an Atlantic salmon aquaculture tagging workshop with the aquaculture industry and state and federal agencies to explore options for marking aquaculture salmon.

March 29, 2001 - The ACOE hosts a meeting with the aquaculture industry and the Services to discuss Section 7 consultation for existing facilities.

April 12, 2001 - Letters from Heritage Salmon and Jorn Vad to the ACOE in response to March 16, 2001 request for information by the ACOE.

April 15, 2001 - Letter from Frank Ayres of Maine Salmon, Inc. to the ACOE in response to March 16, 2001 request for information by the ACOE.

April 16, 2001 - Treat's Island Fisheries, Atlantic Salmon of Maine, LLC, and Island Aquaculture Company send responses to March 16, 2001 request for information by the ACOE.

April 18, 2001 - Letters from International Aqua Foods USA, Inc., D.E. Salmon Inc., and Stolt Sea Farm Inc. to the ACOE in response to March 16, 2001 request for information by the ACOE.

May 2, 2001 - Letter from Sebastian Belle of the MAA to the ACOE providing results of an industry survey on compliance with the MAA Code of Containment.

May 29, 2001 - Facsimile from Barry Calder to the ACOE including information on Maine Coast Nordic and L.R. Enterprises Inc. marine sites.

August 29, 2001 - Services receive August 9, 2001 letter from ACOE requesting initiation of formal Section 7 consultation for all previously authorized finfish aquaculture sites in the State of Maine.

October 11, 2001 - Letter from Elizabeth Butler of Pierce Atwood (representing the permittees Atlantic Salmon of Maine, LLC and Stolt Sea Farm, Inc.) to the Services and the ACOE including a proposal for revised RHA Section 10 permit conditions that these companies would support.

October 12, 2001 - Letter from the Services to the ACOE acknowledging initiation letter and requesting additional information before formal consultation can be initiated.

December 27, 2001 - Letter from the ACOE to the permittees requesting additional site information for Section 7 consultation with the Services.

January 24, 2002 - Letter from Erick Swanson to the ACOE in response to December 27, 2001 request.

February 28, 2002 - Letter from Heritage Salmon to the ACOE in response to December 27, 2001 request.

March 18, 2002 - Letter from David Peterson of Atlantic Salmon of Maine, LLC to the ACOE providing additional information in response to December 27, 2001 request.

March 21, 2002 - Letter from Treat's Island Fisheries to the ACOE providing additional information in response to December 27, 2001 request.

March 28, 2002 - Letters from Island Aquaculture Company, DE Salmon Company, Stolt Sea Farm Inc., and International Aqua Foods USA, Inc. providing information in response to December 27, 2001 request.

April 3, 2002 - Letter from Maine Salmon, Inc. to the ACOE providing information in response to December 27, 2001 request. Facsimile to the ACOE from Maine Coast Nordic and L.R. Enterprises, Inc. including information on marine sites.

April 9, 2002 - Meeting hosted by the EPA and the Maine Department of Environmental Protection (MEDEP) to discuss the aquaculture industry and Maine Pollution Discharge Elimination System (MPDES) permits, attended by state and federal regulatory agencies and Non-Governmental Organizations.

April 12, 2002 - Letter from the Services to the ACOE, acknowledging submission of additional information and initiating formal consultation. The Services' opinion is due to the ACOE by August 18, 2002.

May 14, 2002 - Meeting in Falmouth, Maine with the Services, the ACOE and Atlantic Salmon of Maine, LLC to discuss broodstock and genetics issues.

June 10, 2002 - Letter from David Peterson of Atlantic Salmon of Maine, LLC to the Services regarding the May 14, 2002 meeting.

June 28, 2002 - Letter from the Services to David Peterson of Atlantic Salmon of Maine, LLC, in response to Mr. Peterson's June 10, 2002 letter.

July 2, 2002 - Letter to the Services from Stolt Sea Farm, Inc. endorsing the June 10, 2002 letter from Atlantic Salmon of Maine, LLC.

August 6, 2002 - Meeting with the Services, Atlantic Salmon of Maine, LLC, and Stolt Sea Farm, Inc. to continue discussion of broodstock and genetics issues.

August 15, 2002 - Letter from the Services to the ACOE requesting a 60-day extension until October 17, 2002 to complete the opinion.

August 20, 2002 - Letter from ACOE to the Services approving a time extension until October 17, 2002.

August 22, 2002 - Letter from the Services to David Peterson including a modified version of the Atlantic salmon microsatellite analysis protocol.

September 20, 2002 - Letter from the Services to Sebastian Belle of the MAA reiterating the position of the Services in regard to marking Atlantic salmon that are commercially reared in marine cages.

September 25, 2002 - Draft opinion sent to the ACOE from the Services. Comments due back by October 4, 2002.

October 7, 2002 - Draft opinion sent from the ACOE to the MAA for distribution to the permittees. Comments due back to the ACOE by October 17, 2002.

October 10, 2002 - Letter from Sebastian Belle of the MAA to the Services requesting a clear indication of acceptable marking techniques.

October 17, 2002 - Letter from the Services to Sebastian Belle of the MAA responding to the October 10, 2002 request.

October 25, 2002 - Letter from Atlantic Salmon of Maine to the ACOE requesting an additional 45 days to comment on the draft opinion.

October 28, 2002 - Meeting with the ACOE, the Services, and MEDEP to discuss comments on the draft opinion.

October 29, 2002 - Email from the ACOE to the MAA allowing an extension of time for comments on the draft opinion. Comments from the industry to the ACOE are due by November 8, 2002.

November 8, 2002 - Letter from Heritage Salmon, Inc. to the ACOE including comments on the draft opinion.

November 13, 2002 - Letter from Elizabeth Butler of Pierce Atwood representing the permittees (Atlantic Salmon of Maine; Stolt Sea Farm, Inc.; Island Aquaculture Company, Inc.; Treat's Island Fisheries, Inc.; International Aqua Foods, USA, Inc.; and D.E. Salmon, Inc.) to the ACOE requesting extension of time for comments, and including preliminary comments on the draft opinion.

December 3, 2002 - Letter from the ACOE to the Services commenting on the draft opinion, and including comment letters from the MAA, the Wild Blueberry Commission of Maine, Elizabeth Butler, and Heritage Salmon, Inc.

January 27, 2003 - Meeting with the ACOE, the Services, Atlantic Salmon of Maine, Stolt Sea Farm, Inc., and Maine Senator Susan Collins' staff to discuss the draft opinion.

January 31, 2003 - Letter from Elizabeth Butler (attorney representing Atlantic Salmon of Maine, LLC and Stolt Sea Farm, Inc.) to Richard Bennett, USFWS, and Chris Mantzaris, NOAA Fisheries, offering suggested alternative language for the proposed ACOE special condition regarding genetic strain.

February 21, 2003 - Letter from Elizabeth Butler (attorney representing Atlantic Salmon of Maine, LLC and Stolt Sea Farm, Inc.) to Richard Bennett, USFWS, offering additional comments on the draft opinion and requesting another meeting with the Services to discuss permit conditions.

March 21, 2003 - Letter from Richard Bennett, USFWS, to Senator Susan Collins providing information in response to issues raised at the January 27, 2003 meeting.

March 28, 2003 - Request from Atlantic Salmon of Maine, LLC to the Services pursuant to the Data Quality Act regarding the draft opinion.

March 31, 2003 - Letter from the ACOE to the Services requesting a modification in the pen type and distribution at two existing sites (Deep Cove and Birch Point) operated by Heritage Salmon in Cobscook Bay.

April 1, 2003 - The Services meet with the ACOE to discuss the draft opinion.

April 4, 2003 - Email from Mary Colligan (NOAA Fisheries) to Jay Clement (ACOE) in response to the March 31, 2003 request.

April 18, 2003 – Letter from the ACOE to Heritage Salmon notifying Heritage Salmon that permit numbers ME-EAPT-87009-R-89 and ME-EAPT-900228-R-90 are amended to authorize replacement of the existing aging and deteriorated pens at both sites with new pens.

May 2, 2003 – Meeting in Falmouth, Maine with the Services and the ACOE to discuss the draft opinion.

May 22, 2003 – Meeting in Concord, New Hampshire with Services and the ACOE to discuss the draft opinion.

BIOLOGICAL OPINION

I. DESCRIPTION OF THE PROPOSED ACTION

The ACOE has proposed continuation of existing ACOE permits previously issued to numerous finfish aquaculture farms in the State of Maine under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §403), with modifications. These existing ACOE permits have authorized the installation and maintenance of finfish aquaculture pens within Maine. Subsequent to the ACOE issuance of these permits, the Services listed the GOM DPS of Atlantic salmon as an endangered species pursuant to Section 4 of the ESA. Section 7(a)(2) of the ESA requires federal agencies to consult with the Services to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species. Accordingly, the ACOE initiated formal consultation under Section 7 to ensure compliance with the ESA. The following sections describe the nature and extent of the various aquaculture activities authorized under the current RHA Section 10 permits, followed by descriptions of the ACOE special conditions that will be required through permit modifications.

The finfish aquaculture industry in Maine is currently composed of 42 sites, which encompass about 750 acres of water. Most cage (pen) sites (26) are located in the Cobscook Bay area, near the Maine-New Brunswick border (Baum 2001) (see Figures 1-5 and Table 1). The Atlantic salmon is the primary species of finfish under cultivation, with rainbow trout (*Oncorhynchus mykiss*) a distant second; other species reared (experimentally) in recent years include cod, haddock, flounder, pollock, and charr. In January 2001, there were 570 cages deployed in Maine coastal waters. The most commonly-used cages are 24 x 24 meters in size and are connected by steel walkways, typically in groups of 8 to 20 cages. Additionally, 70- to 120-meter-circumference cages (Polar Cirkals™) are used extensively in the State of Maine (Baum 2001).

The annual total production of farmed Atlantic salmon in Maine increased from 20 metric tons (mt) in 1984 to more than 16,400 mt (>36 million pounds) in 2000 (Baum 2001). Since 2000, annual production of Atlantic salmon in Maine has decreased 28% to 26 million pounds in 2001 (Belle, 11/7/02). In 2002, the industry produced 15 million pounds. In Maine, pen-rearing of salmon to harvestable size requires approximately 18 months, yielding an average standing crop of about ten million salmon in two-year classes. Most salmon are harvested from October through March, although some salmon are harvested throughout the year.

Table 1

Existing Aquaculture Sites - KEY

Code	Location	ACOE Permit	DMR Site ID	Operator	Ownership
A1	Hardwood Island	199203123	TISF HT	Acadia Aquaculture	Acadia Aquaculture
A2	Dunham's Cove	199803638	ACAD DB	Acadia Aquaculture	Acadia Aquaculture
B1	Stone Island	199802925	ASMI ST	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
B2	Libby Island	199601473	ASMI LI	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
B3	Starboard Island	199200040R92	ASMI II	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
B4	Cross Island N	199301092	ASMI CI2	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
B5	Cross Island S	MECRIS872004R89	ASMI CI	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
B6	Flint Island	199402554	ASMI FI	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
B7	Dyer Island	199500257	ASMI DI	Atlantic Salmon of Maine, LLC	Atlantic Salmon of Maine, LLC
C1	Comstock Pt (5,10)	MEEAPT890197R90	TIFI CC1/CC2	Treats Island Fisheries, Inc	Atlantic Salmon of Maine, LLC
C2,C3	Treats Island	MEEAPT871826R90	TIFI TW1/TW2	Treats Island Fisheries, Inc.	Atlantic Salmon of Maine, LLC
C4	Johnson Cove	MEEAPT871825R89	TIFI JC	Treats Island Fisheries, Inc	Atlantic Salmon of Maine, LLC
D1	Black Island	199902033	IACO BI	Island Aquaculture Corp	Atlantic Salmon of Maine, LLC
D2	Harbor Island	199100001R91	IACO HS	Island Aquaculture Corp	Atlantic Salmon of Maine, LLC
D3	Toothacker Cove	199300273	IACO TC	Island Aquaculture Corp	Atlantic Salmon of Maine, LLC
E1	Johnson Bay 3	199400974	SFML JB3	Stolt Sea Farm, Inc	Stolt Sea Farm, Delaware Corp
E2	Rodgers Island	MEWLUB890196R90	SFML RS/RN	Stolt Sea Farm, Inc.	Stolt Sea Farm, Delaware Corp
F1	Gove Pt. W	199501174	DESO GN2	D.E. Salmon, Inc.	Stolt Sea Farm, Delaware Corp
F2	Gove Pt. E	MEEAPT890195R90	DESC GN1	D.E. Salmon, Inc.	Stolt Sea Farm, Delaware Corp
F3	E Johnson Bay	199300051	DESO LU	D.E. Salmon, Inc.	Stolt Sea Farm, Delaware Corp
G1	Harris Cove	199500887	IAFI HP	International Aqua Foods, USA	Stolt Sea Farm, Canadian Corp
G2	Kendall Head S	199301738	IAFI JK	International Aqua Foods, USA	Stolt Sea Farm, Canadian Corp
G3	Prince Cove	MEEAPT882088R89	IAFI PC	International Aqua Foods, USA	Stolt Sea Farm, Canadian Corp
G4	Cooper Island Ledge	MEEAPT890194R89	IAFI CL	International Aqua Foods, USA	Stolt Sea Farm, Canadian Corp
H1	South Bay	MEEAPT890198R90	CONA SB	Heritage	Heritage
H2	Broad Cove	MEEAPT872009R89	CONA BC	Heritage	Heritage
H3	Deep Cove	MEEAPT872009R89	CONA DC	Heritage	Heritage
H4,H5	Comstock Point	MEEAPT890199R90	CONA CP	Heritage	Heritage
H6	Goose Island	MEEAPT893404R90	CONA GI	Heritage	Heritage
I1	Birch Point	MEEAPT900228R90	BPFI BE	Heritage	Gary Small
J1	Shackford Head	MEEAPT892130R90	MESI SH	Heritage	Frank Ayres
K1	Birch Point	MEEAPT900277R90	LREN BS	L.R. Enterprises, Inc.	LR Enterprises
K2	Treat Island	MEEAPT882089R89	LREN TE	L.R. Enterprises, Inc.	LR Enterprises
K3	Gove Point	MEAPTR90	LREN GS	L.R. Enterprises, Inc.	LR Enterprises
L1	Cutler Peninsula	199101882R90	MCNI CW	Maine Coast Nordic	Maine Coast Nordic
L2	Sand Cove North	199600240	MCNB SCN	Maine Coast Nordic	Maine Coast Nordic
L3	Little River S	MECYTL883416R90	MCNC CH	Maine Coast Nordic	Maine Coast Nordic
L4	Little River N	199300240	MCNC CN	Maine Coast Nordic	Maine Coast Nordic
L5	Spectacle Island	199101875R92	MCNI SI	Maine Coast Nordic	Maine Coast Nordic
M1	Sheepscott River	199802560	PIER SR	M. Pierce Associates, Inc.	M. Pierce Associates, Inc.

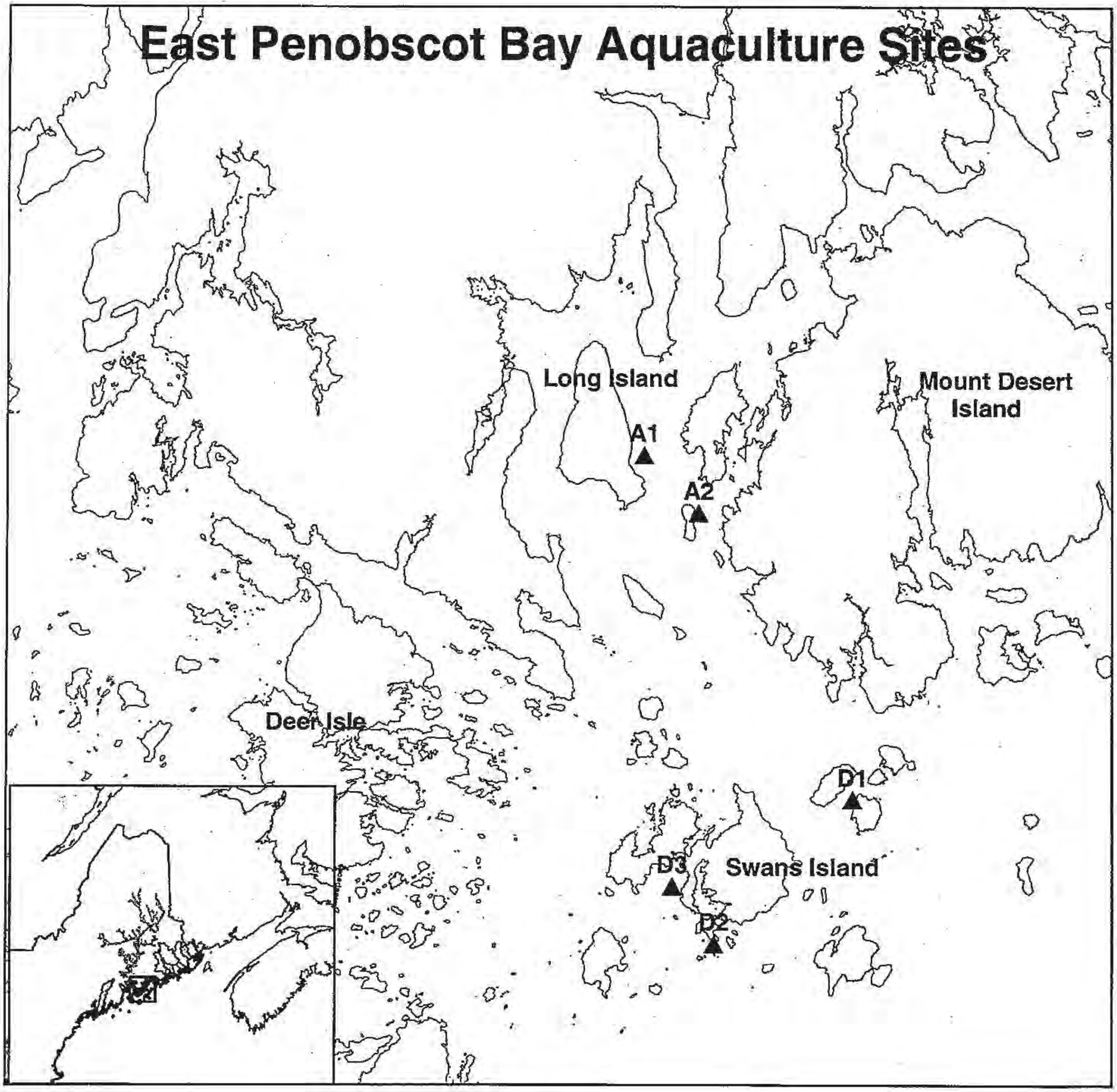

East Penobscot Bay Aquaculture Sites
Long Island
Mount Desert Island
A1
A2
Deer Isle
D1
D3
Swans Island
D2

Figure 1

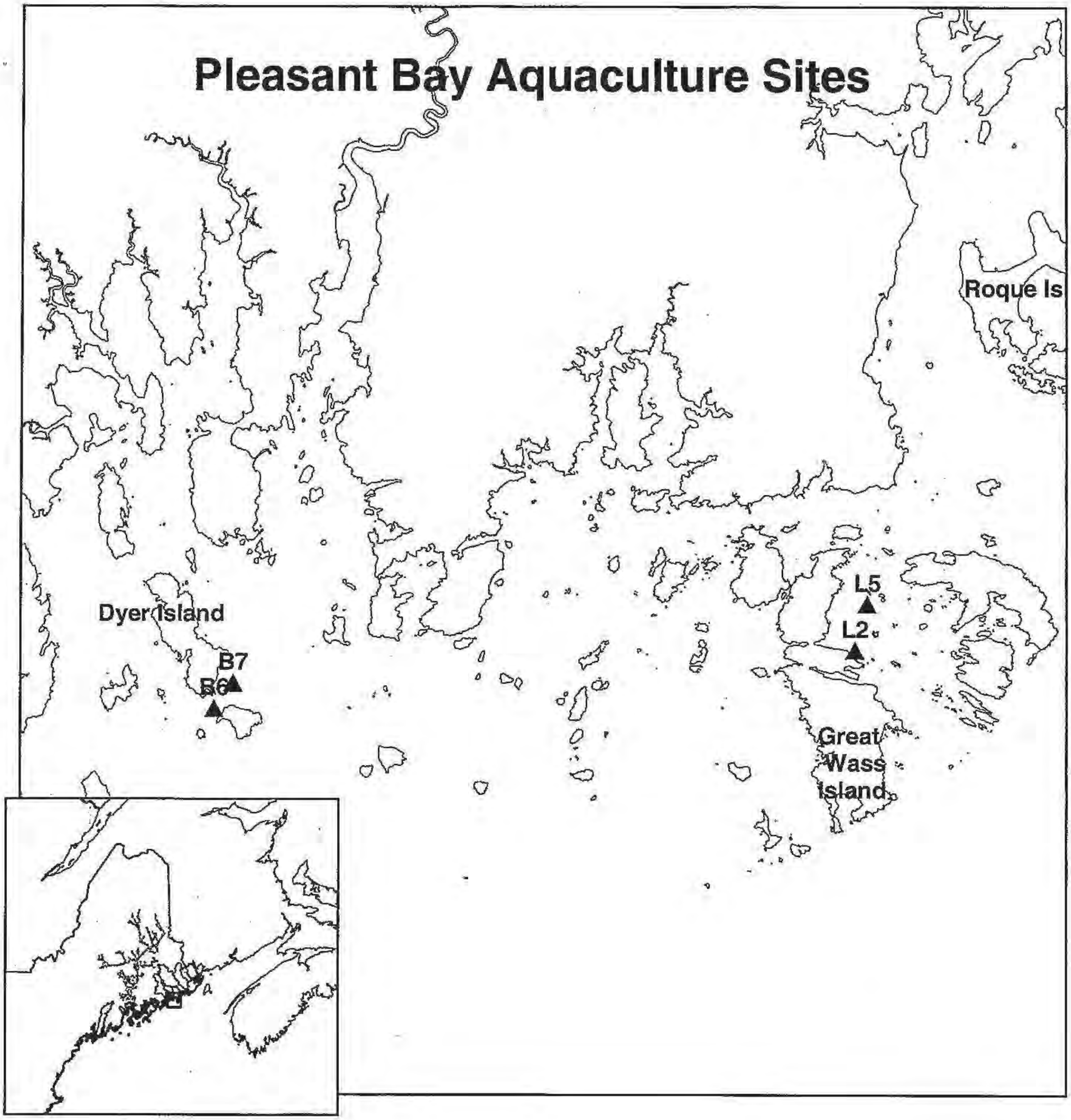

Pleasant Bay Aquaculture Sites
Roque Is
Dyer Island
B7
B6
L5
L2
Great Wass Island

Figure 2

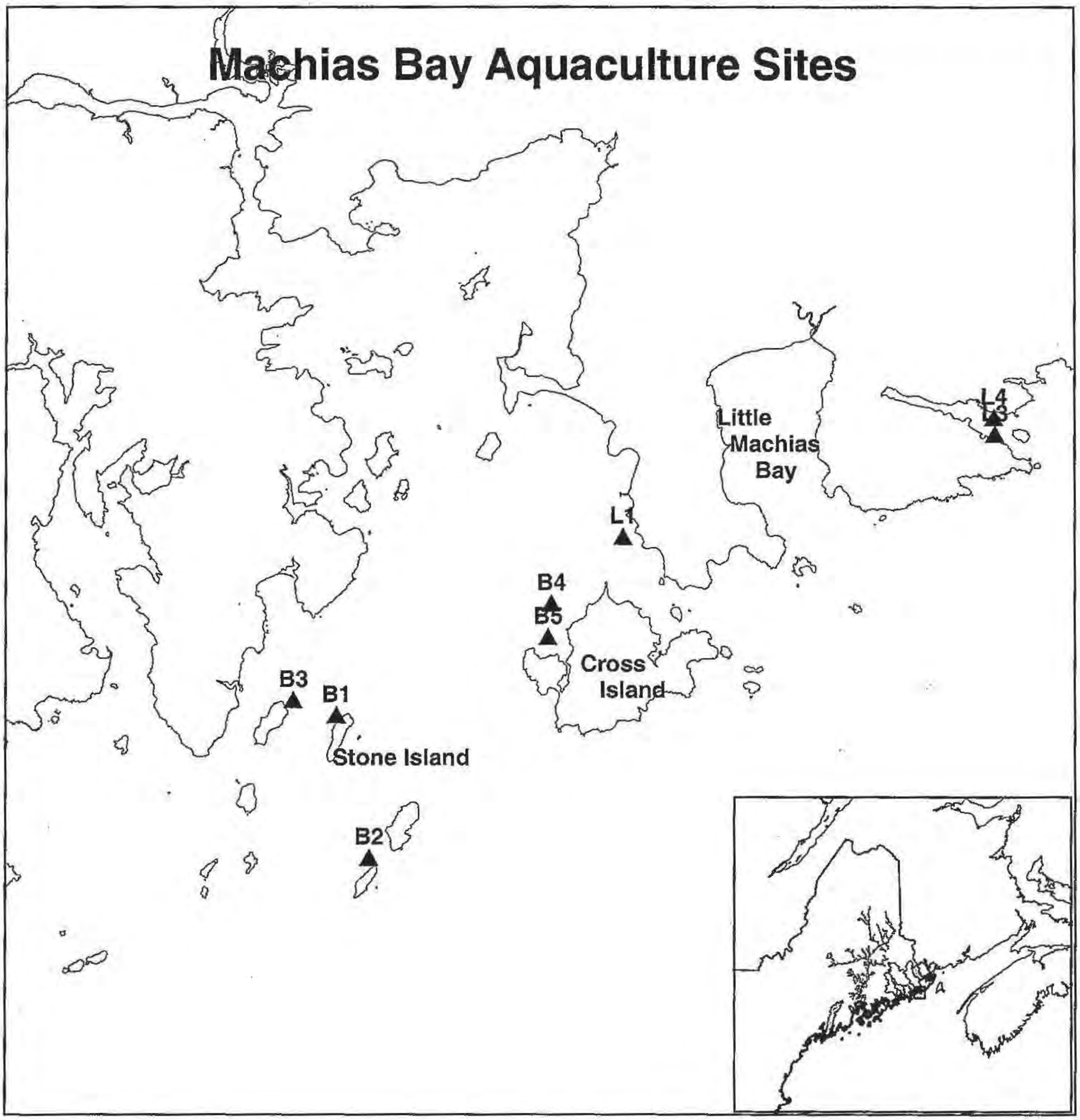

Machias Bay Aquaculture Sites
Little Machias Bay
L4
L3
L1
B4
B5
Cross Island
B3
B1
Stone Island
B2

Figure 3

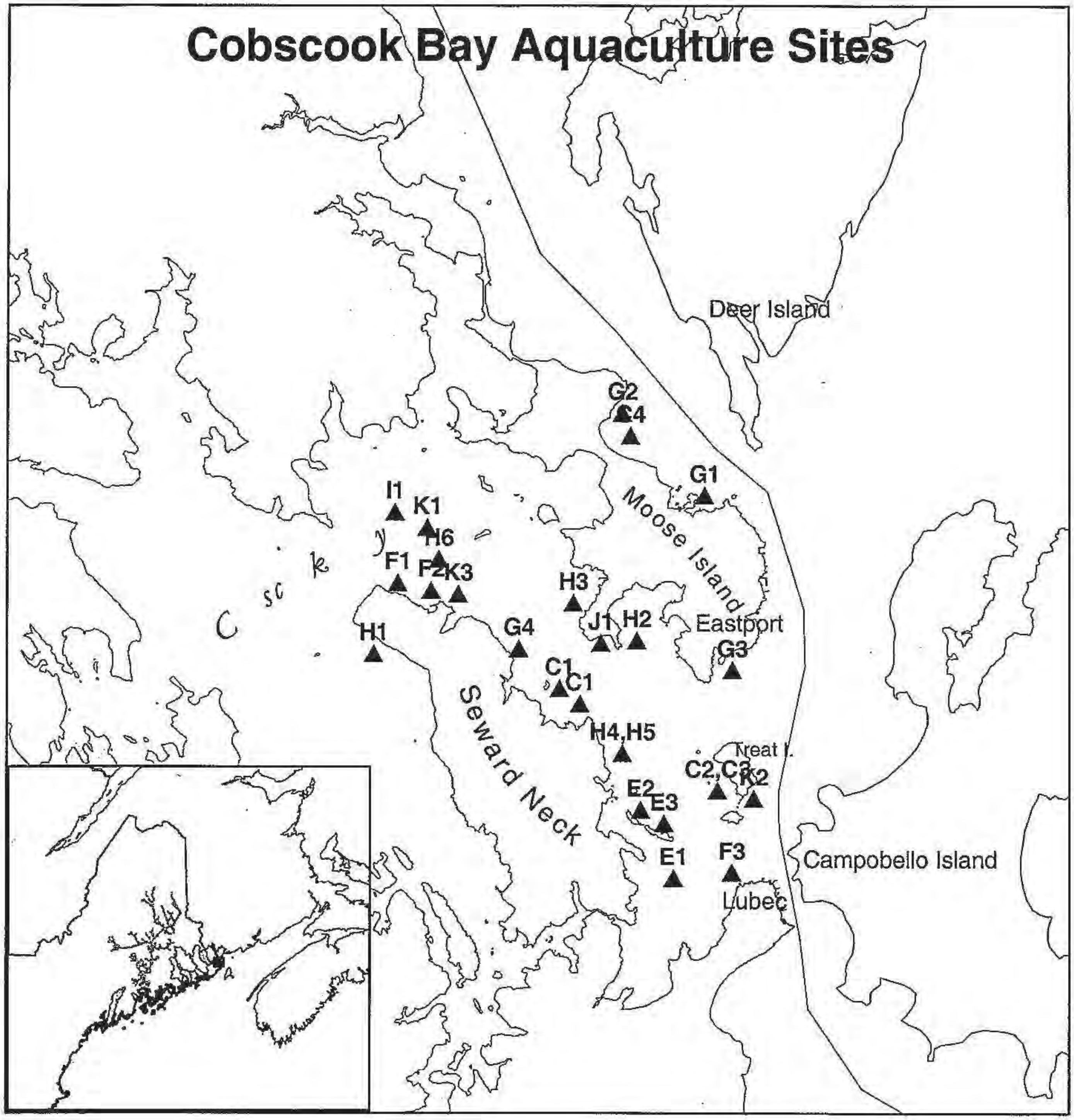

Cobscook Bay Aquaculture Sites
Deer Island
G2
C4
G1
Moose Island
I1
K1
H6
F1
F2
K3
H3
H1
G4
J1
H2
Eastport
G3
C1
C1
Seward Neck
H4,H5
Treat I.
C2,C3
K2
E2
E3
E1
F3
Campobello Island
Lubec

Figure 4

Sheepscot River Site

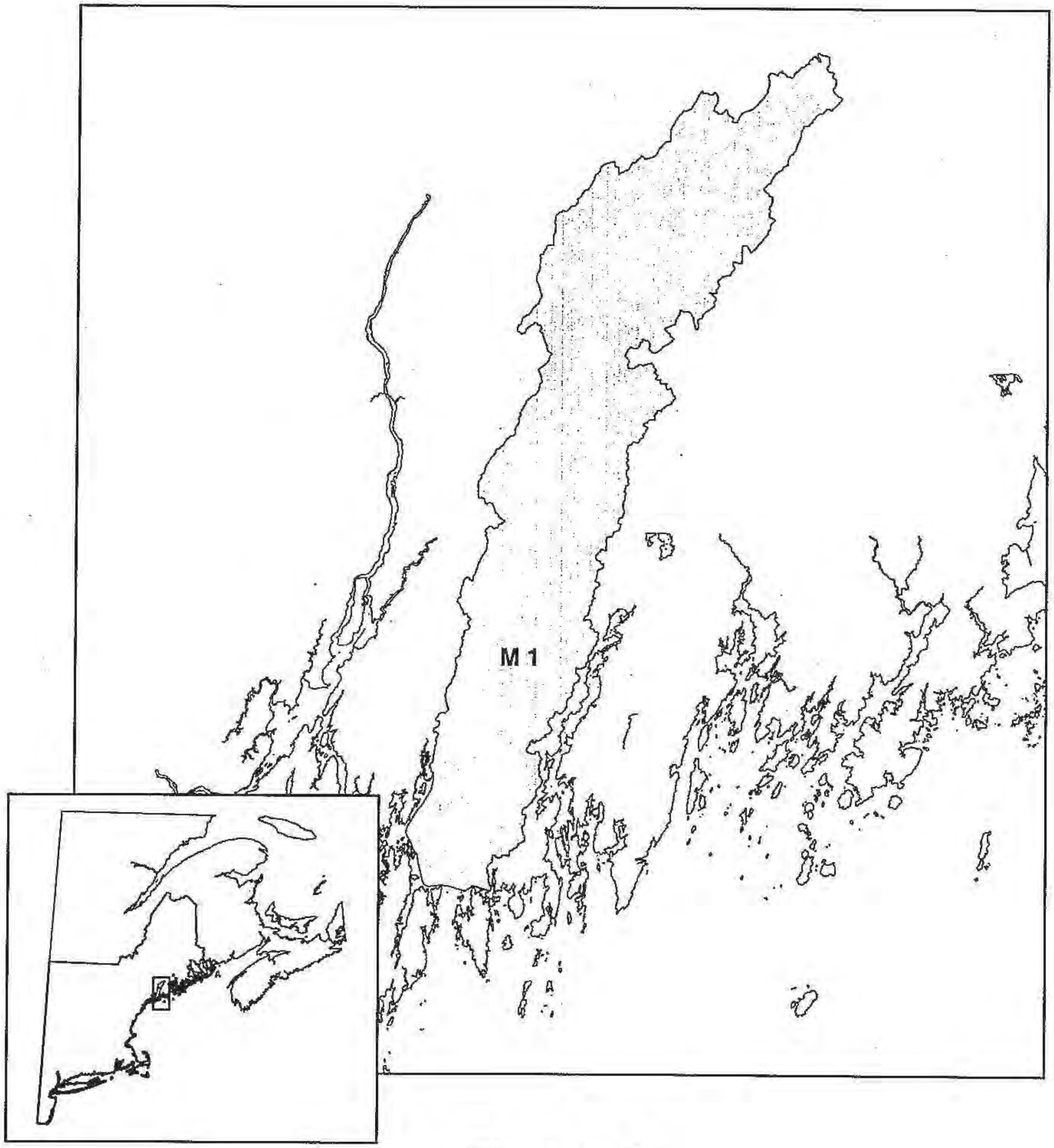


Figure 5

Summary of Existing ACOE RHA Section 10 Permits by Company:

A. Acadia Aquaculture, Inc.

A1. Hardwood Island, Blue Hill Bay (ACOE Permit No: 199203123, Maine Department of Marine Resources (DMR) Site ID: TISF HT)

- *Species Authorized:* Atlantic salmon, rainbow trout, blue mussels
- *Species Cultivated:* Atlantic salmon, blue mussels, rainbow trout (2000)
- *Atlantic Salmon Strains:* The only strains intended for use are St. John and Penobscot River strains. All smolts will be purchased through Heritage Salmon.
- *Gear Type:* Install and maintain 10 floating fish pens within a 500' x 2800' area with an Akvamarina 1000 Feed Barge System (30' x 60'). Two 30' x 30' mussel barges are located on the northern end of the site. Each pen will measure approximately 24 meters and will be organized into a single pen system measuring approximately 56 x 132 meters. The pens will be bottom-moored by anchors. Gear is a new steel system designed by Marine Construction. Four 12-meter pens are used to hold the broodstock.
- *Additional Information:* This site will be used for site rotation and fallowing. Rainbow trout raised in 2000 were part of a research project with Aquabio Product Sciences; all trout were destroyed that fall.

A2. Dunham's Cove, Blue Hill Bay (ACOE Permit No: 199803638, DMR Site Identifier: ACADDB)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated/Atlantic Salmon Strains:* None at this time
- *Gear Type:* None at this time
- *Additional Information:* A NPDES permit for this site was issued by the EPA on February 21, 2002. The DMR lease has been surrendered, so legally there is no state authorization to rear salmon or place structures on this site.

B. Atlantic Salmon of Maine, LLC

B1. Stone Island, Machias Bay (ACOE Permit No: 199802925, DMR ID: ASMI ST)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* Penobscot, St. John and imported gametes from Icelandic and Norwegian sources, including Mowi, Landcatch, and Stofinfiskur hatcheries. All the fish are reported F6 from the river of origin.
- *Gear Type:* Up to 16 floating fish pens are permitted within a 867' x 503' rectangular area. Individual pens will measure approximately 80' x 80' and will be connected to form a system measuring approximately 680' x 170'. All pens will be bottom-moored by 2000-pound granite blocks or anchors.
- *Additional Information:* Has special conditions on ACOE permit from an ESA Section 7 consultation for effects on the bald eagle, a threatened species. The

USFWS issued a biological opinion for this site on July 17, 1997, which was then modified on September 18, 1998 and again on April 30, 2003.

B2. Libby Island, Machias Bay (ACOE Permit No: 199601473, DMR Site ID: ASMI LI)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* same as B1
- *Atlantic Salmon Strains:* same as B1
- *Gear Type:* Up to 84 floating fish pens are permitted within a 1600' x 544' rectangular area. The pens will consist of thirty 70' diameter and six 50' diameter circular pens and forty-eight 50' x 50' square steel pens organized into four groups of 12 pens each. The square pens will be connected together to form a system 110' x 300'. All pens will be bottom-moored by 2000-pound mooring blocks. The site will be serviced by a 40' x 90' work barge which supports a building for feed and equipment storage and employee shelter.

B3. Starboard Island, Machias Bay (ACOE Permit No: 199200040R92, DMR ID ASMI II)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* same as B1
- *Atlantic Salmon Strains:* same as B1
- *Gear Type:* Up to 64 floating fish pens are permitted within a polygon-shaped area measuring 40 acres. The pens will consist of either a total of 44 individually moored 70-foot-diameter circular pens or twenty-four 50' x 50' pens linked together around a central 10-foot-wide catwalk. The pen systems will measure approximately 500' x 110'. Individual pens and pen systems will be moored by 2000-pound granite blocks. The pens will be installed in two phases: the two 20-pen systems or alternatively 20 circular pens during the first phase, the remaining 24 circular pens during the second phase. The site will be serviced by a 40' x 90' work barge which supports a building for feed and equipment storage and employee shelter.

B4. Cross Island North, Machias Bay (ACOE Permit No: 199301092, DMR Site ID: ASMI CI2)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* same as B1
- *Atlantic Salmon Strains:* same as B1
- *Gear Type:* Up to 96 floating fish pens are permitted within a quadrilateral area with sides measuring 1099' x 1000' x 1317' x 1023'. The pens will be organized in six groups of 16 pens each, measuring approximately 400' x 110'. In each group the pens will be linked together around a central 400' x 10' catwalk. All pens will be bottom-moored by 2000-pound granite or concrete blocks.

B5. Cross Island South, Machias Bay (ACOE Permit No: ME-CRIS-872004-R-89, DMR ID: ASMI CI)

- *Species Authorized:* Atlantic salmon

- *Species Cultivated:* same as B1
- *Atlantic Salmon Strains:* same as B1
- *Gear Type:* Up to 32 floating fish pens are permitted within a 940' x 926' rectangular area. Individual pens will measure approximately 80' x 80' and will be connected together to form two, 16-pen systems, each measuring approximately 700' x 190'. Alternatively, the same number of circular pens will be installed on site. The circular pens would measure approximately 90' in diameter and will be connected together to form two, 16-pen clusters, each measuring approximately 700' x 190'. All pens will be bottom-moored by 2000-pound granite blocks or anchors and will be serviced by up to two, 50' x 120' work barges which support a building for feed and equipment storage and employee shelter. At the northwest end of each of the pen clusters, two floating breakwaters will be installed. The breakwaters will consist of tires threaded into two-foot-diameter PVC pipe and will measure approximately 200' in length. They will be installed parallel with one another and secured in the same way as the net pens.

B6. Flint Island, Machias Bay (ACOE Permit No: 199402554, DMR Site ID: ASMI FI)
- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* same as B1
- *Atlantic Salmon Strains:* same as B1
- *Gear Type:* Up to 28 floating fish pens are permitted within a 1000' x 435' rectangular area. Each pen will measure approximately 50' x 50' and will be connected together to form two, 14-pen systems, each measuring approximately 110' x 350'. Alternatively, during the first year, up to 16, 70-foot-diameter circular pens will be used. All pens will be bottom-moored by 2000-pound granite blocks and will be serviced by a 40' x 90' work barge that supports a building for feed and equipment storage and employee shelter.

B7. Dyer Island, Machias Bay (ACOE Permit No: 199500257, DMR Site ID: ASMI DI)
- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* same as B1
- *Atlantic Salmon Strains:* same as B1
- *Gear Type:* Up to 56 floating fish pens are permitted within a 1000' x 871' rectangular area. Each pen will measure approximately 50' x 50' and will be connected together to form four, 14-pen systems, each measuring approximately 110' x 350'. Alternatively, up to 32, 70-foot-diameter circular pens will be used. All pens will be bottom-moored by 2000-pound granite blocks and will be serviced by a 40' x 90' work barge that supports a building for feed and equipment storage and employee shelter.

C. **Treat's Island Fisheries, Inc.** (Atlantic Salmon of Maine, LLC)

C1. Comstock Point 5 and Comstock Point 10, Cobscook Bay (ACOE Permit No: ME-EAPT-890197-R-90, DMR Site ID: TIFI CC1/CC2)

- ***Species Authorized:*** Atlantic salmon, rainbow trout, Atlantic halibut, flounder, pollock, sea scallops, and clams
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Smolts came from Atlantic Salmon of Maine, LLC
- ***Gear Type:*** Ten 72-foot-diameter circular pens and a 20' x 50' feed barge are permitted. The circular pens will be bottom-moored by 4000- to 8000-pound granite blocks. Comstock 5 spans an area of 400' x 500', and Comstock 10 an area of 400' x 1120'.

C2. Treat Island, Cobscook Bay (ACOE Permit No: ME-EAPT-871826-R-90 (Combined with site C3), DMR Site ID: TIFI TW1)

- ***Species Authorized:*** Atlantic salmon, rainbow trout, Atlantic halibut, red algae-nori
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Smolts come from Atlantic Salmon of Maine, LLC
- ***Gear Type:*** Install and maintain twenty 72-foot-diameter circular pens and a 40' x 50' feed barge. The circular pens will be bottom-moored by 4000- to 8000-pound granite blocks. An 800' x 772' area is covered at this site.

C3. Gull Rock, Cobscook Bay (ACOE Permit No: ME-EAPT-871826-R-90 (Combined with site C2), DMR Site ID: TIFI TW2)

- ***Species Authorized:*** Atlantic salmon and rainbow trout
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Smolt come from Atlantic Salmon of Maine, LLC
- ***Gear Type:*** Same as Treat Island (C2) above

C4. Johnson Cove, Cobscook Bay (ACOE Permit No: ME-EAPT-871825-R-89, DMR Site ID: TIFI JC)

- ***Species Authorized:*** Atlantic salmon, rainbow trout, halibut, sea scallops, and clams
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Smolt come from Atlantic Salmon of Maine, LLC
- ***Gear Type:*** Up to 64 floating fish pens and/or scallop cages are permitted within a 900' x 500' area. The pens and/or cages will be organized in two groups, connected by two 20' x 20' floats, each group consisting of 32 pens and measuring approximately 700' x 90'. In each group the pens will be linked around a central 700' x 6' catwalk. All pens will be bottom-moored by 3000-pound granite blocks.

D. Island Aquaculture Corp. (Atlantic Salmon of Maine, LLC)

D1. Black Island, Blue Hill Bay (ACOE Permit No: 199902033, DMR Site ID: IACO BI)

- ***Species Authorized:*** Atlantic salmon, Atlantic cod, Atlantic halibut, haddock, blue mussels
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Penobscot, St. John hybrids crossed with descendants of European lines. Also have some Craig Brook National Fish Hatchery Penobscot descendants in the 2000 generation
- ***Gear Type:*** Up to 18 floating fish pens are permitted within a 1450' x 450' rectangular area. Individual pens will measure approximately 92' x 92' and will be connected to form a system measuring approximately 180' x 780'. Alternatively, a ten-pen system (180' x 436') and an eight-pen system (180' x 780') will be installed. All pens will be bottom-moored by 6000-pound mooring blocks. The site will be serviced by a 30' x 60' work barge.
- ***Additional Information:*** Currently examining the feasibility of mussel culture as a small-scale polyculture experiment.

D2. Harbor Island (Scrag Island), Blue Hill Bay (ACOE Permit No: 1991-00001-R-91, DMR Site ID: IACO HS)

- ***Species Authorized:*** Atlantic salmon, Atlantic cod, and haddock
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** same as D1
- ***Gear Type:*** Up to 12 floating fish pens are permitted within a hexagonal area with sides measuring approximately 360' x 320' x 1473' x 381' x 1574' x 413'. The pens are independently moored by a two-point system and are approximately circular, measuring 76' in diameter, the outer floatation ring also providing an access walkway. Each pen will be secured individually by 6000-pound concrete blocks. The fish pens will be serviced by a 20.5' x 44' work barge which supports a 10' x 8' building for equipment, feed storage, and employee shelter.

D3. Toothacher Cove, Blue Hill Bay (ACOE Permit No: 1993-00273, DMR Site ID: IACO TC)

- ***Species Authorized:*** Atlantic cod, Atlantic salmon, Donaldson sea trout, haddock
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** same as D1
- ***Gear Type:*** Up to 18 floating fish pens are permitted within a 1254' x 627' rectangular area. The pens will consist of up to 12, 54-foot-diameter and up to six 75-foot-diameter circular floating pens moored in two parallel rows of nine pens each, running east to west within the site. The site will be serviced by a 40' x 20.5' work barge that supports a building for feed and equipment storage and employee shelter.

E. Stolt Sea Farm, Inc. (Delaware Corporation)

E1. Johnson Bay, Cobscook Bay (ACOE Permit No: 1994-00974, DMR Site ID: SFML JB3)

- *Species Authorized:* Atlantic salmon, Atlantic cod, haddock, Atlantic halibut
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* 2001 fish descended from St. John and Penobscot point of origin. No fish were stocked in 2000. 1999 fish descended from St. John and Landcatch point of origin, as well as Penobscot point of origin. 1998 and all previous year's fish were descended from St. John point of origin.
- *Gear Type:* Up to eighteen 72-foot-diameter pens and a 20' x 40' feed barge are permitted. The circular pens will be bottom-moored by 4000-pound granite blocks. Planned upgrade options consistent with the permitted area include: 10-90 meter circular pens of eight 100-meter circular pens.

E2. Rogers Island North and South, Cobscook Bay (ACOE Permit No: ME-WLUB-890196-R-90 and 199701558, DMR Site ID: SFML RN/RS)

- *Species Authorized:* Atlantic salmon, rainbow trout
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* same as E1
- *Gear Type:* Up to 40, 15-meter square steel pens permitted. Both sites contain 12, 70-meter polar circle pens and a 20' x 40' support barge with feed building in a 1000' x 425' area. All pens will be bottom-moored by 4000-pound granite blocks.

F. D.E. Salmon, Inc. (Stolt Sea Farm, Inc., Delaware Corporation)

F1. Gove Point West, Cobscook Bay (ACOE Permit No: 1995-01174, DMR Site ID: DESC GN2)

- *Species Authorized:* Atlantic salmon, sea urchins, giant sea scallops
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* D.E. Salmon, Inc. grows fish that have several points of origin, or are crosses among those lines, including St. John and Penobscot strain (originally obtained from the federal hatcheries in Maine), as well as fish descended from imported gametes from the Landcatch hatchery. Smolts are also purchased from time to time from other companies, and it is possible that those lines might contain some genetic material from fish descended from gametes from Iceland or Norwegian hatcheries.
- *Gear Type:* Up to 16 floating fish pens are permitted within a 800' x 545' rectangular area. Each pen will measure 15 meters and will be connected to form a 16-pen system measuring approximately 110' x 404'. All pens are bottom-moored by anchors or mooring stones. A 40' work boat provides feed and equipment storage and employee shelter.
- *Additional Information:* No fish stocked in 2000 and 2001.

F2. Gove Point East, Cobscook Bay (ACOE Permit No: ME-EAPT-890195-R-90, DMR Site ID: DESC GN1)

- ***Species Authorized:*** Atlantic salmon, sea urchins, giant sea scallops
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** same as F1
- ***Gear Type:*** Up to 20 floating fish pens are permitted within a 660' x 660' area. The pens are organized into two groups, consisting of ten 50-meter pens and measuring approximately 250' x 112'. The pens are linked together by a central 250' x 12' catwalk with an attached 14' x 16' work float. A 10' x 8' x 8' building on the float stores feed, equipment, and provides employee shelter. The pens are bottom-moored by 4000-pound granite blocks. Planned future amendments, consistent with the present square footage, sought for include one group of eight 24-meter square steel pens.
- ***Additional Information:*** No fish stocked in 2000 and 2001.

F3. East Johnson Bay, Cobscook Bay ACOE Permit No: 1993-00051, DMR Site ID: DESC LU)

- ***Species Authorized:*** Atlantic salmon, rainbow trout
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** same as F1
- ***Gear Type:*** This site contains eight 70-meter polar circles in a 600' x 726' area, bottom-moored by 4000-pound granite blocks. There is also an on-site support barge with a building that is similar to other finfish aquaculture industries.

G. International Aqua Foods USA, Inc. (Stolt Sea Farm Inc., Canadian Corporation)

G1. Harris Cove, Cobscook Bay (ACOE Permit No: 1995-00887, DMR Site ID: IAFI HP)

- ***Species Authorized:*** Atlantic salmon, Donaldson trout, Atlantic cod, haddock, Atlantic halibut
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Fish stocked in 2000 were descendants from Penobscot, St. John, and Landcatch point of origin and some were Landcatch/Icelandic crosses.
- ***Gear Type:*** Up to 40 floating fish pens within a rectangular shaped 800' x 545' area are permitted. The existing site configuration includes 24, 15-meter square steel pens. A planned upgrade would include 12, 24-meter square steel pens in the same permitted area. All pens will be bottom-moored by 2500-pound anchors and weir stakes and will be serviced by a 40' x 16' work barge which will provide feed and equipment storage and employee shelter.

G2. Kendall Head South, Cobscook Bay (ACOE Permit No: 1993-01738, DMR Site ID: IAFI JK)

- ***Species Authorized:*** Atlantic salmon, rainbow trout, Atlantic halibut
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** same as G1

- *Gear Type:* Up to 32 floating fish pens within a 800' x 1200' rectangular area are permitted. The existing pen configuration consists of four 24-meter square steel pens, eight 15-meter square steel pens, six 12-meter square steel pens, and 16, 70-meter polar circles. The pens will be secured by a combination of timber pilings, 2500-pound danforth anchors, and 6000-pound concrete blocks. A 30' x 16' work barge will be secured to the pens and will support a 10' x 16' building for feed and equipment storage and employee shelter.

G3. Prince Cove, Cobscook Bay (ACOE Permit No: ME-EAPT-882088-R-89, DMR Site ID: IAFI PC)

- *Species Authorized:* Atlantic salmon, rainbow trout, halibut
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* same as G1
- *Gear Type:* Up to 52 floating fish pens within a 1734' x 666' area are permitted. The existing pen configuration within this area is 12, 24-meter steel pens and eight 15-meter square steel pens.

G4. Cooper Island Ledge, Cobscook Bay (ACOE Permit No: ME-EAPT-890194-R-89, DMR Site ID: IAFI CL)

- *Species Authorized:* Rainbow trout, Atlantic salmon, Atlantic halibut, abalone, blue mussels, European and American oysters, sea scallops, bay scallops, hard and soft shelled clams, seaweed, red algae, and fan worms
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* 1999 fish descended from Penobscot and St. John points of origin, as well as crosses among Penobscot, Landcatch, and Icelandic point of origin.
- *Gear Type:* Up to 36 floating fish pens within a rectangular area measuring approximately 735' x 590' are permitted. The existing site configuration includes six 24-meter square steel pens and 12, 15-meter square steel pens covering a 590' x 735' area. The applicant will also install and maintain two 14-foot-diameter floating dulse hoops, a bottom cage shellfish nursery consisting of nine vertical 10' x 2' x 12' scallop grow out systems and bottom-secured grown out bags of softshell clams. The nursery will occupy a 100' x 300' section in the southwest corner of the site. There is also a support barge with a building on site.
- *Additional Information:* Not stocked in 2001.

H. Heritage Salmon

H1. South Bay, Cobscook Bay (ACOE Permit No: ME-EAPT-890198-R-90, DMR Site ID: CONA SB)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* Penobscot and St. John strains
- *Gear Type:* This site contains one 18-cage system and one ten-cage system covering a 1875' x 725' area.

H2. Broad Cove, Cobscook Bay (ACOE Permit No: ME-EAPT-872009-R-89 (combined with Deep Cove Site (H3) below), DMR Site ID: CONA BC)

- ***Species Authorized:*** Atlantic salmon and rainbow trout
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Penobscot and St. John strains
- ***Gear Type:*** This site contains two ten-cage systems in a 1089' x 2000' area.

H3. Deep Cove, Cobscook Bay (ACOE Permit No: ME-EAPT-872009-R-89, DMR Site ID: CONA DC)

- ***Species Authorized:*** Atlantic salmon and rainbow trout
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Penobscot and St. John strains
- ***Gear Type:*** This site contains 15, 100-meter polar circles covering an area of 1100' x 990'. On February 19, 2003, the permittee requested permission from the ACOE to modify the pen type and distribution; the new proposal is for 60, 15-meter steel cages, grouped in three 20-cage systems.

H4. Comstock Point I, Cobscook Bay (ACOE Permit No: ME-EAPT-890199-R-90 (combined with site H5 below), DMR Site ID: CONA CP1)

- ***Species Authorized:*** Atlantic salmon and rainbow trout
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Penobscot and St. John strains
- ***Gear Type:*** This site (combined with the site H5 below) contains two systems, each containing 20, 15-meter cages covering a 840' x 520' area.

H5. Comstock Point II, Cobscook Bay (ACOE Permit No: ME-EAPT-890199-R-90, DMR Site ID: CONA CP2)

- ***Species Authorized:*** Atlantic salmon
- ***Species Cultivated:*** Atlantic salmon
- ***Atlantic Salmon Strains:*** Penobscot and St. John strains
- ***Gear Type:*** This site (combined with the site H4 above) contains two systems, each containing 20, 15-meter cages covering an 840' x 520' area.

H6. Goose Island, Cobscook Bay (ACOE Permit No: ME-EAPT-893404-R-90, DMR Site ID: CONA GI)

- ***Species Authorized:*** Atlantic salmon, rainbow trout, Atlantic halibut, soft-shelled clams and scallops, European oysters
- ***Species Cultivated:*** Not currently operating
- ***Gear Type:*** Install and maintain up to 72 floating fish pens within a 1667' x 600' rectangular area.

I. Birch Point Fisheries

I1. Birch Point, Cobscook Bay (ACOE Permit No: ME-EAPT-900228-R-90, DMR Site ID: BPFI BE)

- *Species Authorized:* Atlantic salmon and rainbow trout
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* St. John and Penobscot strains
- *Gear Type:* One group of 24 net pens, one group of ten pens, and one group of 20 pens. The site is 1242' x 1000' and contains 28.5 acres. On February 19, 2003, the permittee requested permission from the ACOE to modify the pen type and distribution to use 20, 70-meter polar circles moored together in a single group.

J. Maine Salmon, Inc.

J1. Shackford Head, Cobscook Bay (ACOE Permit No: ME-EAPT-892130-R-90, DMR Site ID: MESI SH)

- *Species Authorized:* Atlantic salmon, rainbow trout, Atlantic halibut, sea scallops, American and European oysters
- *Species Cultivated:* As of 4/15/01, Maine Salmon, Inc. only grew Atlantic salmon
- *Atlantic Salmon Strains:* Penobscot and St. John strains
- *Gear Type:* 20 cages take up approximately 0.93 of an acre, which is 11% of the lease site. The cages are 40' x 40' steel.

K. L.R. Enterprises, Inc.

K1. Birch Point, Cobscook Bay (ACOE Permit No: ME-EAPT-900277-R-90, DMR Site ID: LREN TE)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* smolts supplied by Heritage Salmon
- *Gear Type:* Maximum of 40, 15-meter square pens

K2. Treat Island, Cobscook Bay (ACOE Permit No: ME-EAPT-882089-R-89, DMR Site ID: LREN TE)

- *Species Authorized:* Atlantic salmon and rainbow trout
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* no non-native strains
- *Gear Type:* Lease area is 1008' x 650' and contains 12, 20-meter steel cages

K3. Gove Point, Cobscook Bay (ACOE Permit No: ME-EAPT-R-90, DMR ID LREN GS)

- *Species Authorized:* Atlantic salmon, sea urchins, giant sea scallops
- *Species Cultivated:* None at this time
- *Atlantic Salmon Strains:* None at this time
- *Gear Type:* Lease is limited to a maximum of 40, 15-meter square pens. Pens to be located at least 240' from the southern boundary of lease. As of March 20,

2001, no cages were present on this site. Possible redevelopment was considered in spring 2001.

L. Maine Coast Nordic

L1. Cutler Peninsula, Machias Bay (ACOE Permit No: 1991-01882-R-90, DMR Site ID: MCNI CW)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* St. John or Penobscot from Heritage Salmon
- *Gear Type:* March 20, 2001: no cages on site. Plans to install a six-cage 24 x 24 meter steel cage system or five units of 100-meter plastic cages.

L2. Sand Cove North, Eastern Bay (ACOE Permit No: 1996-00240, DMR Site ID: MCNB SCN)

- *Species Authorized:* Atlantic salmon, Atlantic cod, haddock, Atlantic halibut
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* smolts supplied by Heritage Salmon
- *Gear Type:* The site is 1000' x 435' and includes a group of nine pens.

L3. Little River South, Cutler (ACOE Permit No: ME-CYTL-883416-R-90, DMR Site ID: MCNC CH)

- *Species Authorized:* Atlantic salmon, rainbow trout, halibut
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* St. John strain
- *Gear Type:* The site covers an area of 300' x 1000' and includes one row of eight 70-meter cages.

L4. Little River North, Cutler (ACOE Permit No: 1993-00240, DMR Site ID MCNC CN)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* St. John strain
- *Gear Type:* Eight 70-meter cages plus one 40-meter cage. Site area is 300' x 1000'.

L5. Spectacle Island, Eastern Bay, Beals (ACOE Permit No: 199101875-R-92, DMR Site ID: MCNI SI)

- *Species Authorized:* Atlantic salmon
- *Species Cultivated:* Atlantic salmon
- *Atlantic Salmon Strains:* St. John strain
- *Gear Type:* Up to 12, 75-foot-diameter circular pens within a 400' x 1089' rectangular area and a 32' x 16' work barge.

M. Pierce Associates, Inc.

M1. Sheepscot River, Wiscasset, Lincoln County, Maine (ACOE Permit No: 1998802560, DMR Site ID: PIER SR)

- *Species Authorized:* rainbow trout, Arctic char, brown trout
- *Species Cultivated:* female triploid rainbow trout
- *Atlantic Salmon Strains:* None cultivated
- *Gear Type:* Up to nine five-foot-diameter octagonal pens. A permit amendment authorized the addition of four 16' x 16' "experimental pens" to take the place of one of the original 50-foot pens.

ACOE Special Conditions to be Included in the Modified RHA Section 10 Permits:

The ACOE is proposing to include the following special conditions in each of the existing RHA Section 10 permits referenced in this opinion to provide protection to the Atlantic salmon GOM DPS:

1. a. Except as described in this section, the use of reproductively-viable Atlantic salmon originating from non-North American stock is prohibited. Non-North American stock is defined as any Atlantic salmon (*Salmo salar*) that possess genetic material derived partially (hybrids) or entirely (purebreds) from any Atlantic salmon stocks of non-North American heritage, regardless of the number of generations that have passed since the initial introduction of the non-North American genetic material. For the purposes of this permit, classification of brood fish as either North American or non-North American stock will be based on genetic evaluation of each fish's DNA in accordance with the attached Atlantic Salmon Microsatellite Analysis Protocol (Attachment 1). The microsatellite protocol shall be used to classify each brood fish, and only the progeny of brood fish classified as North American stock will be allowed in net pens. No fish classified as non-North American according to Attachment 1 can be utilized to create progeny for stocking in net pens.

   b. Prior to September 1 of each year, beginning in 2003, genetic evaluation information developed pursuant to Attachment 1 shall be submitted to the Services, with confirmation sent to the ACOE.

   c. Prior to November 30 of each year, beginning in 2003, the facility shall submit a letter to the Services certifying that it will be in compliance with condition 1a. Within 30 days of receipt of the letter from the facility, the Services will provide the ACOE with confirmation that the facility will be in compliance with condition 1a. In the event any fish or gametes are classified as non-North American pursuant to Attachment 1, the facility shall also report to the Services the disposition of those fish or gametes. No fish will be stocked into fish pens without prior written approval from the ACOE.

   d. Effective July 31, 2004, all reproductively-viable Atlantic salmon placed in net pens must be of North American origin. Within 30 days after placement of fish, the facility shall provide the ACOE with written confirmation regarding compliance with this condition.

e. All reproductively-viable non-North American Atlantic salmon must be removed from net pens prior to March 1, 2006. Within 30 days after removal of fish, the facility shall provide the ACOE with written confirmation regarding compliance with this condition.

2. Transgenic salmonids are prohibited at these facilities. Transgenic salmonids are defined as species of the genera *Salmo*, *Oncorhynchus* and *Salvelinus* of the family Salmonidae and bearing, within their DNA, copies of novel genetic constructs introduced through recombinant DNA technology using genetic material derived from a species different from the recipient, and including descendants of individuals so transfected. This prohibition does not apply to vaccines.

3. Prior to stocking salmonid species other than Atlantic salmon at these facilities, certification from the Maine Fish Health Technical Committee and DMR of compliance with disease management standards permitting the culture of alternative salmonid species shall be provided to the ACOE. No alternative salmonid species shall be stocked without prior written approval from the ACOE.

4. The facility shall employ a fully functional marine containment management system (CMS) designed, constructed, and operated so as to prevent the accidental or consequential escape of fish to open water. Each CMS plan shall include a site plan or schematic with specifications of that particular system. Each facility shall develop and utilize a CMS consisting of management and auditing methods to describe or address the following: inventory control procedures, predator control procedures, escape response procedures, unusual event management, severe weather procedures, and training. The CMS shall contain a facility-specific list of critical control points (CCP) where escapes have been determined to potentially occur. Each CCP must include the following: the specific location, control mechanisms, critical limits, monitoring procedures, appropriate corrective actions, verification procedures that define adequate CCP monitoring, and a defined recordkeeping system.

a. The CMS will be audited at least once per year and within 30 days of a reportable escape (more than 50 fish two kg or larger) by a party other than the facility operator or owner who is qualified to conduct such audits and is approved by the ACOE and the Services. The first annual audit shall be conducted prior to March 1, 2004. The ACOE, with the approval of the Services, may exempt a facility from an escape-triggered audit when circumstances preclude the possibility that it was the source of the escaped fish. A written report of these audits shall be provided to the facility, the ACOE, and the Services within 30 days of the audit being conducted. If deficiencies are identified during the audit, the report shall contain a corrective action plan, including a timetable for implementation and re-auditing to verify that deficiencies are addressed in accordance with the corrective action plan. Additional third party audits to verify correction of deficiencies shall be conducted in accordance with the corrective action plan or upon request of the ACOE. The facility shall notify the ACOE and the Services upon completion of corrective actions.

b. At each facility, personnel responsible for routine operation shall be properly trained and qualified to implement the CMS.

c. Each facility shall maintain complete records, logs, reports of internal and third party audits, and documents related to the CMS. The CMS shall require the submission of standing inventory at the facility, including all transfers in and out and all losses associated with disease, predation, or escapes as reported to the DMR at the pen level of detail on a monthly basis according to the requirements of 12 MRSA Section 6077.

d. If corrective actions required by the corrective action plan are not implemented, all pens and fish will be removed from the water within 30 days of notification from the ACOE.

5. The permittees shall report any known or suspected escape of more than 50 fish with an average weight of two kg each or more within 24 hours to the contacts given below. The caller should indicate they are providing notification of a reportable escape event at a marine cage. They should identify the location, DMR site ID for marine cages, contact person and number, time of event, estimated size of escape, and actions being taken. The escape reporting form (Attachment 2) should be faxed to the Services (USFWS: 207-827-6099 and NOAA Fisheries: 207-866-7342) and the ACOE (207-623-8206). Other escape events must be logged according to the CMS and provided to the ACOE and the Services upon request.

Contact during the work week:

(1) Primary: DMR, Aquaculture Coordinator, (207) 624-6554

If voice mail indicates Aquaculture Coordinator is out of the office, contact:

(2) Secondary: DMR, Marine Patrol, Division II, Lamoine, (207) 667-3373

Primary contact during the off-hours:

Orono State Police Dispatch, 1-800-432-7381

6. In accordance with the following dates, Atlantic salmon introduced into net pens must be marked to designate their origin so that in the event they escape from the facility, these fish can be identified.

a. In the event that a commercially-reared Atlantic salmon is found in a river within the range of the GOM DPS, and the facility from which it escaped cannot be identified, all facilities shall conduct third party audits of containment procedures as described in Special Condition number 4 above.

b. After April 1, 2004, all new Atlantic salmon placed in net pens must be identified through external means as commercially-reared and be identifiable as having been stocked in Maine waters. Prior to marking fish to be stocked, the facility shall submit to the ACOE and the Services for review and approval a description of the marking method(s) to be used for this purpose.

c. After July 31, 2004, all new fish placed in net pens must be identifiable through external means as commercially-reared and be identifiable through any means as having been stocked in Maine waters and as to the hatchery from which they came. Prior to marking fish to be stocked, the facility shall submit to the ACOE and the Services for review and approval a description of the marking method(s) to be used for this purpose. In the event similar or conflicting marking systems are proposed by different facilities, the ACOE may require a facility to make changes to assure that each facility owner will be uniquely identifiable.

d. After July 31, 2005, all new Atlantic salmon placed in net pens must be identifiable through external means as commercially-reared and be identifiable as having been stocked in Maine waters and to a level that is more specific than the above hatchery mark (e.g., hatchery sublots, facility owners). Prior to marking fish to be stocked, the facility shall submit to the ACOE and the Services for review and approval a description of the marking method(s) to be used for this purpose. In the event similar or conflicting marking systems are proposed by different facilities, the ACOE may require a facility to make changes to assure that the hatchery of origin will be uniquely identifiable.

e. By September 1, 2006, each permittee must submit to the ACOE and the Services for review and approval a final report describing investigations of methods or procedures that may be used to identify Atlantic salmon as to the facility into which they were placed. The facility shall specify, to the ACOE and the Services for their review and approval, a description of the marking method(s) it proposes to use for this purpose. In the event similar or conflicting marking methods are proposed by different facilities, the ACOE may require the permittee to make changes to assure that fish will be uniquely identifiable as to the facility into which they are placed. During development of the marking method, the facility shall submit periodic progress reports describing proposals for and the results of investigations or trials. At a minimum, the progress reports shall be submitted by January 31 and July 31 of each year, or more frequently as indicated by the nature of the investigations, in order to keep the ACOE and the Services informed of developments and proposals on a timely basis.

f. By July 31, 2007, all Atlantic salmon placed in net pens must be identifiable through external means as commercially-reared and identifiable as to the individual facility into which they were placed.

7. Personnel from the ACOE and the Services shall be allowed to inspect the work authorized by these permits during normal operation hours. These personnel will provide credentials attesting to their position and will follow the site's biosecurity procedures. These personnel shall be allowed to take tissue samples from fish or, if necessary, take random samples of fish from these facilities (as well as fish at any life stage from the hatcheries that support these facilities) to monitor compliance with Special Conditions No. 1, 2, and 6. Operational records regarding compliance with this permit shall be made available by the permittee to these personnel for their inspection and reproduction upon request.

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." To ensure that the action area includes all of the direct and indirect effects caused by escaped aquaculture fish, the area for this consultation encompasses the immediate area of each marine aquaculture facility, as well as the entire geographic range of the GOM DPS of Atlantic salmon from the Kennebec River downstream of the former Edwards Dam site to the international boundary separating New Brunswick from the State of Maine. The action area also includes the industry's two freshwater hatcheries that are located within the GOM DPS, at Deblois, Maine on a tributary of the Pleasant River, and at East Machias, Maine on a tributary of the East Machias River.

II. STATUS OF THE SPECIES AND ENVIRONMENTAL BASELINE

The Status of the Species section presents biological information relevant to formulating the 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. The Environmental Baseline provides a snapshot of a species health or status at a given time within the action area and is used as a biological basis upon which to analyze the effects of the proposed action. Assessment of the environmental baseline includes an analysis of 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 is typically a more narrowly focused subset of the Status of the Species evaluation. However, in this opinion, the action area of the proposed agency action encompasses the entire geographic range of the Atlantic salmon GOM DPS. Therefore, the following discussion of the status of the species also fully describes the current environmental baseline condition for the Atlantic salmon GOM DPS.

A. Species Description

The Atlantic salmon is an anadromous fish species, which means that it spends most of its adult life in the ocean but returns to freshwater to reproduce. Coloration varies from silver, while at sea, to a dark brown or bronze after entering fresh water to spawn. 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 down into Long Island Sound. However, the Central New England and Long Island Sound DPS have been extirpated.

The ESA considers the term "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate fish or wildlife that interbreeds when mature." Species sub-structure is particularly important to anadromous salmonids because their strong homing capability fosters the formation of discrete populations exhibiting important adaptations to local riverine ecosystems and the watersheds that determine their character (Berst and Simon 1981; Utter 1981; Utter *et al.* 1993; Nielsen 1998).

A DPS of anadromous Atlantic salmon in the Gulf of Maine was listed 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. The watershed structure, available Atlantic salmon habitat, and abundance of Atlantic salmon at various life stages are best known for the following eight rivers: Dennys River, East Machias River, Machias River, Pleasant River, Narraguagus River, Ducktrap River, Sheepscot River, and Cove Brook (65 FR 69459, Nov. 17, 2000). The USFWS's GOM DPS river-specific hatchery-reared fish are also included as part of the listed entity.

1. *Listing History*

In response to a petition submitted in 1993 to list Atlantic salmon under the ESA, the Services completed a review of the species' status in 1995 (USFWS/NOAA Fisheries 1995). The Services concluded that there was a danger of extinction and later in 1995 published a proposed rule to list a GOM DPS of Atlantic salmon in seven Maine rivers as threatened (60 FR 50530, Sept. 29, 1995). In that proposed rule, the State of Maine was invited to prepare a plan to eliminate, minimize and mitigate threats to Atlantic salmon and their habitat. On December 18, 1997, the Services withdrew the proposed rule to designate the Atlantic salmon GOM DPS as threatened (62 FR 66325, Dec. 18, 1997). The withdrawal was based on an evaluation of the information then known about the biological status of the species, as well as consideration of ongoing actions by international, state, federal, and private entities, including the state's Atlantic Salmon Conservation Plan for Seven Maine Rivers (Conservation Plan) (MASCP 1997).

In January 1999, the Services received the State of Maine's 1998 Annual Progress Report on implementation of the Conservation Plan. After review of the Annual Report, public comments, and a 1999 Atlantic salmon status review (AASBRT 1999), the Services determined that the species' status was more precarious than indicated by the available information at the time of their December 1997 determination not to list the species. On November 17, 1999, the Services proposed to list the Atlantic salmon GOM DPS, this time as an endangered species. After review of public comments and consideration of the best available scientific and commercial information and data, the Services published a final rule on November 17, 2000 listing the Atlantic salmon GOM DPS as an endangered species.

B. Life History

1. *Freshwater Lifestages*

Adult Atlantic salmon ascend the rivers of New England beginning in the spring, 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 (Daniel *et al.* 1984). Redds, the depression 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 476,577 units (100 square yard 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 ten to 60 cm, velocities between 30 and 92 cm per second, and temperature near 16°C (Beland 1984). Parr actively defend territories (Daniel *et al.* 1984; Mills 1964; Kalleberg 1958; Allen 1940). 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 (Hearn 1987; Fausch 1988), 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, chironomides, 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 Elson 1975). This process, called "smoltification," prepares the parr for migration to the ocean and life in salt water. In Maine, the majority (80%) of parr remains 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; USFWS 1989; and Ruggles 1980). 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).

2. *Marine Lifestages*

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 stage grows rapidly and has been documented to move in small schools loosely aggregated close to the surface (Dutil and Coutu 1988). After entering into 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 (Hislop and Youngson 1984; Jutila and Toivonen 1985; Fraser 1987; Hislop and Shelton 1993).

Most of the GOM DPS-origin salmon spend two winters in the ocean before returning to 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).

3. *Disease Factors, Predators, and Competitors*

Many parasites and diseases are known to infect Atlantic salmon, but Maine wild salmon populations are infrequently affected by them (Baum 1997). Most of the infections occur under hatchery or other crowded rearing conditions. The common sea louse, found only on salmonids, is prevalent on Atlantic salmon at sea. On juvenile salmon in Maine rivers, the common brook trout ecto-parasite has been occasionally observed. In salt water, vibriosis is a common bacterial disease affecting most species of fish, including farmed Atlantic salmon. Therefore, vibriosis is also thought to affect wild salmon populations (Baum 1997).

The retrovirus salmon swimbladder sarcoma virus (SSSV) appears to exist at some level in wild populations of salmon in Maine, although symptoms have not been observed in wild salmon (AASBRT 1999). In 1998, SSSV was detected in Pleasant River broodstock held by the USFWS, resulting in the decision to destroy all captive broodstock for this river. SSSV has been identified at very low levels in captive broodstock populations from three other GOM DPS rivers.

Coldwater disease is caused by the bacterium *Flavobacterium psychrophilum* and has recently been found to be a serious problem for Atlantic salmon in New England waters. The pathogen causes mortality in juvenile salmon. The pathogen is transmitted vertically from carrier sea-run adults to offspring via eggs [U.S. Atlantic Salmon Assessment Committee (USASAC) 2000; 65 FR 69476, Nov. 17, 2000)].

The infectious salmon anemia virus (ISAV) appeared on the North American continent in 1996 in Canadian aquaculture pens, within the known infective range of U.S. sea pens. ISAV was first detected at a Maine salmon farm in Cobscook Bay in January 2001, with subsequent outbreaks at several other salmon farms in Cobscook Bay. The ISAV virus is extremely destructive to maturing salmon, and there is no known cure (USASAC 2000; 65 FR 69476, Nov. 17, 2000).

Known predators of Atlantic salmon include marine mammals (e.g., seals, porpoises, and dolphins), terrestrial mammals (e.g., otters, minks), birds, fish and sharks. Atlantic salmon post-smolts are preyed upon by cod, whiting, cormorants, ducks, terns, gulls, and many other opportunistic predators (Hvidsten and Møkkelgjerd 1987; Gunnerød *et al.* 1988; Hvidsten and Lund 1988; Montevecchi *et al.* 1988; Hislop and Shelton 1993). Cormorants and striped bass are transitory predators that impact migrant juveniles in the lower river and estuarine areas. Seals have reached high population levels not reported before, and salmon remain vulnerable to seal predation throughout much of their range.

Competitive interactions of Atlantic salmon with non-salmonine fish, especially introduced species, are not well understood (AASBRT 1999). Interactions between wild Atlantic salmon and other salmonids are mostly limited to brook trout, and occasionally brown trout. Competition appears to play an important regulatory role shortly after fry emerge from redds, when fry densities are at their highest (Hearn 1987). These interactions may cause Atlantic salmon and brook and brown trout populations to fluctuate from year to year. Since brook trout and Atlantic salmon co-evolved, however, wild populations should be able to co-exist with minimal long-term effects (Hearn 1987; Fausch 1988). Where resources are limited, interspecific competition can exist between brown trout and Atlantic salmon and may cause interactive segregation, or affect the growth and survival of these species. Several other fish species occur in the GOM DPS rivers, including smallmouth and largemouth bass, pickerel, and landlocked salmon. In general, conclusions cannot be drawn regarding the competitive effects of these species on salmon, as no data are currently available (AASBRT 1999). Atlantic salmon and rainbow trout produced by the aquaculture industry (including non-North American strains and potentially transgenics) that escape from hatcheries or net pens also compete with wild Atlantic salmon. (This topic is discussed further later in this section of the opinion, as well as in the Effects of the Action section.)

C. Population Dynamics

1. *Historical Abundance*

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.

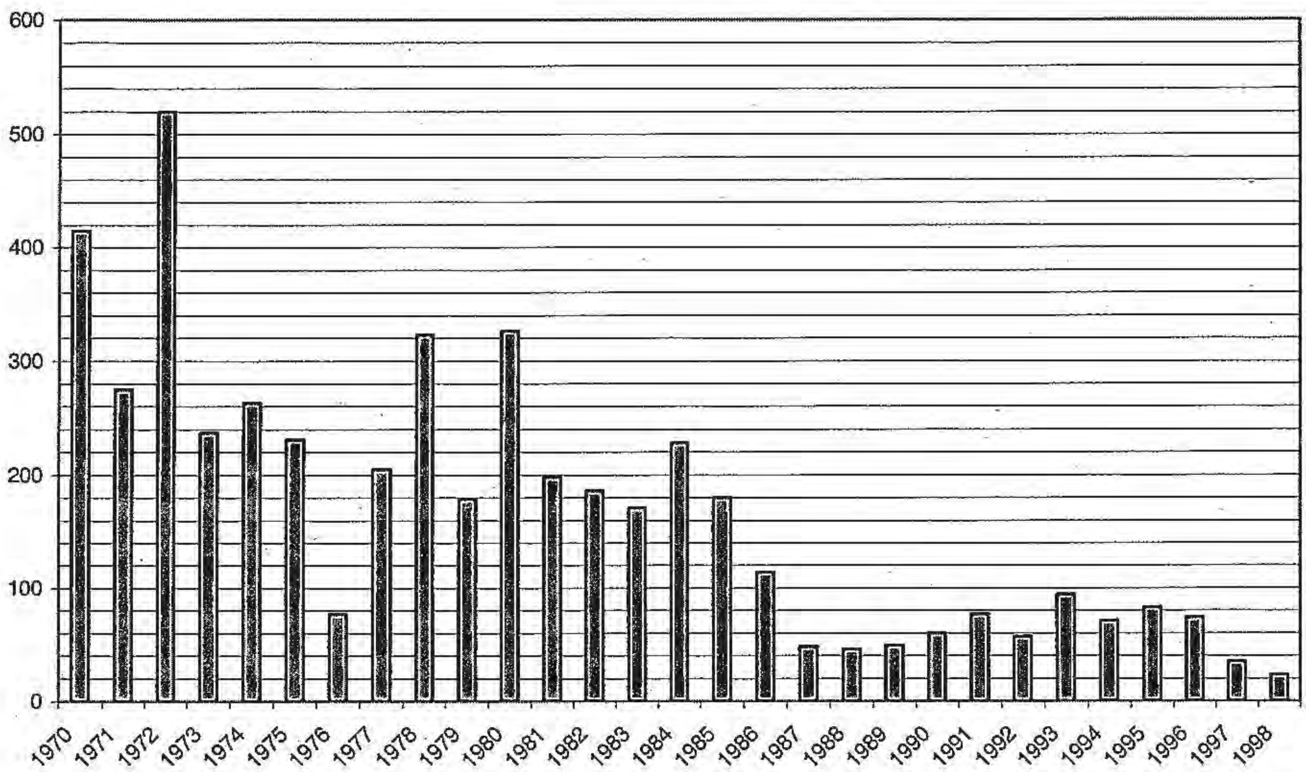
By the early 1800s, Atlantic salmon runs in New England had been severely depleted due to the construction of dams, over fishing, and water pollution, all of which greatly reduced the species' distribution in the southern half of its range. Restoration efforts were initiated in the mid-1800s, but there 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.

2. *Current Abundance*

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 6 demonstrates this trend (AASBRT 1999).

Total documented (rod and trap caught fish) natural (wild and stocked fry) GOM DPS spawner returns for 1995 through 2001 are: 1995 (85); 1996 (82); 1997 (38); 1998 (23); 1999 (32); 2000 (28); and 2001 (60) (USASAC Annual Report 2002/14). These counts (as well as the counts shown in Figure 6) 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 Maine Atlantic Salmon Commission (ASC) demonstrate that salmon do return to those rivers for which no adult counts are possible. Since 2001, scientists have made an estimate of the total number of returning salmon to the GOM DPS. 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. Documented returns based on these redd counts and trap data estimate a total of 91 adult returns in 2000 and 98 adults in 2001, at 95% probability. The 90% probability estimate for returns to the GOM DPS in 2002 ranges from 23-46 adults. This estimate is the lowest on record for the 1991-2002 time series (John Kocik, pers. comm.).

Figure 6. Total Documented Natural (Wild and Fry Stocked) Spawner Returns from USASAC (1999) data (minimal estimates) for the GOM DPS 1970-1998.



Densities of young-of-the-year salmon (0+) and parr (1+ and 2+) generally remain low relative to potential carrying capacity. The 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 short, 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).

D. Status of the Species and Factors Affecting its Environment

Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are confronted with a variety of threats, including artificially-reduced water levels, diseases and parasites, predation, sedimentation of habitat, and genetic intrusion by commercially-raised Atlantic salmon that escape from freshwater hatcheries or marine cages. The Services listed the GOM DPS 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). These and other factors, including conservation actions, affecting the current status of the Atlantic salmon GOM DPS are discussed below.

1. *Agricultural Water Withdrawals*

Water withdrawals have the potential to reduce or expose salmon habitat in rivers. Sufficient water flow, both in quality and quantity, is critical for all life stages of Atlantic salmon, from spawning through smolt emigration and adult migration. Both water quality and quantity can be affected by extraction of water for irrigation or other purposes. Changes in stream flow from withdrawals can also affect basic sediment transport functions and result in stream channel modifications that could be detrimental to salmon.

One of the fourteen goals in the State of Maine's Atlantic Salmon Conservation Plan (see further discussion below on the Conservation Plan in Section II. D. 8. a.) called for the state and its partners to "ensure water withdrawals do not adversely affect Atlantic salmon." To achieve this goal, the Conservation Plan calls for the development of water use management plans for three downeast river basins (Narraguagus, Pleasant, Mopang). In 1999, the State of Maine established a committee to prepare water use management plans (WUMP) for these three downeast rivers. The WUMP committee represented diverse interests, including landowners, lake association members, conservation groups, blueberry growers, and state and federal agencies (USFWS was active on the committee). The WUMP report [Maine State Planning Office (MSPO) 2001] lays out a prescribed set of actions that should result in the protection of salmon habitat while offering some predictability for water users. As a result of the WUMP and its related implementation initiatives, fewer growers are drawing water directly from rivers. Over the past several years, there has been a net reduction in the number of irrigators using water from streams (Nate Pennell, pers. comm.). Although numerous small growers continue to rely on direct withdrawals from rivers, other growers are relying instead on groundwater withdrawals to meet their needs. Despite the fact that Maine has made substantial progress in addressing the issue of agricultural water withdrawals through voluntary water use planning, adequate regulations are not in place to provide sufficient protection to the GOM DPS. Water withdrawals could still occur at a time and place that would result in habitat being unavailable or unsuitable for Atlantic salmon, which could adversely affect salmon numbers.

2. *Disease*

Fish diseases represent a natural source of mortality to Atlantic salmon in the wild, though major losses due to disease are generally associated with salmon used in aquaculture. Recent events have increased the Services' knowledge of the threat from disease to the GOM DPS, including: 1) the appearance of ISAV virus in 1996 in Canada and the collection of aquaculture escapees and wild fish testing positive for the ISAV virus; 2) the appearance of ISAV detected in a Maine salmon farm in Cobscook Bay in January 2001, and subsequent outbreaks at other farms in Cobscook Bay (15 sites confirmed by DMR); 3) the discovery in 1998 of SSSV within the GOM DPS population; and 4) new information that became available in 1999 on the potential impact of coldwater disease on salmon.

a. Salmon Swimbladder Sarcoma Virus

SSSV appears to exist at some level in wild populations of salmon in Maine, although symptoms have not been observed in wild salmon (AASBRT 1999). In 1998, SSSV was detected in Pleasant River broodstock held by the USFWS, resulting in the decision to destroy all captive broodstock for this river. SSSV has also been identified at very low levels in captive broodstock populations from three other GOM DPS rivers. The occurrence of SSSV has inhibited the USFWS's conservation hatchery program for the Pleasant River, but a new broodstock population has been established from smolts collected in the Pleasant River in 2000. The threat of SSSV to salmon populations living in the wild appears to be minimal, but this disease has the potential to significantly affect the USFWS's conservation hatchery program, given that diseases are more likely to manifest themselves under hatchery conditions. The conservation hatchery program is one component of the Services' salmon recovery efforts.

b. Coldwater Disease

Coldwater disease caused by the bacterium *Flavobacterium psychrophilum* has recently been found to be a serious problem for Atlantic salmon in New England waters. The pathogen causes mortality in juvenile salmon. The pathogen is transmitted vertically from carrier sea-run adults to offspring via eggs (Atlantic Salmon Assessment Committee, 2000; 65 FR 69476, Nov. 17, 2000).

c. Summary

Although direct loss of listed salmon in the wild from the above-mentioned diseases is difficult to assess, there is an indirect effect of these diseases through their impact on the river-specific fish culture program to enhance maintenance and recovery of the GOM DPS. The impacts of ISAV, SSSV, and coldwater disease in the fish hatchery environment are two-fold: first, hatchery managers will destroy diseased salmon to prevent the spread of disease and second, loss of hatchery populations hinders salmon recovery. These diseases could pose a significant new hurdle to the USFWS's hatchery program's ability to function effectively, thereby significantly degrading an important salmon recovery strategy (AASBRT 1999).

3. *Predation*

Predation has always been a factor influencing salmon numbers; but under conditions of a healthy population, this would not be expected to threaten the continued existence of that population. However, low numbers of adult salmon returning to spawn in the GOM DPS, combined with the dramatic increases in population levels of some predators, such as cormorants and seals, elevate the threat to wild salmon from predation. Although the magnitude of the effect of predation on the current status of wild salmon is unknown, the loss of even a small number of fish to predation would adversely affect the GOM DPS population.

4. *Survival at Critical Life Stages*

Scientific studies are ongoing to partition Atlantic salmon mortality into critical life stages. For a number of years, marine survival rates have been known to be low for U.S. stocks of Atlantic salmon (Beland and Friedland 1997). Scientists attribute natural mortality in the marine environment to sources including stress, predation, starvation, disease, and parasites. Because the year-to-year variation in return rates for U.S. salmon stocks is generally synchronous with other North American stocks, low marine survival appears, in part, to be due to some unknown factors in the North Atlantic, particularly the Labrador Sea. Low marine survival rates are currently adversely affecting the GOM DPS population.

In recent years, outmigrating smolts have been trapped on some rivers within the GOM DPS. These studies have revealed that parr to smolt survival is significantly lower than was previously estimated (Kocik *et al.* 1999). Investigations of water quality parameters are being conducted in an effort to identify the factors contributing to high mortality during the last winter that juveniles spend in the river before preparing to enter the ocean.

A portion of the smolts leaving some of the GOM DPS rivers have been tagged and tracked in order to gain information on the outmigration route and success. These studies have revealed that a large portion of the smolts do not make it out of the bay and into the open ocean. These results indicate that there may be factors within the nearshore marine environment that are negatively impacting survival. Recent studies on smolt conditions indicate that the smolts are not adequately prepared for the transition to salt water. Smolts entering the estuary and marine environment unprepared for this transition are likely to experience high mortality. Additional studies on smolt physiology are currently being conducted, and data are being collected on various water quality parameters in GOM DPS watersheds.

Studies focused on various life stages of Atlantic salmon have identified low survival rates during the last winter that parr are in the river, during smolt outmigration from rivers, and during the long ocean migration. These low survival rates at various salmon lifestages, in combination, are negatively impacting Atlantic salmon survival and are likely to impede recovery. Research to identify factors affecting survival, and implementation of measures to improve these factors, are ongoing and are of critical importance for the future of the GOM DPS of Atlantic salmon.

5. *Overutilization*

Both commercial and recreational harvest of Atlantic salmon historically played a role in the decline of the GOM DPS of Atlantic salmon. From the 1960s through the early 1980s, the average exploitation rate in Maine rivers was approximately 20% of the run (Beland 1984; Baum 1997). In 1995, the State of Maine passed regulations to allow only catch and release fishing for Atlantic salmon. Because the catch and release salmon fishery posed a threat of mortality or injury to the GOM DPS of Atlantic salmon, it was discontinued by the State of Maine in December 1999. However, recreational fishing targeting other species still has the potential to result in incidental catch of various life stages of Atlantic salmon that could result in their injury or death. Atlantic salmon parr remain vulnerable to harvest by trout anglers, and mortality associated with this activity has been documented (MASCP 1997).

In 1987, the New England Fishery Management Council, pursuant to its authority under the Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. 1801 *et seq.*, prepared and implemented a federal Fishery Management Plan (FMP) for Atlantic salmon. The FMP prohibits fishing for and possession of Atlantic salmon in the U.S. exclusive economic zone, eliminating additional impacts to the GOM DPS. The potential exists, however, for juvenile and adult GOM DPS Atlantic salmon to be taken incidentally as bycatch in commercial fisheries targeting other species. While a review of existing commercial fishery records does not indicate that bycatch of Atlantic salmon is a significant threat, additional investigation is warranted.

On February 5, 1999, the Canadian Department of Fisheries and Oceans announced adoption of the precautionary approach by continuing closure of the commercial Atlantic salmon fishery for Newfoundland and Labrador for an additional three years. The Newfoundland fishery had been closed since 1992. The West Greenland Commission of the North Atlantic Salmon Conservation Organization (NASCO) agreed on a multi-year approach for conservation of salmon stocks in Greenland, including making this fishery for internal use only. The reported West Greenland catch in 1999 was 19 tons and the unreported catch was estimated to be approximately 10-15 tons. Ninety-one percent of the catch was estimated to be of North American origin, the highest proportion on record for this fishery.

In August of 2002, the Organization of Hunters and Fishermen in Greenland and the North Atlantic Salmon Fund signed an agreement to suspend all fishing for Atlantic salmon within Greenland territorial waters, except for annual subsistence harvest. Under this agreement there is no commercial sale of any kind, including export. The agreement covered the 2002 fishing season and will remain in effect through April 25, 2003. Thereafter, its terms and conditions may be extended yearly to cover the successive 2003-2006 fishing seasons. This extension shall take place automatically unless either party gives written notice to the other by April 25, yearly, of its intent to terminate the agreement. Although the commercial harvest of North American origin Atlantic salmon has contributed negatively to the status of the GOM DPS, the continuation of the 2002 agreement will reduce the ongoing threat to the GOM DPS. Given the current low level of abundance for the GOM DPS, even a small amount of ongoing subsistence harvest could substantially affect the status of wild salmon.

A small commercial fishery also exists off St. Pierre et Miquelon, a French territory off the coast of Newfoundland. Efforts to establish a sampling program to determine the composition of the St. Pierre catch have so far been unsuccessful. Without these data, it is not possible to estimate the level of take and the potential threat this fishery may pose to the GOM DPS.

6. *Fish Stocking Practices*

The Maine Department of Inland Fisheries and Wildlife (IFW) stocks a number of native and non-native salmonids into rivers within the GOM DPS. Moreover, many non-native species of fish have been introduced illegally into GOM DPS watersheds by individuals that wish to fish for these species. Introduced salmonids may prey upon GOM DPS juvenile salmon and compete with wild salmon for food and habitat.

Brown trout (*Salmo trutta*) have been stocked by the IFW into a number of headwater lakes within the watersheds of the GOM DPS in Washington County, including the Machias and East Machias Rivers (MASCP 1997). The Sheepscot River is the only salmon river within the GOM DPS where brown trout have been captured during stream assessments (MASCP 1997). Brown trout stocked by the IFW in the Sheepscot River have established a self-sustaining population. Although the potential exists for brown trout to prey upon juvenile Atlantic salmon in the Sheepscot River, most brown trout reside in the headwater section above Sheepscot Lake where few Atlantic salmon spawn (MASCP 1997). Because brown trout females are known to prefer to spawn on existing redd sites, there is some potential for redd superimposition in Atlantic salmon spawning areas (ASC/IFW MOA 2002). Interspecific competition between brown trout and Atlantic salmon also has the potential to negatively affect Atlantic salmon. Habitat use by Atlantic salmon has been found to be restricted through interspecific competition with brown trout that are more aggressive (Heggenes *et al.* 1999; Kennedy *et al.* 1986; Hearn 1987; Fausch 1998). Furthermore, Harwood *et al.* (2001) determined that competition is not limited to the summer months; instead, competition for food and resources observed during overwintering indicates potential effects on both the long-term and short-term growth of wild Atlantic salmon. Also, at lower water temperatures, Atlantic salmon fry may compete less effectively than brown trout. In Europe, however, brown trout and Atlantic salmon are sympatric and habitat segregation allows them to remain genetically isolated (Hesthagen 1988; Hearn 1987).

While there is evidence that brown trout may have a negative impact on Atlantic salmon, within the GOM DPS the extent of predation and competition between brown trout and Atlantic salmon has not been well documented. Although brown trout are capable of hybridizing with Atlantic salmon, this also has not been documented in the GOM DPS rivers. Therefore, it is likely that the impact of brown trout on wild Atlantic salmon in the Sheepscot River is relatively low. However, given that studies in other regions have documented negative interactions between brown trout and Atlantic salmon, brown trout stocking poses a potential threat to Atlantic salmon.

In 1995, the IFW stocked splake [lake trout (*Salvelinus namaycush*) x brook trout (*Salvelinus fontinalis*)] in seven lakes within the Sheepscot, Narraguagus, Pleasant, and Machias River watersheds. In 2001, stocking of splake in Beddington Lake (a lake on the mainstem of the Narraguagus River) was terminated. The splake stocking program in Beddington Lake was the only downeast program on a mid-drainage lake that Atlantic salmon smolts migrate through. In other downeast lakes, splake are only stocked upstream of Atlantic salmon rearing habitats. Little information is currently available to assess the level and significance that predation by splake on Atlantic salmon has had on the GOM DPS, but cessation of the Beddington Lake stocking program has reduced this threat substantially.

Landlocked salmon (*Salmo salar sebago*) are present in lakes within the Sheepscot, Narraguagus, Pleasant, Machias, East Machias, and Dennys River watersheds. Except for Pleasant River Lake, where the relict population of landlocked salmon is sustained by natural reproduction, fishery biologists sustain these landlocked salmon populations through regular stocking programs, some of which began in 1937 or earlier (MASCP 1997). Predation on juvenile salmon by adult landlocked salmon may occur either during periods of cool water temperatures before landlocked salmon move to nearby lakes or during periods of high flows when larger landlocked salmon might temporarily reside near nursery habitat (MASCP 1997). It is believed that the extent of predation of wild Atlantic salmon by landlocked salmon is relatively minor (MASCP 1997).

7. *Water Quality Issues*

a. EPA Superfund Site

The Eastern Surplus Superfund Site is located in Meddybemps, Maine, adjacent to Meddybemps Lake and the Dennys River. The Eastern Surplus Company stockpiled military surplus and salvage items between 1946 and 1980. In 1985, the MEDEP examined the site and discovered over 50 hazardous substances including polychlorinated biphenyls (PCBs), other chlorinated organic compounds, heavy metals, asbestos, and pesticides. Since the first discovery of hazardous waste, the MEDEP and the EPA have conducted several remedial activities to remove contaminated soils, sediments, and groundwater. In 1997, the USFWS conducted a fish and freshwater mussel contaminant study for the EPA on the upper Dennys River near the Eastern Surplus site. PCB and organochlorine pesticide concentrations in wholebody smallmouth bass and white sucker from the Dennys River reach near the superfund site had higher tissue concentrations than bass and suckers collected from an East Machias River reference reach. The PCB and pesticide levels in these Dennys River fish, however, were not highly elevated compared to national and regional fish tissue data. The USFWS suggested that early life stages of Atlantic salmon would accumulate even less contamination than bass and suckers in the upper Dennys River, because young salmon have less residence time in the river (i.e., three years vs. permanent residents) and utilize habitat where less contamination is expected (i.e., riffles with coarse substrates vs. deadwater with fine-grained sediment). The USFWS study only measured fish tissue accumulation of contaminants. It is not known whether chronic low-level exposure of Dennys River contaminants may disrupt fish endocrine systems or have other developmental or generational impacts to early life stages of Atlantic salmon. The EPA plans to conduct a second round of fish tissue contaminant monitoring in the Dennys River in 2003. The second round should provide information regarding the success of the superfund remediation and the current potential contaminant hazards to Atlantic salmon.

b. Sedimentation, Herbicides and other Water Chemistry Issues

The MEDEP has identified sediment pollution as one of the more serious threats to stream health in Maine (AASBRT 1999). Non-point source (NPS) pollution problems occur on all GOM DPS rivers and include various sources such as agriculture, forestry, airborne pollutants (e.g., acid rain), livestock grazing, septic systems, stream channel alteration, and urban runoff. The most common NPS pollutants are sediment and nutrients but others include agricultural pesticides and herbicides, heavy metals, pathogens, and toxic chemicals. The watershed councils for GOM DPS rivers have played a dramatic role in addressing non-point source pollution, resulting in improved habitat for the GOM DPS. Specific projects and accomplishments of the watershed councils are discussed below under *Conservation and Recovery Programs* (see Section II. D. 8. b.).

Hexazinone (velpar), a herbicide used by blueberry growers, has been detected at sites in the Narraguagus River. Concentrations detected have been relatively low and studies demonstrate that the river was capable of producing Atlantic salmon at a level considered normal given the adult abundance at the time. Since these studies, however, increased fry abundance has not resulted in a commensurate increase in parr and smolt abundance (AASBRT 1999). Hexazinone plays a currently unknown but potential role in the status of salmon in the GOM DPS, particularly for the population in the Narraguagus River.

Water sampling by the MEDEP in cooperation with the watershed councils and the University of Maine has identified low pH (i.e., acidic) values coinciding with low calcium and high exchangeable aluminum levels on downeast GOM DPS rivers. Measurements demonstrated healthy water quality conditions in the summer but the occurrence of acidic episodes in the fall. The combination of low pH, high exchangeable aluminum, and low calcium levels is toxic to fish and can injure or kill individuals. Currently, a task force is being identified by the Services and their many partners in salmon conservation to further investigate the role of pH on the status of the GOM DPS and potential measures to improve the situation.

8. *Conservation and Recovery Programs*

The listing of the GOM DPS of Atlantic salmon became effective on December 18, 2000. A number of conservation and recovery activities had been underway for some time prior to the listing to address the declining numbers of Atlantic salmon in Maine rivers. Since the listing became effective, a number of conservation activities have been accomplished, while others are still in progress. These include education and outreach activities, stocking, habitat restoration, and habitat protection through easements and purchases. Many of these actions are being implemented according to the Conservation Plan. The Services are also drafting a recovery plan for the GOM DPS of Atlantic salmon, which will identify key tasks needed for recovery of the GOM DPS, as well as strategies to implement those tasks. The Services are also actively engaged in discussions with various state agencies and industry representatives to identify and insure implementation of measures to protect the GOM DPS of Atlantic salmon.

a. The Atlantic Salmon Conservation Plan for Seven Maine Rivers

In March 1997, the state produced the Atlantic Salmon Conservation Plan for Seven Maine Rivers, an umbrella plan for the conservation and restoration of salmon runs in the Sheepscot, Ducktrap, Narraguagus, Pleasant, Dennys, Machias, and East Machias Rivers. The Task Force that wrote the Conservation Plan was formed in response to the Services' 1995 proposal to list the Atlantic salmon as a threatened species. While the Conservation Plan has great merit, it was not implemented sufficiently to preclude the eventual need for listing the salmon under the ESA. The Conservation Plan is a collaborative effort between the public and private sectors and initiated the formation of watershed councils (see Section II. D. 8. b.).

The Conservation Plan outlines 14 goals, divided under the following four subjects: 1) Fish Management; 2) Habitat Protection; 3) Habitat Enhancement; and 4) Species Protection. The State of Maine and its partners have made steady and substantial progress toward meeting the Conservation Plan's goals. Progress includes more comprehensive fish health standards and protocols, construction and operation of weirs, and limitation of direct water withdrawals from certain rivers to protect Atlantic salmon habitat. Volunteers and professionals have begun water quality monitoring on each identified salmon river; the state has prohibited angling for Atlantic salmon throughout Maine; and many organizations, government agencies, and landowners have documented and are addressing a variety of non-point source pollution problems. Biologists continue to implement recovery measures through population assessments and scientifically-based river-specific stocking programs; work continues toward permanent protection of critical riparian habitat on each river; and conservationists are improving fish passage by removing debris dams and upgrading fish passage facilities (Maine Atlantic Salmon Commission 2000). While progress is still being made towards achieving many of the goals outlined in the Conservation Plan, it has not been successful in removing threats to or recovering numbers of GOM DPS salmon to a degree where the protections of the ESA are no longer required.

b. Watershed Councils

Watershed councils for each of the GOM DPS rivers, which were formed at the recommendation of the Conservation Plan, are involved in a number of habitat assessment and protection efforts including water quality testing, non-point source pollution inventories, and securing conservation easements on property adjacent to riverine salmon habitat. Some examples of watershed council activities are given below.

The Dennys River Watershed Council has worked with the Maine Department of Transportation and private landowners to reduce sediment inputs from roadways and bridges. The council has worked to improve fish passage at three locations within the watershed, and has advocated for additional cleanup measures and continued monitoring of discharge from a junkyard and superfund site located adjacent to the Dennys River in the Town of Meddybemps. Most recently, the council organized a cooperative effort between state and federal agencies and conservation groups to assess, improve, and monitor fish passage and water quality within Venture Brook, a tributary of the Dennys River.

The East Machias Watershed Council has targeted the reduction of non-point source pollution as a primary focus of their efforts to protect Atlantic salmon habitat. An all-terrain vehicle (ATV) crossing at Munson Rips, which runs directly through Atlantic salmon habitat on the East Machias River, was identified as a direct contributor of sediment and petroleum products in the river. The council worked with other groups and agencies to build a bridge over the East Machias River in 2002, thereby removing vehicle traffic from the river.

The Ducktrap Coalition, led by the Coastal Mountains Land Trust, has preserved 80% of the land along the Ducktrap River (approximately 1000 acres), that includes highly productive juvenile and nursery Atlantic salmon habitat. The Ducktrap River Watershed Council is the only GOM DPS watershed council that has taken on land protection as their major conservation effort. The other councils have focused on non-point source pollution issues, such as addressing problems associated with poor land management practices and erosion from bridges and roads.

There are three land trusts that serve to protect and conserve land parcels along six of the GOM DPS rivers. These include the Sheepscot Valley Conservation Association, serving the Sheepscot River; the Quoddy Regional Land Trust, which serves primarily the land east of and including the East Machias River; and the Downeast Rivers Land Trust, which serves the land west of the East Machias River. All of these groups have had some success in protecting small plots of land along these rivers.

The Cove Brook Watershed Council has only recently become established and received 501(c)(3) status, giving them the capacity to hold land. The council is currently undertaking a watershed management plan that includes identification of non-point sources of pollution, collection of water quality data, assessment of land use patterns, and instream habitat assessments for salmon (Dan Kircheis, pers. comm.).

The effects of the watershed council's activities on the current status of salmon are not known. Their activities, however, play an important role in assuring that adequate and suitable habitat is available for Atlantic salmon, should populations recover to levels that can more fully utilize the habitat within the range of the GOM DPS.

c. Project SHARE

Project SHARE (Salmon Habitat and River Enhancement), a non-profit organization, was established in 1994 through the efforts of concerned landowners, salmon anglers, businesses, and various government agencies, to establish a forum to protect and enhance Atlantic salmon habitat in the Dennys, Narraguagus, Pleasant, Machias and East Machias Rivers. SHARE is governed by a Steering Committee (Board of Directors) and is organized into two standing committees that focus on research and education. SHARE also hosts a restoration working group that facilitates strategies to identify, prioritize, repair, and restore threats to Atlantic salmon habitat. Recent projects undertaken by this group include: Chase Mill Stream fish ladder restoration project; Munson Rips ATV bridge project; creation of a wetland and native plant nursery for use in restoring damaged riparian habitat along salmon rivers; and a downeast watershed tour in

October 2001 to highlight habitat restoration accomplishments (e.g., road culvert replacement) and future needs. The Chase Mills Stream fish ladder restoration ensured that Atlantic salmon will continue to have access to upstream spawning and juvenile rearing habitat in the East Machias River watershed. The Munson Rips ATV project removed vehicle traffic directly from the East Machias River in a location where there is valuable spawning and juvenile rearing habitat. In 2002, a salmon redd was found directly underneath the new bridge; without the bridge, this redd would likely have been destroyed by ATV activity.

d. Maine Atlantic Salmon Commission

The ASC is charged with restoration and management of Atlantic salmon throughout its original range in the State of Maine. Research and management activities include the following: broodstock collection, stocking programs, operation of weirs and traps (including three on GOM DPS rivers), electrofishing surveys to evaluate fish production and to measure success of various stocking programs, redd counts, habitat surveys, various research projects (often in cooperation with NOAA Fisheries) and administration of the Conservation Plan. The ASC closely coordinates with the Services on all of these activities. These activities result in valuable information used by the ASC and Services biologists to make population estimates, assess the status of the GOM DPS, and develop appropriate recovery strategies.

The ASC has also taken on a land conservation and protection role and has acquired significant land parcels along the Dennys River, as well as a small parcel on the Narraguagus River. In 2001, the USFWS awarded $2,000,000 to the State of Maine under the Recovery Land Acquisition Grants Program. These funds contributed to the state's Machias River Project. One of the specific objectives of this project is to permanently protect the riparian system that supports and helps define Atlantic salmon habitat. The State of Maine and the ASC are in the process of using the $2,000,000 to acquire a conservation easement that includes development and mineral rights and timber harvesting restrictions along 213 stream and riverfront miles. This conservation easement will also secure a functioning buffer along a wide corridor on the main stem of the Machias River and on tributaries of third order and larger stems. This will result in the permanent protection of over 86% of all spawning, nursery, migration corridors, and adult holding areas for Atlantic salmon within the Machias River drainage.

e. Conservation Hatchery Program

Atlantic salmon stocking in rivers of the GOM DPS has historically used stocks from the GOM DPS and neighboring river systems. The river-specific stocking program for Atlantic salmon in the GOM DPS was initiated in 1991 by the State of Maine and the USFWS. Currently, captive broodstock populations are held in isolation bays at the Craig Brook National Fish Hatchery (CBNFH) in Orland, Maine for the following rivers: Dennys, East Machias, Machias, Narraguagus, Sheepscot, and Pleasant. Broodstock collections began in 1991 and initially focused on the collection of returning adults from the sea. However, due to insufficient numbers of returning adults, parr were collected beginning in 1992. These collections have increased the effective population size (wild and captive) and provide a buffer against extinction in the wild. The focus of the program has been to produce fry that are then stocked back into the river of parental origin; some parr or smolts are also being stocked. The stocking program attempts to saturate the available habitat in each river. The hatchery program has contributed to increases in adult returns, but not to the levels needed for self-sustaining populations in the GOM DPS.

Recently, the Maine aquaculture industry has participated in the supplementation program by rearing eggs derived from these river-specific broodstock. In July 1996, the Services, the State of Maine and representatives of the three largest salmon aquaculture companies (Atlantic Salmon of Maine, Heritage Salmon, and Maine Aquafoods) signed a Memorandum of Understanding, which outlined the transfer of river-specific eyed eggs to private aquaculture facilities. The USFWS transferred eyed eggs from the CBNFH to the industry in 1996 (30,000), 1997 (80,000), and 1998 (70,000). In 1996, the eggs originated from the Dennys, Machias, and Narraguagus broodstock populations. In 1997, the eggs originated from the Dennys, East Machias, and Machias broodstock populations. In 1998, the eggs originated from the Dennys, Machias, Narraguagus, and Sheepscot broodstock populations. The transferred eggs were reared at various hatcheries owned by the aquaculture companies. The majority of the fish grown from these eggs were released into the river of origin as 1+ parr and smolts, while the remainders were stocked into their river of origin as mature, marine-reared adults. Eggs transferred in 1997 matured in 2000 while the 1998 transfer matured in 2001.

In 2000, 1038 adult salmon were stocked into the Dennys (112), Machias (176), and St. Croix Rivers (750). Post-stocking assessments documented an increase in redd production attributable to these stocked adults. In 2001, 729 adult salmon were stocked into the Dennys (75), Machias (104), and St. Croix Rivers (550). Preliminary analyses indicated that the 2001-stocked adults were also responsible for an increase in the number of redds documented within each recipient river (Finaly *et al.* 2002). In an effort to directly estimate the reproductive success of these fish, Mackey and Atkinson (2003) trapped redds in the Dennys River and Cathance Stream in the spring of 2001 and 2002 to estimate the number of fry emerging per redd and to document the quality of the fry (size). Small numbers of fry were detected, verifying that some reproduction did occur. Although interpretation of the results was problematic, the authors still believed they had detected both failed and extremely low rates of reproduction by the net pen-reared adults (Mackey and Atkinson 2003).

A study by Mackey and Brown (2003) investigated the possibility that the poor reproductive success displayed by stocked pen-reared adult Atlantic salmon was due to fertilization problems caused by poor or defective gametes. The study indicated that there was not a problem with the gametes of these fish. However, the low rates and late timing of sexual maturity among both males and females in the study indicate that spawning in the wild may have been at a lower rate than expected due to a paucity of sexually mature fish. Furthermore, spawning well past the window of natural spawning may have reduced the reproductive success of those fish that did sexually mature and spawn. The study concludes that future enhancement efforts that use adult salmon as natural spawners should not be attempted before issues of maturation rates and timing are resolved (Mackey and Brown 2003). Although these assessment studies were somewhat problematic, all efforts undertaken to date (ultrasonic telemetry, redd counts, fry trapping, electrofishing) to evaluate the success of the adult pen-reared stocked salmon indicate that they achieved low reproductive success (Mackey, pers. comm.). As a result, the adult stocking program has probably not contributed positively to the current status of the GOM DPS. However, this approach may show promise, particularly in rivers with very low or no adult returns, if some factors (such as low maturation rates and timing) can be addressed (Mackey and Atkinson 2003).

f. Staltonstall-Kennedy Grant Program

In 2002, $5,000,000 was made available under the Staltonstall-Kennedy Act to fund projects under the heading "Atlantic Salmon Aquaculture Development Considering the Endangered Species Status of Atlantic Salmon." The request for proposals for distribution of these funds stated that interbreeding with and competition from escaped farm-raised salmon from Maine's aquaculture industry may threaten the wild salmon population in the Gulf of Maine. It further stated that the continuation of the Atlantic salmon aquaculture industry depends on eliminating the threats that the industry poses to endangered wild Atlantic salmon (67 FR 34428, May 14, 2002). Activities acceptable for funding include the following: (1) development of more secure marine cages to reduce farmed fish escapement; (2) development of broodstock strains that grow quicker, better resist disease, or pose less genetic threat to North American wild salmon stocks; (3) development of improved marks or tags to trace potential escapes of farmed fish; (4) development of vaccines or other methods to prevent the spread of disease between farmed fish and wild salmon; and (5) development of improved methods to monitor sea cage integrity and farmed fish diseases. Research towards these goals could result in improvements in Maine's salmon aquaculture industry and reduce impacts to the GOM DPS.

g. ESA Section 10 Permits

Regulations developed under Section 10 of the ESA allow for "take" of listed species for the purposes of scientific research and recovery actions. Since the ESA listing, four separate applications for permits to perform scientific research and/or recovery actions on the GOM DPS of Atlantic salmon have been submitted to the USFWS. All four permits have subsequently been issued. These permits cover the river-specific hatchery and stocking program of the USFWS, research and monitoring activities of the ASC, research activities of the NOAA Fisheries, and research conducted by the U.S. Geological Survey's Biological Resources Division.

All of these activities can result in some level of take of Atlantic salmon. A certain amount of mortality is expected as a result of many of these activities, particularly with respect to fish culture. Harassment and stress may also occur as a result of capture and release activities. These permitted activities, while resulting in some take, will result in additional scientific information, improved fish culture and assessment techniques, a greater understanding of the species and its habitat, and will also collectively promote recovery of the species. Most of the "take" associated with these salmon recovery actions will be an integral consequence of these actions, rather than incidental to them. There are, however, occasions wherein take will be considered incidental (e.g., habitat improvements, sampling for other species such as invertebrates, and construction or placement of in-river weirs). The USFWS has authorized incidental take of salmon, related to various recovery actions, within the GOM DPS for any given year not to exceed 2% of the life stage being impacted, except that for adults, it would be less than 1%.

9. *Aquaculture*

Atlantic salmon that escape from marine aquaculture facilities and freshwater hatcheries that supply these marine facilities pose a threat to native Atlantic salmon populations in coastal Maine rivers. The threat posed by commercially-cultured salmon is increased by the fact that the industry currently uses fish that are not native to North America. Escapement and resultant interactions with native stocks continue under current aquaculture practices. There is substantial documentation that escaped farmed salmon disrupt redds of wild salmon, compete with wild fish for food and habitat, interbreed with wild salmon (disrupting local adaptations), degrade benthic habitat, and transfer disease or parasites (Fleming *et al.* 2000; Clifford *et al.* 1998; Youngson *et al.* 1993; Webb *et al.* 1993; Windsor and Hutchinson 1990; Saunders 1991). There is also a concern with potential interactions when wild adult salmon migrate near closely spaced aquaculture cages, creating the potential for behavioral interactions, disease transfer or interactions with predators [Department of Fisheries and Oceans (DFO) 1999; Crozier 1993; Saegrov *et al.* 1997; Carr *et al.* 1997; Lura and Saegrov 1991]. Examples of these adverse impacts to wild salmon are discussed in more detail below, as well as a brief history of the Services' involvement with the aquaculture industry.

a. Background

Since the beginning of the salmon aquaculture industry in Maine in the mid-1980s, the Services have opposed the use of reproductively-viable European strains (pure and hybrid) of Atlantic salmon within North America. The Services' continued opposition is based on genetic studies that demonstrate that there are significant differences between North American and European Atlantic salmon [National Resource Council (NRC) 2002, and references therein], and on the fact that interbreeding among genetically-divergent populations will negatively impact natural populations (e.g., Utter *et al.*, 1993; Verspoor 1997; Youngson and Verspoor 1998). The introgression by non-North American stocks presents a substantial threat to the genetic integrity of North American stocks and threatens fitness through outbreeding depression.

Atlantic salmon that either escaped or were released from aquaculture facilities have been found in Maine rivers (USASAC 1996; 1997). In October 1998, a Code of Practice for the Responsible Containment of Farmed Atlantic Salmon in Maine Waters was adopted by the MAA and its member farms. This Code was predicated on a risk management approach and sought to minimize potential interactions between wild salmon and escaped farmed salmon. The Services are not aware of monitoring results of that Code but note that escapees continue to be documented in the GOM DPS through 2002.

When the proposed listing of Atlantic salmon as a threatened species was withdrawn in 1997 (62 FR 66325, Dec. 18, 1997), the Services believed that certain restrictions on the importation and use of foreign salmon stocks were in place and being enforced. In 1991, Maine State Law (PL 1991 c381 subsection 2) was passed restricting the importation of fish and eggs. However, the law failed to restrict the importation of European milt, thus enabling expansion of the use of hybrids between European and North American salmon in aquaculture. Some ACOE permit holders continued to use European strains or hybrids despite their commitment not to do so when obtaining permits (permit applicants signed a statement indicating that no European strains or hybrids would be placed in cages). Once the Services learned that the industry was still using non-North American strains, the concern with the risks inherent in wild stocks interacting with aquaculture escapees was significantly increased.

In 1997 and 1998, the Services worked with the aquaculture industry and state representatives in an attempt to eliminate further importation of European stocks, remove pure European strain fish from marine aquaculture cages, and phase out the holding of North American/European hybrids. This effort was unsuccessful. In July of 1999, the Services initiated discussion directly with DMR. These discussions were only partially successful and did not result in any further regulation at the state level or the implementation of any protective measures by the aquaculture industry in Maine. In addition, permits had still not been issued by the EPA under the Clean Water Act to limit the discharge of pollutants from these aquaculture facilities.

In May of 2001, Maine's three largest aquaculture companies signed an agreement with several conservation groups pledging to strengthen fish containment and husbandry practices. The agreement is voluntary but is intended to allow for continuous improvement in the containment of farmed salmon and for the development of a mandatory, enforceable Containment Management System for Maine salmon farmers. Representatives from the MAA, state and federal agencies, and conservation groups formed a steering committee to provide advice and direction on a National Fish and Wildlife Foundation grant to the MAA that addresses containment issues and fish marking techniques. The steering committee reviews the work of two groups, the Containment Audit Working Group and the Marking Working Group. These groups have developed a containment audit policy based on a Hazard Analysis Critical Control Point model and are testing various options for marking aquaculture fish.

b. Documentation of Escapes from Marine Aquaculture Facilities

Based on the information presented below, and on the previously cited evidence regarding impacts of escapees, it is the Services' opinion that the escape of aquaculture salmon into the GOM DPS has had a negative effect on wild salmon and that this effect will likely continue into the future. In order to evaluate the past and future effects of aquaculture escapes on wild salmon, the Services requested that the ACOE provide information from each aquaculture company on past escape events. The following table (Table 2) summarizes the information that was received from the ACOE for this Section 7 consultation:

Table 2. Summary of Aquaculture Fish Escapees Provided to the Services.*

Year	Cobscook Bay	Machias Bay	Pleasant Bay
1994	13,403	0	0
1995	14,391	Unknown # at one site	0
1996	12,163	0	0
1997	41,107	1	1
1998	0	0	0
1999	0	8,633	0
2000	22,315	99,758	11,559
2001	0	16,021	20,725

*This table is based on incomplete reports from the industry of escape events and therefore does not represent a complete history of all escapes throughout the history of the industry in Maine. Zeros do not necessarily mean that no escape(s) occurred that year, but instead that none were reported.

The information in Table 2 is not a complete historical summary of aquaculture fish escapes from marine cages in Maine. For example, some of the companies reported that they have no records of escape events prior to the present ownership or management (e.g., some companies have no records prior to 1999). Furthermore, no records were provided of any escape events prior to 1994; however, other records show that aquaculture escapees were found in Maine rivers prior to 1994 (see below). Despite their incompleteness, these records clearly establish that tens of thousands of aquaculture salmon have escaped from Maine facilities since 1994 and continue to escape under the most current aquaculture practices. As demonstrated below, there is substantial evidence that, where these aquaculture facilities exist, there are substantial escape events and that a portion of the escaped fish make their way into river systems.

Atlantic salmon from marine aquaculture facilities have been found in the Union, St. Croix, Penobscot, Dennys, East Machias, and Narraguagus Rivers (USASAC 1995-2002). The Dennys, East Machias, and Narraguagus Rivers have persistent, naturally remnant populations of Atlantic salmon that are part of the GOM DPS. Escaped aquaculture salmon have also been documented in the recreational fishery and observed in the Boyden, Hobart, and Pennamaquan Rivers (all streams that flow into Cobscook Bay, where 26 of the 42 farm sites in the Maine industry are currently located). The first documented incidence of adult aquaculture salmon in Maine rivers occurred in 1990 when 14 of 83 (17%) of the rod catch in the East Machias River were of marine aquaculture origin. In 1993, there were an estimated 20 marine aquaculture strays and 13 wild salmon in the Dennys River (61% of the run was aquaculture escapees). In 1994 and 1997, escaped aquaculture salmon represented 89% (48 of 54) and 100% (2 of 2), respectively, of the documented run for the Dennys River. In 2001, three or four superimposed redds were documented in the Dennys River, which had been constructed either by aquaculture escapees or released captive-reared broodstock, in the short stretch of suitable spawning habitat between the weir and tidewater (USASAC 2002).

Aquaculture fish have also been reported by anglers in the Dennys and East Machias Rivers since 1995. In 1999, 23 (64%) of the fish captured in a trap in the St. Croix River were of aquaculture origin; 63 (91%) of the fish captured in the Union River were aquaculture fish; and three of the fish trapped in the Narraguagus River were commercially cultured. In 2001, 65 of 83 (78%) of the fish captured in the Dennys River and 58 of 77 (75%) in the St. Croix were aquaculture escapees (USASAC Annual Report 2002/14). In 2002, four of the six returns to the Dennys River (67%) were of suspected aquaculture origin (ASC 2002 Trap Catch Statistics).

Beginning in 1996, sexually-mature escapees have been documented annually in Maine rivers. In the St. Croix River, 17 escapees were examined in September 1998 and five (30%) exhibited evidence of sexual maturation. In 1999, all three escapees in the Narraguagus River were sexually mature males (USASAC Annual Report 2000/12). In 2001 in the Dennys River, four of the 16 female escapees examined were sexually mature and one of the seven male escapees examined was sexually mature (USASAC Annual Report 2002/14).

Currently, there are fish weirs or traps located on three GOM DPS rivers (Pleasant, Narraguagus, and Dennys) that have remnant salmon populations. A weir is essentially a fence that is designed to lead the fish into a net or pound where they are captured (Baum 1997). These weirs and traps are used by state and federal fishery agencies to collect biological information about Atlantic salmon populations and, since the development of a salmon aquaculture industry in Maine, to prevent aquaculture escapees from entering Maine salmon streams and adversely affecting wild salmon. Aquaculture escapees are currently identified at the weirs by fisheries biologists using scale reading and physical characteristics such as fin deformities and body shape and size. A seasonal weir is placed each year on the Dennys River at the head of tide in Dennysville, Maine and on the Pleasant River in Columbia Falls, Maine just upstream of the Route 1 Bridge. These two A-frame weirs both started operation in the spring of 2000. These weirs are designed to capture adult salmon migrating upstream, while allowing downstream migrating fish to pass freely.

Prior to 2000, other types of temporary weirs (e.g., picket, floating, and resistance board) were sometimes placed on the Dennys, Pleasant and Sheepscot Rivers. These types of weirs are generally less effective in capturing fish than the current A-frame weirs. During periods when these older weirs were compromised, salmon may have gained upstream access (including aquaculture escapees). A fishway trap is located at the ice dam on the Narraguagus River in Cherryfield; this trap has been operated since 1991. Salmon have been observed jumping over the ice dam, so the fish trap is not considered 100% effective at intercepting upstream migrating salmon (USASAC 1996). The weirs and traps are generally in place and operating from mid-spring until the late fall of each year, although the dates can vary from year to year. The Services are currently evaluating options for placing a weir on the East Machias River; placement of a weir here is important due to the potential for aquaculture escapees from fish farms in Machias Bay to enter this GOM DPS river.

Although weirs are a useful tool for tracking GOM DPS salmon and reducing the number of aquaculture escapees that interact with GOM DPS salmon, there are some drawbacks to their placement in the rivers. The design and location of the weirs is intended to minimize any threats that may occur from excess handling, predators, and the possibility of excluding a fish from upstream passage to spawning habitat. Nevertheless, these threats will continue to exist, at some minimal level, as long as the weirs are in place. Interference with upstream fish passage and handling are the most significant known threats to adult migrating salmon associated with weirs. Adult salmon have been documented entering and then leaving a weir on their own, perhaps never to return to the weir (i.e., those adult fish were potentially prohibited from reaching upstream spawning habitat and reproducing). Although uncommon, biologists in Maine have mistakenly identified a wild fish as an aquaculture fish and have returned the fish downstream of the weir rather than allowing the fish upstream passage. Handling adds additional stress to adult salmon, which can result in mortality or increased susceptibility to disease or predation, especially when water temperatures are high. A fish may be handled several times in the attempt to capture the fish and positively identify its origin. Lastly, wild and aquaculture salmon can be present in weirs at the same time, increasing the risk of disease transfer from farmed salmon to the GOM DPS. For the time being, fisheries biologists have determined that the benefits of learning more about the status of the GOM DPS and reducing interactions with aquaculture escapees outweigh the risks inherent in the use of weirs.

In Atlantic Canada, most aquaculture occurs in the lower Bay of Fundy, where there are an estimated 60 facilities. Although reports of large-scale escapes are rare, in 1994 between 20,000 and 40,000 fish escaped from an aquaculture facility in New Brunswick, a number that was equal to the total estimated wild salmon return in Nova Scotia and New Brunswick. Since the aquaculture industry began in the Canadian Maritimes in 1979, escapees have been documented in 14 rivers in New Brunswick and Nova Scotia (DFO 1999). The Magaguadavic River in Canada is monitored for interactions between wild and commercially-culture fish. In at least two years, over 90% of the adults entering this river were of aquaculture origin. Escapees from Canadian fish farms, particularly those from Passamaquoddy Bay and the Bay of Fundy, are likely to enter Maine rivers and thus may have contributed to the current endangered status of the Atlantic salmon.

A study in Norway (Heggberget *et al.* 1993) documented farmed Atlantic salmon migrating distances of 15-90 km from the point of intentional release. Bergan *et al.* (1991) reported that the proportion of escapees in rivers near fish farms (less than 20 km) was higher than in other rivers. Recent evidence suggests that escaped Atlantic salmon are capable of swimming significant distances from their marine pen sites in the Pacific Ocean (Volpe *et al.* 2000). The northern limit of Atlantic salmon aquaculture in the Pacific Northwest is the northern tip of Vancouver Island, British Columbia (approximately lat 51°N); both marine and freshwater recoveries of Atlantic salmon are now well documented in Alaska, at least 300 miles away.

Table 3 gives approximate distances of existing farm sites from GOM DPS river mouths in Maine. These distances represent those sites (within each of the bays that currently contain aquaculture farms) that are the closest and farthest distance from a GOM DPS river.

Table 3. Approximate Distance of Existing Farm Sites from GOM DPS River Mouths in Maine.

FARM SITE	DISTANCE	GOM DPS RIVER
H1-Cobscook Bay	13 km	Dennys River
G2-Cobscook Bay	25 km	Dennys River
L1-Machias Bay	9.5 km	Machias River
L4-Machias Bay	21 km	Machias River
B7-Pleasant Bay	7 km	Pleasant River
L2-Pleasant Bay	26 km	Pleasant River
B6-Pleasant Bay	7 km	Narraguagus River
L2-Pleasant Bay	30 km	Narraguagus River
D3-East Penobscot Bay	87 km	Cove Brook
A1-East Penobscot Bay	93 km	Cove Brook
D3-East Penobscot Bay	50 km	Ducktrap River
A1-East Penobscot Bay	65 km	Ducktrap River
M1-Sheepscot River	within waters	Sheepscot River

There is little information available to evaluate the distances that escaped farmed salmon have moved in Maine because 1) aquaculture fish have not been marked, either in Maine or Canada; and 2) reporting of escape events has not been required. However, the Services know that 1) aquaculture fish have been detected in several Maine rivers, and 2) all existing farm sites are located in bays proximal to GOM DPS rivers. Despite the lack of specific information on the movements of Maine aquaculture salmon escapees, based on the studies of Heggberget et al., Bergan et al., and Volpe et al., in combination with the distances of Maine salmon farms from GOM DPS rivers, the Services are confident that escapees from Maine sites have entered GOM DPS rivers, including those without weirs or traps.

c. Hatchery Escapement

There are currently five commercial hatcheries in Maine that supply juvenile salmon for grow-out in cage sites in Maine, as well as Canada. Two commercial hatcheries are located within the Atlantic salmon GOM DPS (Heritage Salmon hatcheries in East Machias, Maine at Gardner Lake and in Deblois, Maine). Cases of chronic and large escapements from freshwater hatcheries in Maine have been documented and are discussed further below. A relationship has been demonstrated between the reproductive success of cultured fish and the amount of time that the fish has lived in nature before reaching sexual maturity (i.e., better reproductive success if the escaped fish have lived longer in a stream) (Jonsson 1997). Consequently, the Services believe that escapees from freshwater hatcheries may pose a larger threat to wild populations than escapees from marine cage sites. The earliest life stages of fish (such as sac fry) that might escape from hatcheries, however, are not likely to survive cold river temperatures (David Bean, pers. comm.).

Interactions (i.e., competition for food and habitat) between escaped hatchery juveniles and wild salmon, particularly in the East Machias and Pleasant Rivers, are reasonably certain to have occurred and to have negatively contributed to the current status of the GOM DPS. Furthermore, genetic testing of juvenile Atlantic salmon collected in the Pleasant and East Machias Rivers has identified fish with genotypes indicative of European origin. These fish would have been either escapees from the industry hatchery in the watershed, the offspring of an aquaculture escapee that entered the rivers and spawned, or the offspring of a juvenile hatchery escapee that later matured and spawned as either a precocious male parr or a returning adult. Genetic introgression would have resulted from fish that are a product of interbreeding between GOM DPS salmon and aquaculture escapees. When genetically divergent populations (e.g., GOM DPS salmon and aquaculture escapees) interbreed, the resulting progeny may be less fit than their parents because of the loss of local adaptations. The loss of fitness incurred by the affected individuals is termed outbreeding depression. Outbreeding depression is more likely to occur when interbreeding is between genetically differentiated populations, such as when a hatchery broodstock is from non-local sources [Independent Scientific Advisory Board (ISAB) 2002].

In 1999, the NOAA Fisheries Northeast Fisheries Science Center monitored the outmigration of smolts on the Pleasant River using a rotary screw smolt trap deployed near the head of tide in Columbia Falls, Maine. A total of 676 smolts were captured between April 22 and May 29; 31 smolts (approximately 5%) were observed with fin deformities, coloration and body form suggesting that they were from freshwater hatcheries (aquaculture fish generally display these characteristics due to the conditions of rearing in the freshwater hatchery). Scale samples and tissue samples for DNA analysis were also collected. Based on additional information provided by scale pattern analysis and genetic assignment test, it was subsequently determined that approximately 20-25% of the 1999 smolt run in the Pleasant River was of commercial hatchery origin. Following the capture of these fish, electrofishing surveys were conducted within Beaver Meadow Brook at the outflow of the Deblois hatchery. Cursory electrofishing surveys documented 87 salmon parr near the vicinity of the hatchery outflow. It should be noted that the hatchery is located at the upstream end of Beaver Meadow Brook (which does not have salmon habitat) and that the nearest reach of the Pleasant River is dead water habitat (i.e., unsuitable). This information led the Maine Atlantic Salmon Technical Advisory Committee (TAC) to conclude that hatchery-origin Atlantic salmon are escaping into the Pleasant River drainage from the Deblois hatchery, and that the escaped fish represent a threat to the remnant Atlantic salmon populations in the Pleasant River drainage (TAC 2000). Subsequent improvements were made at the Deblois hatchery to address escapement, including the addition of filters and screens.

Since 1989, annual population assessments conducted by ASC fishery scientists on Chase Mill Stream, a tributary to the East Machias River, have resulted in the capture of suspected aquaculture salmon in the vicinity of a private aquaculture hatchery discharge (Heritage Salmon

Inc. hatchery at Gardner Lake). These fish are frequently characterized by deformed fins and occasionally by their large size, compared to wild parr. Until 1999, no attempt was made to assess the origin of these fish. In October 1999, Chase Mill Stream was specifically electrofished in the vicinity of the hatchery outlet and 28 suspected aquaculture-origin salmon were collected (USASAC 2000/12). Subsequent improvements were also made at the Gardner Lake hatchery to address escapement, including the addition of filters and screens.

In recent years the annual production of smolts for the Gardner Lake hatchery has been approximately one million. Heritage Salmon has not produced smolts at the Deblois hatchery since 2001. Furthermore, the lease on the Deblois facility will not be continued by Heritage Salmon beyond its expiration in 2004 (Kaelin, 11/8/02). Recent improvements (e.g., installation of drum filter and screens) have been made at both of these hatcheries to help minimize escapement. Moreover, the industry has developed a hatchery management system that includes a Hazard Analysis Critical Control Point-(HAACP)-based plan for each hatchery that follows the hatchery production cycle from arrival of eggs to smolt transport. The effectiveness of HAACP plans, filters, and screens in eliminating escapes from the two hatcheries has not been fully analyzed at this time. Escapes of juvenile salmon from hatcheries could still occur from catastrophic events (e.g., floods, icing of the water intake, and power outages). Escapement of juvenile aquaculture salmon from hatcheries into GOM DPS river watersheds could negatively contribute to the status of the GOM DPS, although with recent hatchery improvements, escape events are much less likely to occur.

d. Interactions between Aquaculture Escapees and Wild Salmon in Rivers

Detailed discussion of the impacts of escaped aquaculture salmon on wild populations is included below to support the conclusion that escapees have negatively affected the status of the GOM DPS. This subject is presented in more detail in this opinion because of the relationship of this subject to the proposed action (i.e., many of the aquaculture-related factors contributing to the current status of the GOM DPS will continue to have an adverse effect on wild salmon in the future, even after adding the proposed conditions to existing permits).

Experimental tests of genetic divergence between farmed and wild salmon indicate that farming generates rapid genetic changes as a result of both intentional and unintentional selection in culture and that those changes alter important fitness-related traits (McGinnity *et al.* 1997; Gross 1998). The changes have been identified as a threat to wild populations when cultured fish escape and subsequently compete and breed with wild salmon (Hindar *et al.* 1991; Fleming and Einum 1997). Genetic interactions between wild and farmed fish can disrupt local adaptations, threaten stock viability and character, and lower recruitment (DFO 1999; Einum and Fleming 1997; Fleming and Einum 1997; Grant 1997; Saegrov *et al.* 1997).

Genetic studies demonstrate that there are significant differences between North American and European Atlantic salmon (NRC 2002, and references therein), and most geneticists believe that interbreeding among genetically divergent populations negatively impacts natural populations (e.g., Utter *et al.* 1993; Verspoor 1997; Youngson and Verspoor 1998). Mork (1991) characterized the potential permanent effect of one generation "burst" immigrations (i.e., when large numbers of fish escape from farms near spawning rivers) on the genetic differentiation among wild stocks. He reported that small Atlantic salmon populations may be most vulnerable to burst immigrations, and that these events could be the most significant way in which farmed salmon affect the genetic structure of wild populations. Natural selection may be able to purge wild populations of maladaptive traits, but may be less able to do so if the intrusions occur regularly year after year. Under this scenario, wild population fitness is likely to decrease as the selection from the artificial culture operation overrides wild selection (Fleming and Einum 1997; Hindar *et al.* 1991).

The following paragraphs describe studies from Europe and Canada demonstrating genetic interactions and competition between wild and escaped aquaculture Atlantic salmon. Similar studies on genetic and behavioral interactions have not yet been conducted in Maine. However, given the knowledge that aquaculture fish do escape from Maine marine pens and subsequently enter Maine GOM DPS rivers, conclusions from these European and Canadian studies can be used to analyze how aquaculture escapees are likely to have affected the current status of the GOM DPS.

Analysis of carotenoid pigments in eggs taken from the Magaguadavic River in New Brunswick in 1993 revealed that at least 20% of the redds were constructed by females that were commercially cultured and another 35% were of possible commercially-cultured origin (Carr *et al.* 1997). A study in the River Vosso, western Norway, examined synthetic astaxanthin (an additive to commercial fish feed) in offspring of fish. The study found that nine (45%) of the 20 female spawners in the sample were of confirmed farmed origin. Eggs from two of the farmed females showed that they had escaped recently and had entered the river and spawned before ingesting much natural food. Seven of the farmed females spawned eggs that indicated the females had ingested natural food for a prolonged period, indicating that they lived in the ocean for some time before entering the river to spawn. The study concluded that it is likely that all of the three-year classes of Atlantic salmon, which dominated the parr stock in this river in 1996, had more than 50% farmed female contribution. This study concluded that the effect of farmed escapees was dramatic and that the original stock was being gradually replaced by farmed salmon (Saegrov *et al.* 1997).

A multi-year study (1992-1995) was conducted in a natural tributary of the Burrishoole River system in western Ireland to compare the performance of wild, farmed, and hybrid Atlantic salmon progeny. Survival of progeny of farmed fish to the smolt stage was significantly lower than that of wild salmon. The progeny of farmed fish, however, grew faster and displaced native fish downstream (McGinnity *et al.* 1997). This study demonstrated that both farmed fish and hybrids can survive in the wild. It also indicates that escaped farmed salmon can produce long-term genetic changes in natural populations (McGinnity *et al.* 1997). The authors caution that repeated intrusions of escaped farmed salmon will depress smolt productivity in a cumulative fashion, potentially creating an extinction vortex, i.e., an inescapable downward spiral in population numbers.

Fleming *et al.* (2000) undertook a large-scale experiment in order to quantify the lifetime success and interactions of farm salmon invading a Norwegian river. Sexually mature farm and native salmon were genetically screened, radio-tagged and released into the River Imsa where no other salmon had been allowed to ascend. The farm fish were competitively and reproductively inferior, with this inferiority more pronounced in farm males than in females. There were also indications of selection against farm genotypes during early survival of offspring of released adults, but not thereafter. Evidence of resource competition and competitive displacement existed, as the productivity of the native population was depressed by more than 30%. There was also considerable overlap in the diets of native, farmed, and hybrid offspring. Results indicated that such annual invasions have the potential for impacting population productivity, disrupting local adaptations, and reducing the genetic diversity of wild salmon populations. The native population will eventually be composed of individuals that have all descended from the migrants. Thus, farm salmon compete well against wild fish in the short term. Furthermore, even though farm fish may be competitively and reproductively inferior in the long term, repeated intrusions of escapes from new year classes of farm fish will result in genetic introgression.

Hindar *et al.* (1991) stated that the effects of gene flow can be reduced by assuring that the genetic differences between escaped fish and recipient wild populations are as small as possible. The authors further indicated that one way to achieve this objective of minimal differences is to strive for aquaculture programs that are based on local salmon populations. This approach will not prevent the cultured stocks from becoming increasingly different from their wild ancestors, because of selective breeding within the aquaculture industry and the inevitable process of domestication. It will, however, prevent the introduction of highly exotic genes into local wild populations.

Farmed salmon in Scandanavian countries have been documented to spawn successfully, but later in the season than wild salmon (Lura and Saegrov 1991; Jonsson *et al.* 1991), a factor that increases the potential for limiting the success of wild spawners through redd superimposition. Superimposition occurs when an existing redd is overlaid with eggs from a later spawning fish. Redds can suffer egg mortality (e.g., the eggs can be dislodged from the gravel) when new redds are superimposed on top of the existing redd. Lura and Saegrov (1991) observed farmed females destroying the redds of wild salmon (i.e., superimposition in an effort to create new redds). It is reasonably certain that at least some aquaculture escapees from Maine salmon farms have exhibited the same behavior, disrupting redds and therefore reducing the reproductive success of GOM DPS salmon. Redd disruption is of particular concern due to the very low numbers of redds observed in GOM DPS rivers over the last few years (e.g., redd counts in 2002 in each of the eight GOM DPS rivers ranged from a low of 0 to a high of six redds; in 2001 from 0 to 71 redds; and in 2000 from one to 60 redds). These redd counts do not necessarily represent a complete count of all redds in each watershed but are useful in establishing trends and serve as the best available scientific information.

Aquaculture escapees occur annually in Maine rivers (see Table 4 in Section VI) and genetic analysis of juvenile Atlantic salmon collected from five of the GOM DPS rivers has identified fish with genotypes indicative of European origin (Dave Perkins, pers. comm.). For at least three of these rivers without aquaculture hatcheries, the European-origin fish must have been the offspring of aquaculture escapees that spawned in the river with either wild fish or other escapees. Given the prevalence of Atlantic salmon introgression observed in rivers outside the U.S., indications of spawning by escapees in the GOM DPS rivers are not unexpected. Based on the scientific literature, along with the presence of escapees and putative offspring in the GOM DPS rivers, the Services have concluded that escapes from the Maine aquaculture industry constitute an existing and imminent threat to the GOM DPS through genetic interactions.

e. Diseases and Parasites

Transmission from farms to local wild stocks

Migrating GOM DPS Atlantic salmon can be exposed to and infected by close proximity to diseased aquaculture sites or infected by escaped farmed salmon (DFO 1999). The greatest disease risk to both farmed and wild stocks is through the introduction of exotic pathogens into areas where local stock have no innate resistance, or through amplification of endemic pathogens. Serious epizootics[1] of furunculosis and *Gyrodactylus salaris* in stocks of salmon in Scotland indicate the severe consequences of new disease outbreaks linked to movements of live fish for farming or restocking purposes (McVicar 1997). This epizootic of furunculosis in Scotland became a severe problem in farmed Atlantic salmon during the latter part of the 1980s. In view of the fact that the furunculosis bacterium can spread up to a radius of 10 km from cage sites, it is highly probable that local stocks of wild fish were being regularly exposed to the infection during that period (McVicar 1997). Transfer of furunculosis from farmed salmon to wild salmon in Norwegian rivers has been documented (DFO 1999). Yet another example of a disease transmitted from a farm to a local wild stock is the spread of Infectious Pancreatic Necrosis virus from a heavily infected freshwater rainbow trout farm into neighboring stocks of wild fish, including salmon, up to 7 km away (McVicar 1997). Although transmission of disease from Maine salmon farms to the GOM DPS has not been detected, these examples of disease transfer from farmed to wild salmon in other countries clearly demonstrate the risk to the GOM DPS.

Sea Lice

Control of disease outbreaks within farms has markedly improved in recent years, reducing the risk of farms being a focus or multiplier of locally occurring diseases, but problems still remain with some diseases and parasites, particularly sea lice. Lice from salmon farms contribute to lice populations in wild salmonids, but the extent and consequences of this have not been quantified (McVicar 1997). Outmigrating salmon may acquire sea lice infestations if they migrate close to infected salmon aquaculture facilities. For adult salmon returning to their natal streams to spawn, the threat is likely lower. As soon as the fish enters freshwater, sea lice die and fall off. In Norway, the level of sea lice infestation on wild fish in some areas where Atlantic salmon

[1] An epizootic is a disease affecting a greater number of individuals than normal; typically epizootics involve many individuals in the same region at the same time.

farming is concentrated has been found to be ten times greater than in areas where there are no farms (NASCO 1993). A study by Jacobsen and Gaard (1997) also observed sea lice on wild and escaped farmed salmon in open ocean feeding grounds in the Norwegian Sea. It is possible that escaped farm salmon transfer increasing numbers of sea lice to wild salmon in the open ocean. Unfortunately, no historic infestation data are available from the high seas to help answer this question (Jacobsen and Gaard 1997). Sea lice affect fish by degrading their protective mucous layer and making them more susceptible to secondary infection or infestation by other parasites, thereby reducing fitness of the host. High densities of sea lice can cause direct mortality to the host. While sea lice are commonly present in low numbers in wild stocks, their presence rarely causes mortality or severe pathological effects (such as experienced on commercial aquaculture farms). Risks to the GOM DPS from transfer of sea lice from aquaculture salmon raised in Maine net pens is reduced by sea lice treatments at fish pens to control outbreaks. In view of the fact that new management plans (in effect as of spring 2002) require farm sites in Maine to lie fallow between each production cycle, disrupting the sea lice life cycle, this risk should be further reduced in the future.

ISAV

In Maine, the recent outbreak of ISAV in Cobscook Bay and the close proximity of several fish farms to GOM DPS rivers raises concerns about wild salmon declines in the marine environment. The ISA virus has been found in wild salmon in Scotland (Raynard *et al.* 2001), as well as in confined rainbow trout, wild sea trout, and eels (65 FR 69469, Nov. 17, 2000). There has been one documented case of wild salmon exhibiting ISAV in Canada, but these wild fish were confined for a period in a trapping facility with infected aquaculture salmon (Whoriskey 1999).

In response to the recent outbreaks of ISAV at finfish aquaculture facilities, the Maine DMR has implemented new fish health regulations. The DMR's rules include mandatory surveillance and reporting of all testing results for ISAV in Cobscook Bay; sites with a confirmed case of ISAV are automatically subject to a remedial action plan developed by the DMR. Vessel and equipment movement is also restricted. Prior to the rule changes, surveillance was not mandatory and reporting for the disease was only required when either active or passive surveillance identified a confirmed case of the disease. Sampling is now conducted monthly for all active finfish facilities in the state. The new rules expand the DMR's authority to take action not only at infected facilities, but at those exposed to ISAV as well. These rules require the DMR to consult with all relevant state and federal entities with expertise in ISAV control.

On December 18, 2001, the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) implemented an ISAV indemnity, surveillance, biosecurity, and epidemiological research program for farm-raised fish in the United States. Participation in this program is mandatory for all salmon growers and covers all salmon finfish farms in the state. USDA's goal is to control and contain the disease through rapid detection and depopulation of salmon that have been infected with or exposed to ISAV. The APHIS program is being interfaced with the State of Maine's husbandry and bay management program that is being implemented via the DMR's authority described in the fish health regulations above.

On January 7, 2002, the DMR and the APHIS ordered the eradication of up to 1.5 million salmon located in seven aquaculture facilities in Cobscook Bay that were infected with or exposed to the ISAV. The January 2002 order followed the earlier removal of over one million ISAV-exposed fish by the aquaculture industry, as directed by the DMR. The fish were removed from Cobscook Bay and the entire bay was fallowed for ninety-two days. The fallowing involved the removal of all the fish and the cleaning and disinfection of all the associated net pens, barges, and equipment at all the farms. The equipment was cleaned and disinfected by high pressure steam, either at the facility or off site. All cleaning and disinfection were authorized and supervised by the APHIS program. Additional surveillance by the APHIS and the DMR includes tracking of the following: the dispersion of the virus in the water column; the attenuation of the virus on surfaces over time; and the environmental distribution of the virus in the water column, sediments, alternative species, and sea lice.

The DMR, working directly with the aquaculture industry, developed a comprehensive program of husbandry and management practices to restock Cobscook Bay in the spring of 2002 and 2003. DMR's husbandry program requires that bay management areas be created for all finfish facilities; i.e., all farms within a bay management area must abide by standards that 1) require farms to be stocked with only one year class of fish, 2) limit the capacity of bays and individual farms impacted by ISAV, 3) mandate fallowing between production cycles, and 4) govern the density and stocking procedures for individual farms. Cobscook Bay was divided into two management areas: only the southern portion of the bay was stocked in 2002 (and will be stocked in even years thereafter); the northern portion was empty until spring 2003. In 2002 and 2003, fish farms in the bay were stocked with approximately 25% less fish than there were historically; it is unknown at this time whether this reduction in stocking level will continue into the future. The DMR's bay management program is being developed following an evaluation of other ISAV control programs in New Brunswick, Canada; Scotland; and Norway. These jurisdictions have developed control programs that have been successful in minimizing further outbreaks of the disease.

The new programs developed by the APHIS and the DMR to address outbreaks of ISAV in the aquaculture industry should reduce the threat of this disease to wild salmon. Amplification of endemic diseases, such as ISAV, poses a threat to wild populations of salmon, but continued surveillance and monitoring programs should reduce the risk of future outbreaks within the aquaculture industry and therefore reduce the risk of transmission of ISAV to wild salmon. Furthermore, the U.S. is working with Canada on joint strategies for managing ISAV, recognizing the importance of working together on issues affecting a common water body.

Although ISAV has not been observed to be a problem for wild stocks, the Services are concerned that ISAV will directly affect pre-spawning adults. More studies and tests need to be conducted on wild and aquaculture fish to look at existence of and trends in disease prevalence. Intensifying ISAV surveillance, avoiding future outbreaks, improving containment of aquaculture fish, and maintaining healthy, disease-free fish farms should reduce the disease risk that aquaculture salmon pose to wild stocks. ISAV and other diseases and parasites probably have not had much of an impact on the current status of the GOM DPS but remain a threat.

f. Salmonids Other than Atlantic Salmon

Some of the ACOE permits included in this action authorize the permittees to culture salmonid species other than Atlantic salmon. Salmonid species other than Atlantic salmon that escape from private aquaculture operations also pose a threat to wild Atlantic salmon populations. Because other salmonid species would be grown using the same equipment and husbandry practices as are used for Atlantic salmon, escapement of these other species would be expected.

Crossman (1991) reported the escape of rainbow trout from Canadian aquaculture facilities in New Brunswick and Newfoundland. Escaped salmonids can adversely impact wild Atlantic salmon through competition for food and habitat, transfer of disease, and redd superimposition. During the juvenile life stage of various salmonids, similar life histories and habitat preferences can overlap, creating interspecific competition that could adversely affect growth and survival of juvenile Atlantic salmon. Interspecific competition between Atlantic salmon and other salmonid species is dependent on a number of factors, including the availability of food and habitat. Ecological interactions between salmonids can lead to increased mortality and decreased growth (Fausch and White 1986).

Early life stages of the Atlantic salmon and rainbow trout are remarkably similar in habitat preferences, behavior and feeding (Bley and Moring 1988). The rainbow trout is native to the western United States and is an introduced species in Maine. In areas where Atlantic salmon and rainbow trout co-occur, significant niche overlap is expected to occur and under limiting circumstances, vigorous competition for resources is expected (Volpe *et al.* 2001). At juvenile stages, rainbow trout are likely to significantly interact with Atlantic salmon (Gibson 1981). Interspecific competition during juvenile stages may be an important factor affecting growth and survival of Atlantic salmon (Fausch 1988). In a study by Volpe *et al.* (2001), rainbow trout performance was superior to that of Atlantic salmon. The potential also exists for Atlantic salmon redds to be superimposed by spring-spawning rainbow trout (Volpe *et al.* 2001). This risk, however, is reduced considering the biology of the species. Rainbow trout are typically late winter-early spring spawners, while Atlantic salmon in Maine typically spawn in the fall (mid-October through mid-November). This difference in spawning timing reduces the risk of reproductive interference. However, rainbow trout can still superimpose already established redds of Atlantic salmon. If the eggs in the Atlantic salmon redds have achieved sufficient development (such as reaching the eyed-egg stage) at the time of redd superimposition by rainbow trout, the Atlantic salmon eggs would be less susceptible to damage from this disruption, reducing the impact from redd superimposition. Colonization of freshwater habitats within GOM DPS rivers by rainbow trout, either through intentional stocking or escapement from aquaculture facilities, could have adverse effects on wild salmon populations. Escapees could have a competitive advantage through domestication; selection for higher growth rates and aggressive feeding behaviors would enhance an escapee's ability to out-compete and displace resident Atlantic salmon.

Some salmonid strains, including sea trout (*Salmon trutta L.*) and rainbow trout are known to be asymptomatic carriers of ISAV (Nylund *et al.* 1997). Escaped or caged rainbow trout may pose a threat to endangered Atlantic salmon by functioning as a reservoir for ISAV. The virus does not seem to cause significant mortality of infected rainbow trout (Nylund *et al.* 1997).

The Services recognize that there has been limited use of other salmonid species by the aquaculture industry in Maine, although site M1 (Pierce Associates, Inc.) has routinely grown rainbow trout in the Sheepscot River. These rainbow trout have been all female triploid (i.e., sterile) fish. Sterility in fishes includes the induction of a chromosomal abnormality, triploidisation, which can be accomplished in two ways: 1) chemical (anesthetic) and 2) physical (pressure and heat shocking ova), the latter of which is preferred in salmonids (Johnstone 1998). Both techniques are highly variable, and neither is 100% effective (Sutterlin and Collier 1991). Therefore, a single sex population (all female) is used to eliminate the ability to effectively mate and produce offspring (Cotter *et al.* 2000). In a competition experiment, triploids were less aggressive than diploid rainbow trout (O'Flynn *et al.* 1997), which could reduce impacts to wild salmon through competition for food and space. Furthermore, the Services have no information on past escape events that may have resulted in other farmed salmonid species entering GOM DPS rivers. Although there is no indication that other aquaculture salmonids have impacted the status of the listed salmon to date, use of these fish poses risks similar to those posed by farmed Atlantic salmon, such as competition for food and space, disease transfer, and redd superimposition.

g. Clean Water Act Section 402 Permits

Since the listing of Atlantic salmon on November 17, 2000, there have been two formal Section 7 consultations completed that focused on impacts to the GOM DPS. One consultation was between the Services and the EPA and concerned the EPA's proposed approval of the State of Maine's application to administer the NPDES permit program. The other related to the issuance of an EPA NPDES permit authorizing the discharge of pollutants from site A2 (Acadia Aquaculture Inc., Blue Hill Bay, Dunham's Cove). Based on the proposed permitting procedures and commitments made by the EPA, the Services were able to conclude that the EPA's proposed action could result in take but was not likely to jeopardize the GOM DPS.

State administration of the NPDES program was subsequently approved by the EPA on January 12, 2001. Unfortunately, the state has not yet issued any discharge permits to the finfish aquaculture industry and the adverse effects of salmon aquaculture on wild salmon continue to occur. Furthermore, while the EPA was issued an Incidental Take Statement (ITS) as a result of the Section 7 consultation on the NPDES delegation, neither the protective conditions, nor the reasonable and prudent measures and the terms and conditions that are required to exempt Section 9 take prohibitions have been implemented. Consequently, any take of Atlantic salmon that might have occurred since the permitting program was delegated to the State of Maine was unauthorized.

On February 21, 2002, the EPA issued a final NPDES permit for Acadia Aquaculture. The permit conditions proposed by the EPA to protect Atlantic salmon are similar to the ACOE special conditions included in this proposed action. Although this site has both an ACOE permit and a NPDES permit, it does not hold a valid state lease. Since the site has not yet been developed, it has not yet had an impact on the GOM DPS. Should this site ever be developed, however, the effects of the action are included in the environmental baseline of this opinion, including the analysis of effects of the proposed action and the authorized incidental take.

E. Analysis of the species/critical habitat likely to be affected

1. *Other ESA Listed Species in the Project Area*

Following is a discussion of other ESA-listed species present in the project area, along with reasons they are not likely to be adversely affected. These species will not be considered further in the consultation. There is no critical habitat designated for any federally-listed species in the project area.

The federally-threatened bald eagle and the endangered roseate tern (under the jurisdiction of USFWS) also occur in the action area. There are several bald eagle nest sites located throughout Cobscook, Machias, Pleasant, and East Penobscot Bays. Bald eagles are also seen in the project area throughout the winter season. With the exception of site B1 (Stone Island), however, none of the existing farms are located close enough to current bald eagle nest sites to cause adverse effects to the bald eagle by disturbance or entanglement in nets. To address the impacts of the Stone Island net pens on bald eagles, the USFWS completed a formal Section 7 consultation in 1997. Roseate terns currently nest on Petit Manan Island, approximately eight miles southwest of Flint Island, the nearest salmon aquaculture facility. There is no evidence to suggest that there would be any interaction between these terns and the net pens that would impact the terns. Therefore, the USFWS has determined that the proposed action is not likely to adversely affect the roseate tern or bald eagles, other than those eagles covered in the 1997 opinion, and no further consultation related to these species is needed pursuant to the ESA.

There is potential for ESA-listed species under the jurisdiction of NOAA Fisheries, including the North Atlantic right whale, humpback whale, fin whale and sei whales, leatherback sea turtles and loggerhead sea turtles, to infrequently transit through Cobscook, Machias, Pleasant, and East Penobscot Bays in pursuit of food. It is unlikely that loggerhead turtles, a threatened species, would be found as far north as the project area and in the vicinity of the nearshore marine cages. Despite the presence of marine cages off the coast of Maine for the past twenty years, there are no known entanglements of marine mammals or sea turtles in any marine cage. This is likely due to the fact that the gear is very visible to marine mammals and the fact that the mooring lines are very taut, posing a low risk of entanglement to marine mammals and sea turtles. The marine cages are set nearshore or inshore, thereby reducing the potential for interaction with these predominantly pelagic species. Given the low probability of interaction between the marine cage and marine mammals or sea turtles, the proposed action is not likely to adversely affect the Atlantic right whale, humpback whale, fin whale, sei whale, leatherback sea turtle, and loggerhead sea turtle; therefore, no further consultation related to these species is needed pursuant to the ESA.

The shortnose sturgeon (*Acipenser brevirostrum*) is also a federally-endangered species under the jurisdiction of NOAA Fisheries. Shortnose sturgeon occur in the estuarine complex formed by the Sheepscot, Kennebec, and Androscoggin Rivers. A shortnose sturgeon was also captured in the Penobscot River estuary on June 30, 1978. This capture indicates that a contemporary shortnose sturgeon population exists in the Penobscot River, as this capture occurred within the generation time of the species. Sturgeon may occur in the vicinity of two sites in Penobscot Bay (A1 and A2). Site A2 has never been developed, and does not have a valid state lease; therefore, no impacts to sturgeon are expected from this site. A baseline survey for site A1 suggests that the area is not foraging habitat for sturgeon, therefore sturgeon are unlikely to spend time in the vicinity of site A1.

Shortnose sturgeon are known to occur in the Sheepscot River. Site M1 is the only finfish aquaculture site in the vicinity of the Sheepscot River. Shortnose sturgeon have been documented in Montsweag Bay during the summer, and one was entrained in an intake at the Maine Yankee Power Plant (near site M1) on June 7, 1994. Sturgeon are sensitive to low dissolved oxygen levels (DO) (<5mg/L). Site M1 is located in an area sturgeon may migrate through, and it is unlikely at this time that site A1 creates low dissolved oxygen levels as it is not stocked regularly or with large amounts of fish. There are plans in the future, however, to monitor DO at the site. Rainbow trout are currently the only species being raised at site M1 (artic char and brown trout are also authorized, however, Atlantic salmon is not), therefore it is unlikely that escapes from site M1, or any of the other sites in the project description, would result in adverse impacts, as sturgeon and rainbow trout behaviors do not overlap, eliminating impacts from competition and reproduction. Given the low probability of impacts to sturgeon from sites M1, A1, and A2, and given the fact that the rest of the finfish aquaculture sites are located outside of the sturgeon's range, the proposed action is not likely to adversely affect the shortnose sturgeon; therefore, no further consultation related to this species is needed pursuant to the ESA.

2. *Summary of Current Status of Atlantic salmon*

The Services agree with the ACOE's determination that the proposed project is likely to adversely affect the endangered Atlantic salmon. As discussed earlier in this biological opinion, any other listed species have either been addressed in other biological opinions, or are not likely to be adversely affected by this action, therefore, the endangered Atlantic salmon is the only listed species further considered in this opinion.

Naturally-reproducing Atlantic salmon populations in the GOM DPS are at extremely low levels of abundance. This conclusion is based principally on the fact that spawner abundance is below 10% of the number required to maximize juvenile production, juvenile abundance indices are lower than historical counts, and smolt production is less than a third of estimated capacity (AASBRT 1999). Conclusions about the status of the GOM DPS, however, must take into consideration the multiple-year classes of fish within the river and at sea at any given time, as well as the river-specific fish being reared in the USFWS's hatchery program.

The river-specific hatchery program, which was initiated in 1991, significantly supplements natural production in the GOM DPS watersheds. In some river systems, sufficient numbers of stocked fry are available to fully saturate available habitat. Parr abundance has significantly increased as a result of the fry stocking program. Although numbers of parr have increased, parr abundance has not increased at the same rate as would be expected based on the level of fry stocking and previous estimates of in-river survival. This observation has increased scrutiny of water quality and habitat conditions in an attempt to identify factors within the river that may be causing parr mortality. The overwinter survival for parr during the winter just prior to their preparation for leaving the river and migrating to the ocean is of particular concern.

The higher numbers of parr in the rivers have resulted in more smolts leaving the GOM DPS watersheds. Although the numbers of smolts have increased, they have not increased at the rate that would have been predicted based on levels of fry stocking and previous estimates of fry to smolt survival. Smolt tracking studies also have identified high outmigration mortality. In an attempt to identify factors that are causing high smolt mortality, studies were conducted to examine smolt condition. Preliminary results from these studies indicate that, at least for the 2002 Dennys River smolt class, the condition of smolts was poor. This would likely have resulted in very poor transition to salt water and high smolt mortality. Further research is ongoing to examine if this is a situation unique to the Dennys River and to identify water quality parameters that could be leading to poor smolt condition.

The North Atlantic Salmon Working Group of the International Council for the Exploration of the Sea prepares an annual estimate of pre-fishery abundance of Atlantic salmon in the North Atlantic based on spawner abundance and habitat conditions. This relationship contains two phases, a high productivity phase and a low productivity phase based on observations of spawners and pre-fishery abundance since 1977. The relationship has been in the low productivity phase for the last twelve years. The stocking efforts described above have resulted in an increase in the number of salmon leaving the GOM DPS. However, low productivity in the marine environment in recent years has prevented this level of stocking from increasing returns. A change in the marine environment to the high productivity phase would result in more returns to the GOM DPS.

Current adult returns to the GOM DPS are alarmingly low. However, in order to acquire a full picture of the future of the species, one must consider the numbers of fish in the USFWS's hatchery program, the numbers of fry annually stocked, parr abundance, smolt outmigration, and marine survival. Efforts to increase abundance at each lifestage and to minimize mortality between life stages are ongoing and are essential to the recovery of the species.

III. EFFECTS OF THE ACTION

This section of the opinion analyzes the direct and indirect effects of the proposed action on the GOM DPS of Atlantic salmon, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02, June 30, 1986). Indirect effects are those that are caused by the proposed action, are 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 opinion examines the likely effects of the proposed action on the GOM DPS of Atlantic salmon, within the context of the species' current status and the environmental baseline (which considers past and present impacts in the action area).

The ACOE special conditions proposed to be included in the existing RHA Section 10 permits are specifically designed to address the effects of aquaculture on the endangered Atlantic salmon, as discussed above. However, even if the procedures described in the ACOE special conditions are implemented as envisioned, there will still be failures of containment systems, accidents, storms, or other events that result in an escape of aquaculture fish (e.g., in December 2000, approximately 100,000 aquaculture salmon escaped into Machias Bay when a storm destroyed a steel cage off of Stone Island). Maine's fish farms are located in a highly dynamic ocean environment where net pens and their associated mooring gear are subject to damage from strong winds, high waves, ice, and boating accidents; these forces can damage gear and result in fish escapes, despite the best efforts of the aquaculture company's on-site staff. Furthermore, there will still be threats related to disease and parasites from aquaculture fish contained in net pens. Consequently, it is likely that some adverse effects to the Atlantic salmon GOM DPS will continue to occur with implementation of the proposed action. However, implementation of the proposed permit modifications significantly reduces the likelihood of interaction between farmed and wild fish and, consequently, the likelihood that any future interaction will appreciably reduce the potential for survival and recovery of the GOM DPS.

Background

The proposed ACOE special conditions will significantly reduce, but will not eliminate, the losses of farmed fish from net pens in the vicinity of the GOM DPS of Atlantic salmon. Losses of fish from net pens can occur in any one of three ways: (1) "trickle" losses of small numbers of fish during regular activities, such as feeding; (2) systemic losses during specific activities such as stocking smolts into cages, grading fish in net pens and harvesting; and (3) catastrophic losses due to predators, storms, structural damage, mooring failure, or accidents, such as vessels running into a cage. Losses from U.S. cages have been attributed to all of these causes. When fish escape from a net pen, they enter the marine environment and may head farther out to sea or head into a coastal river. There are not sufficient data currently available to be able to estimate what percentage of fish that escape from a cage will enter rivers. The percentage is likely influenced by the season during which the loss occurs, the age of the fish that escape, the proximity of the cage to a river, as well as other factors. The annual detection of escapees in rivers with weirs since 1994 does provide evidence that some percentage of the fish that escape from marine cages do enter rivers. As demonstrated in Tables 2 and 3, over the past nine years, tens of thousands of fish have escaped; furthermore, some of these fish have entered some of the GOM DPS rivers. It is also important to note that some of the escapees that have been intercepted in Maine rivers have been sexually mature.

Escaped fish that enter rivers with weirs may be intercepted and removed from the river, thereby preventing further in-river interactions between those escaped fish and wild salmon. However, weirs are not a complete barrier preventing interactions because 1) in some rivers there is spawning habitat below the weirs (e.g., the Dennys River), 2) the weirs are not present year-round, and 3) the efficacy of the screening depends on the ability to be able to positively identify the fish as an aquaculture escapee. The accuracy of identification of farmed fish at a weir or trap can be affected by the presence, persistence and readability of an external mark; scale preparation and readability; and experience of the individual tending the weir or trap. When water temperatures are high, the opportunity to handle fish in order to conduct an external examination can be severely limited (i.e., to avoid stress or injury to wild salmon that would be subsequently released upstream of the weir to spawn). Weirs or traps are currently located on the Dennys, Narraguagus and Pleasant Rivers. The Machias and East Machias Rivers have many marine cages located near their mouths, but do not contain weirs or traps. Therefore, aquaculture escapees continue to have free access to these river systems where take is anticipated. The detection of escapees in a weir or trap on the Dennys, Narraguagus or Pleasant Rivers provides evidence that there have been losses at marine cages and that some percentage of the escaped fish have entered rivers within the GOM DPS.

Individual fish captured in a weir/trap and positively identified as aquaculture escapees will be removed from the system, and therefore are prevented from having additional impacts on wild salmon through redd superimposition, genetic introgression, competition or disease transfer. Their presence in a weir/trap, however, indicates that escapees are present in the marine environment, and some percentage of these escapees will continue to enter other rivers within the GOM DPS without weirs/traps and are likely to then adversely affect the wild stock through redd superimposition, genetic introgression, or competition. While escapees may affect wild stocks within the GOM DPS through the transfer of disease, there is currently not sufficient information to assume that disease transfer is reasonably certain to occur and result in take.

Available evidence suggests that aquaculture escapees sometimes spawn later in the year than wild fish (Lura and Saegrov 1991). Escapees have been shown to dig redds on top of the redds previously created by wild fish. In doing so, the escapees can dislodge the eggs of the wild fish or lay their eggs on top of the wild salmon eggs, resulting in a direct take of eggs, as well as take (i.e., harm or harass) through the reduction in the reproductive success of the wild fish. Aquaculture escapees are also anticipated to negatively impact the reproductive success of wild fish by competing with wild stocks for habitat, food or mates. If aquaculture escapees are present in the rivers at the same time as wild fish, they may spawn with the wild fish, resulting in hybridization. As explained previously in Section II. D. (Status of the Species and Factors Affecting its Environment), this genetic introgression is likely to result in reduced genetic fitness of the wild stock, reducing its reproductive success and therefore reducing numbers of wild fish in the future. The impact of this anticipated introgression is magnified by the extremely low number of fish surviving in the wild. Aquaculture escapees may also breed with each other, creating juveniles that will compete with wild juveniles for food and habitat and pose a future risk (i.e., if they become sexually mature) for genetic interactions with wild salmon. By competing with wild stocks for habitat, food or mates, aquaculture escapees can also negatively impact the reproductive success of wild fish.

Disease and parasites may be transferred from aquaculture fish to wild fish in a variety of ways, including: (1) when wild fish migrate past net pens on their migration into or out of the rivers; (2) when aquaculture escapees and wild fish interact in the marine environment; or (3) when aquaculture escapees and wild fish interact in rivers, including when these fish are held at weirs or traps. Disease and parasite impacts were described in greater detail in Section II. D. (Status of the Species and Factors Affecting its Environment). While there is little evidence that impacts have manifested themselves in the wild salmon population to date, the threat remains as long as the aquaculture industry continues to operate in the geographic range of the GOM DPS.

A. Containment

Special Condition No. 4 (Containment) should reduce the effects of escapement described above by requiring each facility to employ an approved Containment Management System (CMS), including a loss control plan that outlines critical control points (CCP) where escapement may occur. The development of the CMS will enable facility operators to be aware ahead of time of areas, activities, and situations where the potential for escapement is elevated. This increased awareness and preplanning for escape response, severe weather procedures, and unusual event management should reduce the frequency and magnitude of escapes. Auditing and the requirement for corrective actions should further the effectiveness of this system in reducing escapes over time, by allowing a mechanism to continually update and improve upon the strategies and information outlined in each facility's CMS.

Reductions in the numbers of escapees entering rivers, as a result of the adoption of the CMS, will reduce the potential for genetic and ecological impacts from aquaculture activities. Fewer fish escaping from net pens results in fewer fish entering rivers and therefore reduces the likelihood of interbreeding between escaped Atlantic salmon and the GOM DPS of Atlantic salmon. A reduction in number of escapees in rivers also reduces the impact of competition between farmed Atlantic salmon or farmed rainbow trout and wild Atlantic salmon. As explained previously, competition for habitat and mates is reasonably certain to impair essential behavioral patterns of wild Atlantic salmon including breeding, feeding, or sheltering (included in the concepts of harm and harass,[2] which are included in the definition of take).

The CMS includes measures to reduce the potential for escapement to occur from all three of the types of losses identified above (i.e., trickle, systemic, and catastrophic losses). Inventory tracking, monitoring food consumption, and monitoring CCP will increase the potential for prompt identification of losses, which will result in quicker correction of the factors that lead to the loss, which in turn will reduce the potential for future losses. Monitoring the CCP involved in management measures, such as smolt stocking, grading and harvesting, may result in the identification of improvements that need to be made in these management practices to reduce the potential for systemic losses during these activities. The CMS also includes provisions for maintaining records on equipment status, including dates of installation and maintenance, and requirements for net testing and mooring inspection. These provisions will reduce the potential for predator attacks or storms to cause damage that could result in catastrophic loss of fish from the net pens. This is significant, as equipment failures are more likely to result in large, one-time escape events, than are the other two types of losses identified above (i.e., trickle and systemic).

[2] While NOAA Fisheries does not have a regulatory definition of harass or harassment like the USFWS, for the purposes of this Opinion NOAA Fisheries believes that impairing essential behavioral patterns of wild Atlantic salmon does constitute harassment under the ESA.

The CMS also requires mandatory reporting of losses, which will assist in the development of a database that will facilitate our future ability to better understand the relationship between losses at cages and escapees entering rivers. While the two are known to be linked, and it is reasonable to assume that reductions in losses at cages will result in reductions in escapees entering rivers, there is no information, at this point in time, to be able to more specifically describe the relationship.

Although it is not possible to precisely quantify the impact of these ACOE special conditions, it is reasonable to conclude that Special Condition No. 4 will result in a reduction in the frequency and magnitude of losses from net pens, which in turn will result in a reduction in the frequency and magnitude of escapees entering GOM DPS rivers. Unfortunately, evaluating the success of the CMS will be limited by the lack of a baseline, i.e., the lack of accurate information provided by the industry identifying the frequency, nature, genetic composition, and extent of past and ongoing escapes that is needed for comparison purposes. At this point, it is reasonable to assume that the implementation of Special Condition No. 4 will result in at least a 25% reduction in the loss of fish from cages and a resulting 25% reduction in escapees entering rivers, as measured by a 25% reduction in escapees detected in weirs/traps.

In order to set a reduction target, the Services attempted to locate quantitative data on reductions in escapes as a result of implementation of containment improvements. Data was only available from the Norwegian aquaculture industry. It is reasonable to use this data as a measure of what might be achieved or expected in the U.S. due to similarities in equipment and operating practices. In Norway a National Action Plan to prevent aquaculture escapes was developed and implemented in 2000. The Norwegian National Action Plan included containment measures similar to those proposed in the draft ACOE permits in this biological opinion, including inventory tracking focusing on critical control points and increased training for aquaculture industry employees. Between 1999 and 2001, Norway experienced a 22% decline in absolute numbers of reported escapes of farm-raised salmon. The data collected refers to losses reported at the cage site, whereas our incidental take statement measures escapees detected in rivers. The reported decrease of 22% was documented while the number of fish in production increased. In terms of the number of escapees relative to salmon production, the number of escaped farm-raised salmon declined almost 41% (from about 2.8 percent of total production in 1999 to about 1.7 % of total production in 2001 (NASCO 2003). Because we are not scaling the incidental take statement to production, the 41% may appear to be the more appropriate number to use. The large difference between the 22% and 41% reflects a significant increase in production in the Norwegian industry between 1999 and 2001. The facilities included in the project description are operating at or near capacity and therefore a significant increase in U.S. production would not be reasonably expected. Without an anticipated significant increase in U.S. production, it would appear reasonable to anticipate a greater than 22% reduction in reported escapes. Importantly, some of the anticipated reduction in escapes as a consequence of implementation of the containment measures has been realized since some improvements have already been implemented. Therefore, it would be unreasonable to anticipate a 41% reduction in escapes, as was observed in Norway. Taking into consideration the best available quantitative data, which is limited to the experience in Norway, a conservative estimate of anticipated reduction in detection of escapees in rivers is 25%. Based on the Norwegian experience, it is reasonable to conclude that the CMS implemented through Special Condition No. 4 will result in at least a 25% reduction in escapees in the Maine aquaculture industry.

These expected reductions are significant in reducing the frequency and number of escapees entering rivers. The potential for the most significant adverse genetic impacts to wild stocks is greatest if escapees persistently enter a river on an annual basis. Wild populations are better able to withstand and recover from a one-time genetic impact of escapees interbreeding with wild stocks than if interbreeding occurs on an annual basis. In focusing on areas where there is a greater potential for either "trickle" or systemic losses, through the development of CCP and monitoring, the potential for the repeated annual intrusion of escapees is significantly reduced.

B. Phase-out of European Stocks and Genetic Introgression

Special Condition No. 1 (Genetic Strain) removes the greatest aquaculture-related effect (i.e., genetic introgression between the GOM DPS and non-North American strain stocks) on the survival and recovery of the GOM DPS of Atlantic salmon. Condition No. 1 will progressively reduce the percentage of farm fish in cages that are reproductively-viable non-North American strain salmon and will eventually eliminate them from Maine waters. This will reduce the severity of the adverse effects from the current use of genetically divergent strains of aquaculture salmon on the GOM DPS. The large genetic difference between North American and non-North American strain Atlantic salmon increases the likelihood that introgression between the two will result in significant, long-term, adverse genetic impacts on the wild stock, which would have the effect of reducing the likelihood of survival and recovery of the GOM DPS of Atlantic salmon.

By preventing the additional spawning of non-North American strain Atlantic salmon, Special Condition No. 1 immediately prevents the creation of any additional pure or hybrid non-North American strain Atlantic salmon. According to Special Condition No. 1, all new, reproductively-viable fish stocked after July 31, 2004 must be of North American origin. However, pure or hybrid non-North American strain Atlantic salmon currently growing in freshwater hatcheries or marine cages will be allowed to remain until they reach the size at which they would typically be harvested. Allowing the industry to continue raising these fish to harvestable size reduces the economic impact of the condition. Since no fish stocked after July 31, 2004 will be of non-North American origin, the percentage of fish in the water of non-North American origin will be reduced with each harvesting event. By March 1, 2006, all non-North American Atlantic salmon will have been removed from net pens.

Non-North American origin Atlantic salmon with the potential to escape from net pens will continue to be present in the Gulf of Maine during the 2003, 2004, 2005 and 2006 spawning periods for the GOM DPS of Atlantic salmon. Therefore, the potential for introgression between escaped fish of non-North American origin and wild fish will exist for at least four more years (given that Atlantic salmon can survive to spawn more than once). While this has the potential to adversely affect the GOM DPS of Atlantic salmon over the long term if unabated, it is unlikely to reduce appreciably the likelihood of survival and recovery of the GOM DPS because of the phase-out and elimination of European fish in the near future. The short-term, potential impact is decreasing each year, as each year the number of fish in cages that are non-North American will be reduced, and weirs and traps will be used to screen out aquaculture escapees in three river systems. The "short-term" timeframe is approximately five years, when the Services expect that some non-North American escapees will still be present in the ocean or the GOM DPS rivers. Over the long term, the potential for future introgression from non-North American Atlantic salmon to the GOM DPS is eliminated.

Adverse genetic interactions between North American aquaculture strain Atlantic salmon and wild salmon can still occur, although the absence of non-North American strain salmon will pose significantly less risk to the GOM DPS because the potential for highly exotic genes to be introduced into GOM DPS salmon will be eliminated (Hindar *et al.* 1991). Through the process of domestication, even North American strain aquaculture fish will genetically diverge from the wild strain. Therefore, even when reproductively-viable non-North American strain Atlantic salmon have been removed from net pens, it is still necessary to minimize escapees in order to minimize the adverse genetic impacts on the GOM DPS. If a North American strain aquaculture escapee successfully interbreeds with a wild salmon, this adverse genetic interaction can disrupt local adaptations, threaten stock viability, and lower recruitment. Furthermore, the potential for fish disease transmission and other undesirable ecological interactions exists, regardless of the genetic strain utilized by the aquaculture industry.

Evaluation of the threat posed by introgression is complicated by a number of factors. The presence of aquaculture escapees in a river introduces the possibility of introgression. However, interbreeding between an escapee and a wild fish can only occur if the escaped fish enters a river at a time when wild fish are spawning, the escapee is sexually mature, and it finds a wild mate. Interbreeding may be less likely to occur in the Sheepscot and Ducktrap Rivers and in Cove Brook, which are geographically more distant from marine cages containing reproductively-viable non-North American salmon than are the other five GOM DPS rivers. However, the USFWS does have genetic evidence of aquaculture escapees successfully spawning in the Sheepscot River; new information gained from the future reporting of escape events and interception of marked fish may provide greater insight into the migration patterns of and distances traveled by escapees. As explained previously, the aquaculture facility located in the Sheepscot River raises female, triploid rainbow trout and therefore does not pose a genetic threat to wild Atlantic salmon. Of the remaining five rivers, three (the Narraguagus, Dennys and Pleasant Rivers) have traps/weirs. Marine cages are located in close proximity to the Machias and East Machias Rivers, which do not currently have trapping facilities to intercept aquaculture escapees. Although it has been speculated that the natural falls near the mouth of the Machias River may be difficult for aquaculture escapees to navigate, the USFWS has genetic evidence that aquaculture escapees have successfully spawned in the Machias River upstream of these falls.

Based on the relatively low number of escapees detected in the rivers with weirs (see Table 3), it is reasonable to assume that a relatively low number of escapees have had access to the Machias and East Machias Rivers. Although the numbers are low, and only a small proportion of those entering the rivers are likely to successfully interbreed with wild fish for the reasons identified above, they still pose a significant threat to the GOM DPS, given the low numbers of documented adult salmon returns to these rivers. A persistent genetic effect on a river population only occurs if the offspring of hybridization between a wild fish and an escapee successfully breeds in the future. Offspring could contribute to genetic effects without leaving the river if they become precocious male parr. The potential for offspring to contribute as a sexually mature returning adult is further minimized by high mortalities during the outmigration and marine migration.

As the preceding discussion illustrates, there are a number of natural and human-caused factors which reduce the potential for hybridization to occur between escaped fish and wild fish. These factors reduce the potential for hybridization to occur at a high level within any one river, to occur in multiple GOM DPS rivers, or to occur for multiple years. Despite the foregoing, past documentation of sexually mature escapees in the rivers makes it reasonable to conclude that some hybridization will still occur. The wild fish involved in such hybridization are adversely affected, as some may be deprived of the opportunity to spawn with another wild fish and contribute to future generations (a male usually mates with more than one female, while the female only mates with only one male during each spawning season). This effect is on the individual fish level. For this to translate into an effect on a year class in a specific river, a significant proportion of the returning adults in the river would have to be involved in such hybridization (in light of stocking). The potential for a year class effect to translate into an effect on an entire river population is minimized because of the complex life history of Atlantic salmon. In other words, in one calendar year, the spawning population might be adversely affected by hybridization between wild and escaped farmed fish, but the other multiple year classes present within the river and at sea would not be affected by that hybridization.

For introgression to reduce appreciably the likelihood of survival and recovery of the GOM DPS of Atlantic salmon as a whole, hybridization between escapees and wild fish would have to occur at a significant level within each river, occur in a number of rivers, and occur over a number of years. The likelihood of this occurring is reduced by the fact that 1) not all of the rivers are in close proximity to marine cages, 2) some of the rivers are screened at least a portion of the year, and 3) the CMS is anticipated to significantly reduce the number of escapees entering rivers within the GOM DPS.

C. Competition and Disease Transfer

Special Condition No. 6 (Marking) will reduce effects of interactions between farm escapees and GOM DPS salmon. External marks (e.g., fin clips) will greatly enhance the ability of field scientists to quickly detect and remove aquaculture escapees at weirs on GOM DPS rivers (as well as reduce stress caused to wild fish from handling to determine whether they are wild or aquaculture salmon). When the weirs are operating, this will prevent aquaculture fish from having access to GOM DPS rivers where weirs are located and will minimize the chance for interactions to occur. If an external mark is not applied (because a more specific internal mark has been applied), scale analysis and morphology will be used to identify escapees. The accuracy of field determinations made based on scale analysis and morphology would then be verified through extraction of the internal mark. Ongoing efforts to enhance the reference database of salmon scales and to provide sufficient training to field personnel have improved and will continue to improve the accuracy of the scale identification conducted streamside. Hatchery and site-specific marks will enable facility operators to work with the ACOE and the Services to quickly identify the cause of escapement and to correct problems leading to the escape. The ability to reduce, and ideally eliminate, the presence of escapees in rivers is dependent on the ability to identify and control the losses at the net pens.

Special Condition No. 5 will also minimize effects by requiring reporting of known or suspected escapes of more than 50 fish with an average weight of 2 kg each or more within 24 hours. Fifty fish was identified by the aquaculture industry as a minimum number of escapees that they could reasonably detect; a 2 kg fish was identified by the Services and the ASC as a minimum weight at which an Atlantic salmon could be sexually mature. This reporting requirement will enhance the ability to retrieve escaped fish when possible and alert field scientists operating weirs on GOM DPS rivers to the fact that an escape has occurred. The reporting requirement will also contribute to a database that, in combination with information on detection of escapees in rivers, will allow for a clearer understanding of the chain of events that starts with salmon escaping from a net pen and ends with escapees entering rivers. This system will help determine, over time, what specific factors (e.g., season, age/size class, proximity to GOM DPS rivers, etc.) are more or less likely to result in escapees entering the GOM DPS rivers.

Proper containment (Special Condition No. 4), fish husbandry practices, and disease management (Special Condition No. 3) for other salmonid species reared in marine cages will collectively reduce the risks that disease transfer and competition pose to wild Atlantic salmon.

D. Transgenics

The potential use of transgenic salmonids in the aquaculture industry has recently been identified as a possible threat to wild Atlantic salmon populations. Transgenic salmonids include fish species of the genera *Salmo, Oncorhynchus*, or *Salvelinus* in the family Salmonidae that bear, within their DNA, copies of novel genetic constructs introduced through recombinant DNA technology using genetic material derived from a species different from the recipient, and descendants of any individuals so transfected. Escaped, reproductively-viable transgenic salmon could interbreed with wild fish. Research to develop transgenic fish for aquaculture increased through the 1980s and had advanced to the extent that, by 1989, production of 14 species of transgenic fish, including Atlantic salmon, had been reported (Kapuscinski and Hallerman 1990).

Transgenic fish produced for culture in marine net pens must be selected to survive under nearly natural physical and chemical environmental conditions. If they escape, therefore, it is likely that a portion of them will survive. In a study by Sheela *et al.* (1999), transgenes were inherited in many progeny from transformed fish, as determined through DNA analyses and through expression of the reporter gene. If an introduced construct can find its way onto or into a chromosome before the first cell division of a newly-fertilized egg, all the cells in the developing organism, including future germ cells, will contain copies (Lutz 2000). The transmission of novel genes to wild fish could lead to physiological and behavioral changes, and traits other than those targeted by the insert gene are likely to be affected. Ecological effects are expected to be greatest where transgenic fish exhibit substantial altered performance. Such fish could destabilize or change aquatic ecosystems (Kapuscinski and Hallerman 1990).

In a study by Cook *et al.* (2000), growth-enhanced transgenic Atlantic salmon exhibited a 2.62- to 2.85-fold greater rate of growth relative to non-transgenic salmon, over the body weight interval examined. This study found that the transgenic experimental subjects possessed the physiological plasticity necessary to accommodate acceleration in growth well beyond the normal range for this species, with few effects other than a greater appetite and a leaner body (Cook *et al.* 2000). Because aquatic ecosystems function through complex interactions involving transfers of energy, organisms, nutrients, and information, it is difficult to predict the community-level impacts of releasing transgenic fishes that exhibit one or more types of phenotypic change (Kapuscinski and Hallerman 1990). At this time, more research is needed to identify the impacts that escaped transgenic salmon would have on natural populations and their habitat before use for commercial aquaculture is considered.

Research and development efforts on transgenic forms of Atlantic salmon and rainbow trout are currently being directed toward their potential use for sea pen aquaculture. Emphasis has been placed on enhancement of growth and low water temperature tolerance through the transfer of genetic material from other cold-tolerant species, such as flounder. In 2002, the Food and Drug Administration received an application for approval to sell and possibly grow transgenic salmon in the United States for use by the aquaculture industry.

The prohibition on the use of transgenic salmonids at existing marine sites off the coast of Maine (Special Condition No. 2) will eliminate the potentially adverse disease and ecological risks posed by the use of transgenic salmonids in aquaculture. The risk posed by a transgenic salmonid to wild salmon would be greatly affected by the specific gene manipulation conducted. Anyone proposing the use of transgenic salmonids in aquaculture would need to provide information on the methods used and the potential for genetic, fish health and ecological impacts on wild stocks. This information would have to be evaluated to determine the level of risk posed to wild Atlantic salmon stocks and a decision would have to be made as to whether that level of risk was acceptable or not. The use of transgenic salmonids will be prohibited under Condition No. 2 until such time as these risks can be evaluated.

Summary of Effects

In summary, the proposed action is most likely to adversely affect individual Atlantic salmon by causing take through harm or harassment in the GOM DPS rivers without weirs or traps (i.e., Sheepscot, Ducktrap, Machias, and East Machias Rivers, and Cove Brook). Some take may also occur in rivers with weirs, for example where there is spawning habitat located downstream of the weir or if a fish enters when the weir is not in place. The harm or harassment is reasonably certain to result from one or more factors discussed above, including redd superimposition, competition, and genetic introgression. The scientific studies, escape reports from the aquaculture industry, and the detection of aquaculture fish in Maine rivers all discussed in this opinion establish that the anticipated impacts are reasonably certain to occur.

In view of this, the Services have evaluated these impacts at a very detailed level of analysis and evaluated several factors influencing the impact these effects will have on the GOM DPS. This analysis helps to distinguish the important difference between the impacts to individual GOM DPS salmon and effects to the population of salmon defined by the GOM DPS. The demonstrated influx of aquaculture fish into at least one GOM DPS river, repeatedly, over the last several years makes these impacts to wild salmon reasonably certain to occur. The greater the number of escapees that enter the GOM DPS rivers and the greater the period of time over which these events occur, the greater is the likelihood that the entire GOM DPS salmon population would be impacted versus occasional impacts to individual salmon within the GOM DPS.

Although the Services are reasonably certain that one or more of these impacts (e.g., introgression) will occur as a result of the action, the Services do not believe that every incidence of an aquaculture fish entering a GOM DPS river will result in such take of GOM DPS salmon. The Services do not anticipate that each aquaculture escapee that enters a GOM DPS river will cause introgression or redd superimposition. For example, an escapee may not find a wild fish to spawn with.

While a certain level of impact is still anticipated, including some take, there are a number of factors mitigating these impacts at the GOM DPS population level. First, the new permit conditions will both reduce the number of escapees entering GOM DPS rivers and eliminate the greatest long-term threat to wild salmon by phasing out the use of non-North American strains. Furthermore, there are multiple rivers in the GOM DPS and multiple-year classes present at any given time for each river (both within the river and at sea); consequently, each time an aquaculture escapee enters a GOM DPS river and causes an impact to wild salmon, the effect of that impact (e.g., redd superimposition or hybridization) is limited to only a subset of the entire river's population. The operation of a weir or trap on three of the GOM DPS rivers also substantially reduces the opportunities for interactions between aquaculture escapees and wild salmon. Finally, the USFWS's river-specific stocking program currently helps to maintain populations for six of the eight GOM DPS rivers, helping to offset the extremely low number of adult returns in recent years.

Therefore, while the probability of impacts to some individuals will remain high, the magnitude of these impacts to the population is anticipated to decrease over time due to the new special conditions. The potential for impacts to individuals will decrease as a result of the expected 25% decrease in escapees associated with implementation of the CMS. A decrease in the frequency of impacts to individuals will further reduce the potential for impacts to a year class and a river population. The severity of impact that any individual aquaculture escapee poses will also be decreased as the use of non-North American Atlantic salmon is eliminated.

IV. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area considered in this opinion. Future federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to Section 7 of the ESA.

Future local activities that may impact the Atlantic salmon GOM DPS include agricultural and forestry practices, peat mining, and sport fishing.

A. Agriculture

Agricultural production within the GOM DPS includes the following: hay, silage, corn, livestock, Christmas trees, market vegetables, blueberries, cranberries, and horticultural plants (Maine Atlantic Salmon Task Force 1997). Water withdrawal for irrigation is the farming practice of greatest concern to the Services. Only the Narraguagus and Pleasant River watersheds are expected to continue to support significant agricultural water use, primarily for the blueberry industry, that may affect salmon in the future. However, as a result of Maine's Atlantic Salmon Conservation Plan, WUMP were developed to better address the needs of Atlantic salmon, while allowing for continued use of irrigation water by the blueberry industry (see also Section II.D.1. *Agricultural Water Withdrawals*). The WUMP initiative identifies best management practices to conserve water on blueberry farms, and emphasizes use of alternatives sources, including wells and retention ponds, to avoid direct withdrawals from rivers and streams containing Atlantic salmon habitat. Although voluntary and non-regulatory in approach, the WUMP initiative should help reduce effects to salmon that would be caused by excessive agricultural water withdrawals.

No other agricultural practices are known to be major threats to salmon. However, due to the low numbers of returning adult salmon, minor impacts from erosion and sedimentation, livestock waste in salmon streams, or other agricultural practices take on added significance. Watershed councils are expected to continue to play an active role in successfully addressing a variety of non-point source pollution problems, including those related to agriculture and forestry, in all of the GOM DPS watersheds. Non-point source pollution issues from nutrients and sediments and from livestock and manure management are a high-priority threat only in the Sheepscot River watershed (MASCP 1997).

B. Forestry

The Services do not believe that current and anticipated future forestry practices pose a significant threat to the well-being of the GOM DPS. Forestry is the dominant land use in the Pleasant, Narraguagus, Machias, East Machias, and Dennys River watersheds. The Cove Brook, Sheepscot and Ducktrap River watersheds experience only limited forestry activity. Given the precarious status of the species, however, even minor impacts to wild salmon or their habitat should be recognized and addressed. Practices that cause erosion, reduced streamside shading, and debris dams are reasonably certain to occur and should be addressed. Forestry activities that cause erosion and stream sedimentation can degrade salmon spawning and juvenile rearing habitat. Removal of streamside vegetation can cause an increase in stream water temperatures that could lead to stressful conditions for salmon or make the habitat unsuitable. Debris dams caused by logging wastes can result in migration barriers that reduce the availability of salmon habitat. Consequently, the Services will continue to work with the state and the private sector to improve salmon habitat and to modify any forestry practices that are shown to be detrimental. Watershed councils and Project Share are also expected to continue to play a role in addressing these forestry impacts through habitat restoration and conservation activities.

C. Peat Mining

Continuation of activities at an existing peat mining facility in the Narraguagus River drainage may adversely affect Atlantic salmon within the GOM DPS. Peat mining can adversely affect Atlantic salmon and their habitat through the discharge of low pH water containing suspended peat silt and dissolved metals and pesticides. There is a concern that these factors may adversely influence juvenile salmon survival.

D. Recreational Fishing

Although the catch and release sport fishery for Atlantic salmon has been discontinued in Maine, recreational fishing that targets other species can potentially lead to incidental catch of various life stages of Atlantic salmon, resulting in injury or death. Atlantic salmon parr can be confused with brook trout and mistakenly harvested by anglers. The IFW has stated that they are not able to estimate the number of Atlantic salmon caught as recreational bycatch or to estimate the resultant mortality [Land and Water Resources Council (LWRC) 1999]. Documented poaching events in 1998 and 2000 indicate that poaching occurs at fairly low levels in Maine rivers, and that poaching continues to pose a potential threat to Atlantic salmon.

Stocking of non-indigenous fish species and native enhancement fish for recreational fishing can increase the risks to wild salmon in the GOM DPS through increased competition for food and through predation on juvenile salmon. Brook trout, brown trout, black bass, and landlocked salmon have all been stocked within GOM DPS streams or headwaters; impacts on salmon are still being monitored and evaluated. The State of Maine is assessing current stocking practices to identify possible adverse impacts to wild salmon.

E. Aquaculture in Canada

The Atlantic salmon aquaculture industry in Maritime Canada, including Passamaquoddy Bay in New Brunswick adjacent to Cobscook Bay in Maine, first harvested salmon in 1979. In 1997, there were 91 farms in Maritime Canada and Newfoundland that harvested 20,310 metric tons of salmon. Close to 95% of the Maritimes' production comes from salmon farms located in the Passamaquoddy and Grand Manan areas of the western Bay of Fundy, just across the border from Maine. In 2000, New Brunswick had 96 salmon farms. The DFO reports evidence of farmed salmon escaping into the marine ecosystem and then ascending rivers, as well as hatchery escapees entering rivers directly and then migrating out to sea (DFO 1999). The salmon aquaculture industry in Maritime Canada has experienced outbreaks of the disease ISAV in recent years. This aquaculture industry is expected to continue into the future. The Services expect that some Atlantic salmon that escape from aquaculture facilities in Maritime Canada are reasonably likely to reach the range of the GOM DPS of Atlantic salmon, particularly in the Dennys River watershed, and cause adverse impacts to GOM DPS salmon through a variety of interactions including interbreeding, redd superimposition, and/or transfer of disease.

F. Summary

Overall, the significance of the cumulative effects of the various activities discussed in this section on the GOM DPS of Atlantic salmon is difficult to assess. The effects of these activities would also be expected to vary from one GOM DPS watershed to the next. It is important to realize that, although the cumulative effects mentioned are not threatening to the Atlantic salmon GOM DPS at the population level, the action area encompasses the entire range of the GOM DPS. This results in a wide variety of perhaps individually minor impacts to the GOM DPS occurring over a vast area of land encompassing eight watersheds.

V. CONCLUSION

Based on the close proximity of hundreds of fish pens to the GOM DPS of Atlantic salmon, and the anticipated continued escapes, the best available scientific data and commercial information indicates that the continued operation of Maine aquaculture facilities poses a threat to individual wild salmon because escaped aquaculture salmon compete for food and habitat, disrupt redds, interbreed, thus disrupting breeding, feeding and sheltering of wild Atlantic salmon. Aquaculture facilities may also promote the transfer of disease and parasites to wild salmon, which may also adversely affect wild salmon.

The special conditions proposed by the ACOE are designed to reduce the impacts of existing aquaculture operations on endangered Atlantic salmon. Special Condition No. 1 removes the greatest aquaculture-related threat to the survival and recovery of the GOM DPS by phasing out and eventually eliminating the use of reproductively-viable non-North American Atlantic salmon. The other ACOE special conditions reduce the potential for future impacts by reducing the risk of escapement, monitoring the health of farmed fish, and providing a mechanism to repair containment problems and evaluate the effectiveness of containment through marking.

Despite full implementation of the ACOE proposed special conditions, it is likely as explained in the Effects of the Action section, that a limited amount of take will still occur through interbreeding, competition, or the transfer of diseases and parasites. However, as also explained in the Effects of the Action section, the amount and extent of these impacts is mitigated by a number of factors. These factors include the following: 1) operation of weirs, 2) multiple river populations within the GOM DPS, 3) multiple-year classes of salmon present at any given time for each GOM DPS river, 4) the USFWS's ongoing conservation hatchery program, and 5) the ACOE's proposed permit conditions.

The ACOE permit conditions will eliminate the greatest long term threat and minimize the short-term adverse effects to listed Atlantic salmon by: (1) eliminating the use of non-North American strain Atlantic salmon; (2) developing containment management systems with loss control plans and audits; (3) marking aquaculture fish; (4) prohibiting the use of transgenic salmonids; and (5) requiring fish health certification before stocking alternative salmonids. As described in the Effects of the Action section, the anticipated level of impact remaining after the ACOE permit conditions are implemented is not anticipated to have a population level impact on the Atlantic salmon GOM DPS.

Therefore, after considering the environmental baseline, the effects of the proposed action, and the potential for future cumulative effects in the action area, the Services have determined that the continued operation of the 42 existing marine cage sites with the proposed ACOE special conditions is not reasonably likely to reduce the reproduction, number, and distribution of the GOM DPS of Atlantic salmon in a way that appreciably reduces its likelihood of survival and recovery in the wild. This determination is based on an assessment of the modified permits, including implementation of all of the ACOE special conditions in the project description.

In summary, the Services have determined that the continuation of the ACOE permits with the proposed modifications is not likely to jeopardize the continued existence of the Atlantic salmon GOM DPS. Currently, no critical habitat has been designated for this species. However, this biological opinion did consider effects of the action on GOM DPS salmon habitat.

VI. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species without special exemption. The term "take" is defined to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Services to include an act that actually kills or injures wildlife. Such acts may include significant habitat modification or degradation that results in death or injury to a listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. The term "harass" is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. (NOAA Fisheries has not defined the term "harass" in its ESA regulations.) 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 taking under the ESA, provided that such taking is in compliance with the terms and conditions of this ITS.

The ACOE has a continuing oversight responsibility for the activities covered by this ITS. The measures described below are non-discretionary, and must be undertaken by the ACOE so that they become binding conditions of any permit modifications issued to the permittees for the exemption in Section 7(o)(2) to apply. If the ACOE either (1) fails to assume and implement the terms and conditions or (2) fails to require the permittees to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit, the protective coverage of Section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the ACOE or permittees must report the progress of the action and its impact on the species to the Services as specified in the ITS [50 CFR § 402.14(i)(3)]. If the terms and conditions of this ITS are complied with and the project is implemented as proposed, the ACOE and the permittees will be exempted from the prohibitions of Section 9 for take within the anticipated amount or extent.

A. Amount or Extent of Anticipated Take

Incidental take is anticipated to occur as a result of the proposed action of continuing the existing permits with the addition of the ACOE special conditions. The reasonable and prudent measures in this opinion, with their implementing terms and conditions, are designed to minimize the impact of incidental take that will result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, the ACOE must reinitiate consultations consistent with 50 CFR 402.16. The ACOE must immediately provide an explanation of the causes and circumstances surrounding this taking.

As described in the Effects of the Action section, fish that escape from marine aquaculture facilities (net pens) and enter a GOM DPS river will harm or harass wild Atlantic salmon through redd superimposition, competition for food and space, and/or genetic introgression. The Services anticipate that the presence of aquaculture fish in a GOM DPS river will result in take, because it is reasonable to expect that the escapees will, at a minimum, impair essential behavioral patterns, most notably breeding and competition for food and space. Reproduction of wild stocks will be disrupted through interbreeding between aquaculture and wild salmon or by redd superimposition. The intrusion of aquaculture fish into GOM DPS rivers and their interbreeding with wild Atlantic salmon will result in genetic modifications to the wild population. These genetic modifications will decrease the wild fish's ability to compete for mates, food, nest sites, and other habitat needs, thus rendering the wild fish less fit for survival. Due to the difficulties associated with actually witnessing harmful interactions taking place in a GOM DPS river, detections of escapees in GOM DPS rivers will serve as a surrogate measure of take for this ITS.

Based on the best scientific and commercial information available, the Services determined the following when developing this surrogate measure of take: (1) When salmon escape from an aquaculture facility, some portion of those escapees are likely to enter or attempt to enter a GOM DPS river. Escaped salmon may enter or try to enter both GOM DPS rivers with weirs or traps and those without. (2) There is ample evidence to indicate that salmon will continue to escape, and therefore will continue to enter GOM DPS rivers both with and without weirs. (3) Absent the ability to detect salmon entering the rivers without weirs, or even all fish entering rivers with weirs (e.g., some escapees may remain below the weir and interact with wild fish there), it is reasonable to use detection levels of aquaculture salmon at rivers with weirs as a relative index of the number of undetected, escaped salmon that are entering GOM DPS rivers. In other words, detection levels at the rivers with weirs are indicative of proportional entries into GOM DPS rivers, and of anticipated take from escaped aquaculture salmon.

The Services believe that sexually mature aquaculture fish entering a GOM DPS river are reasonably certain to impair the essential behavior patterns of the wild salmon as described above. It will not be possible to identify the exact form of the take created by a single aquaculture fish unless the interaction is directly observed; however, the best available scientific information indicates that there is a reasonable certainty that escaped aquaculture fish will harm or harass (as defined above) native salmon and/or salmon eggs through one or more of the following means: redd superimposition, competition for food and space (e.g., breeding habitat), or genetic introgression.

The impact of an escape event at a marine site is affected by several factors including the age, sexual maturity and the number of fish lost; the proximity to a GOM DPS river; and the genetic strain. Devising an ITS that incorporates all of these variables is impaired by the current lack of cage inventory and monitoring information. The shaded portion of Table 4 shows documented aquaculture escapees that were caught in three Maine GOM DPS rivers from 1994-2002. The other GOM DPS rivers do not have fish traps or weirs; therefore, there is limited information on the number of aquaculture fish entering these rivers.

Table 4. Aquaculture Atlantic Salmon Caught in Weirs in Maine Rivers, in Numbers of Fish, 1994-2002 (U.S. Atlantic Salmon Assessment Committee Reports, 1995-2002).

YEAR	St. Croix	Union	Narraguagus (GOM DPS river)	Dennys (GOM DPS river)	Pleasant (GOM DPS river)	Narraguagus, Dennys, and Pleasant Total (GOM DPS rivers)
1994	97	n/a	1	48	n/a	49
1995	14	n/a	0	4	n/a	4
1996	20	n/a	8	21	n/a	29
1997	27	n/a	0	2	n/a	2
1998	24	n/a	0	1	n/a	1
1999	23	63	3	n/a	n/a	3
2000	30	6	0	29	0	29
2001	58	2	0	65	0	65
2002	5	6	0	4	0	4

These data reflect the best available information to estimate the number of aquaculture fish entering the GOM DPS and other Maine rivers. However, these historical data do not represent complete information on the total number of marine aquaculture escapees intruding into the GOM DPS rivers because: 1) there is a lack of counting or interception facilities on several GOM DPS rivers,[3] 2) escapees are not currently marked (aquaculture escapees are currently identified by physical characteristics such as fin deformities, scale patterns, and body shape and size), 3) these interception facilities do not operate year-round, and 4) commercial salmon culture in Maine started several years before existing trapping/counting facilities were placed on salmon

[3] A weir was scheduled for construction on the East Machias River in 2001. However, the weir was not installed, because the Town of East Machias denied local approval for the project. The Services and the ASC are currently evaluating alternative locations for a weir on the East Machias River.

rivers. An accurate count of Maine industry origin escapees is further confounded by the fact that some of the escapees detected in the GOM DPS rivers may have come from nearby Canadian marine cages. While these data do not show the total number of marine aquaculture escapees entering the GOM DPS rivers, they can be used as an index for the number of escapees entering the GOM DPS rivers. In view of the fact that the Services are not able to count every escapee entering each GOM DPS river, the actual detection of escapees in a GOM DPS river at which there are weirs or traps, while an underestimate of opportunities for interaction, appears to be the only viable surrogate method by which to measure incidental take.

For the reasons described above, the Services have chosen to express incidental take in terms of the number of aquaculture fish being detected in GOM DPS rivers with weirs or traps. From 1994 through 2002, the average number of aquaculture escapees detected at the Dennys and Narraguagus River weirs was 21 per year (see Table 4 above). Based on this average and on the expectation that the special conditions proposed by the ACOE will reduce the number of escapees by 25% (see Effects of the Action section), the Services expect that up to 16 aquaculture escapees per year will be captured at weirs in GOM DPS rivers. However, the proposed improvements in containment and the accompanying decrease in escapees caught at weirs are not expected to be fully realized for several years. In fact, the Services expect that reductions in the number of escapees caught at weirs will not be fully achieved until 2006. In view of the above, the Services expect that up to 21 escapees will be caught at weirs in GOM DPS rivers in 2003, 2004, and 2005; and up to 16 escapees will be caught at weirs in subsequent years beginning in 2006 regardless of whether a weir is currently in place or will be installed in the future.

To accommodate the variability in escapees detected in GOM DPS rivers over time, the Services used a three-year rolling average of the number of fish detected at weirs or traps on GOM DPS rivers to set incidental take levels. The term rolling average means that the average is to be calculated for the current year plus the two previous years (i.e., at year four, the ACOE would not need to wait two more years before calculating a three-year average, but would instead average years four, three, and two). Thus, if the three-year (calendar year) average of U.S. industry aquaculture escapees detected at weirs in GOM DPS rivers exceeds the average number of fish expected to be caught at weirs for that three-year time period, the anticipated level of incidental take will have been exceeded. This also sets an upper limit of escapees being caught in weirs for an individual year. For example, if in a single calendar year, more fish are caught at weirs than were expected over a three-year period, the anticipated level of incidental take will have been exceeded, since the three-year rolling average will have been exceeded in that one year. Table 5 shows the numbers of aquaculture escapees that are expected to be caught at weirs and how these numbers translate to take levels. Exceeding the incidental take level authorized by this opinion will require reinitiation of consultation, consistent with 50 CFR 402.16.[4]

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[4] The Services will continue to evaluate the appropriateness of this amount of take in light of any presently unknown advances in technology applied in the future (which could reduce escapement) or in light of the addition of weirs/traps to more DPS rivers (which could increase the number of escapees intercepted at DPS rivers).

B. Reasonable and Prudent Measures

Section 7(b)(4) of the ESA requires that when an agency action is found to comply with Section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of listed species, the Services will issue a statement specifying the impact of any incidental taking. Section 7(b)(4) also states that reasonable and prudent measures necessary to minimize impacts, and terms and conditions to implement those measures, must be provided. Only incidental taking by the federal agency or applicant that complies with the specified terms and conditions is exempted.

Table 5. Aquaculture Escapees Expected to be Caught at Weirs on GOM DPS Rivers, Showing Calculation of Incidental Take (2003-2012).

Year	Max # of captured escapees expected	Three year rolling average to set IT	Max in one year before IT is exceeded*
2003	21		63
2004	21		63
2005	21	21 (2003-05)	63
2006	16	19 (2004-06)	58
2007	16	18 (2005-07)	53
2008	16	16 (2006-08)	48
2009	16	16 (2007-09)	48
2010	16	16 (2008-10)	48
2011	16	16 (2009-11)	48
2012	16	16 (2010-12)	48

*This level can only be achieved and incidental take exemption maintained if this assumes zero escapees are caught at weirs in the other two years used to calculate the rolling average.

The reasonable and prudent measures and terms and conditions are required to document the incidental take and to minimize the impact of that take on the GOM DPS of Atlantic salmon. These measures and terms and conditions are non-discretionary and must be implemented in order for the protection of Section 7(o)(2) to apply.

The Services believe that the following reasonable and prudent measure is necessary and appropriate to minimize incidental take of the GOM DPS of Atlantic salmon. The ACOE will ensure that this reasonable and prudent measure is implemented by working with the USFWS, NOAA Fisheries, the EPA, the State of Maine, and the permittees, to collect the necessary information and develop procedures for the following:

Minimize the likelihood of incidental take from the escape of aquaculture salmon, and monitor and report on the implementation of the ACOE special conditions.

C. Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the ESA, the ACOE must assure compliance with the following terms and conditions, which implement the reasonable and prudent measure described in the previous section, and outline the required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. To implement the above Reasonable and Prudent Measure, the ACOE will use its authority under Section 10 of the Rivers and Harbors Act to ensure that the special conditions proposed in the project description are adhered to by each permittee.

2. To implement the above Reasonable and Prudent Measure, the ACOE will promptly notify the Services if any permittee fails to adhere to any of the special conditions.

3. To implement the above Reasonable and Prudent Measure, the ACOE will complete an annual report and send it to the Services. The report will cover the calendar year period and will be due by the following January 31. The purpose of the reporting is to validate the extent and amount of take. The report will include but not be limited to the following:

    a) a summary of each site's activities, including current information on species cultivated and stocking and harvesting figures;

    b) a summary of fish escapes at each site, including number of fish, description of incident, and corrective actions taken;

    c) a summary of known recoveries of aquaculture escapees and incidences of take as defined in this opinion.

VII. 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.

1. The ACOE should evaluate the locations of proposed marine aquaculture sites to minimize the risk of catastrophic fish losses, disease transfer, and interference with migration patterns of wild Atlantic salmon.

2. The ACOE should continue to work with other state and federal agencies, the aquaculture

industry, and other interested parties to coordinate, conduct, or support research to determine measures that could be implemented to reduce the potential for discharge of fish from freshwater and marine aquaculture facilities.

3. The ACOE should work with the aquaculture industry and regulatory agencies to develop Bay Management Plans for the Maine industry. The plans should include, but not be limited to:

   - a concise description of the bay/area in terms of physical characteristics, history, aquaculture operations, future/potential carrying capacity, water quality problems, flushing rates, etc.
   - codes of practice for current aquaculture operations and translation of those codes to the specific circumstances of each bay or coastal region
   - consideration of species other than salmon if appropriate
   - a development plan for aquaculture in the bay
   - information on other activities in the bay
   - coordination with Canada as appropriate

4. The ACOE should evaluate the implications for Atlantic salmon resulting from removal of the ice-control dam on the Narraguagus River in Cherryfield, and consider other alternatives for ice control.

5. The ACOE should work with the Maine Department of Transportation and state and federal fisheries agencies to evaluate the effectiveness of various culvert designs on fish passage, particularly for Atlantic salmon.

6. The ACOE should work with the Services and other state and federal agencies to identify and implement appropriate stream restoration projects within the GOM DPS watersheds that would improve Atlantic salmon habitat.

In order for the Services to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Services request notification of the implementation of any conservation recommendations.

VIII. REINITIATION NOTICE

This concludes formal consultation for the ACOE's proposed modification of existing permits authorizing the installation and maintenance of existing fish pens within the State of Maine. In addition to the reinitiation procedures described in this biological opinion, 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: (a) if the amount or extent of taking specified in the ITS is exceeded; (b) if new information reveals effects of the action that may affect the Atlantic salmon GOM DPS in a manner or to an extent not previously considered;[5] (c)

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[5] For example, the Services are anticipating the release of a final report by the National Academy of

if the identified action is subsequently modified in a manner that causes an effect to the Atlantic salmon GOM DPS that was not considered in the biological opinion; (d) if critical habitat for the Atlantic salmon GOM DPS is designated that may be affected by the identified action; or (e) if a new species is listed or critical habitat designated that may be affected by the action (50 CFR 402.16).

Sciences that addresses issues such as the factors that have caused Maine's salmon populations to decline and options for helping salmon recover.

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Attachment 1

Atlantic Salmon Microsatellite Analysis Protocol

This protocol will be used to determine which Atlantic salmon can be used for breeding and production stock under the State of Maine General Permit for Aquaculture Facilities and for Army Corps of Engineers permits prohibiting use of non-North American strain salmon. The protocol describes a standardized procedure to classify fish as either North American or non-North American stock and is largely based on the procedures used by King *et al.* (2001). The permittee will be responsible for providing genotype data to the Services for data analysis and fish classification as described herein.

DNA isolation

Genomic DNA will be isolated from tissue, fin clip or scale samples from each fish intended for use as broodstock employing either a commercially-available DNA extraction, such as PureGene (Gentra Systems) or DNeasy tissue kit (Qiagen Inc.) or a phenol/chloroform based extraction system such as used in Patton *et al.* (1997), or, particularly for scales, a Chelex-resin based protocol such as given in King *et al.* (2001). Quality and quantity of DNA will be visualized on 0.8% agarose gels, which will include a commercially-available DNA standard for quantification and size determination.

Microsatellite analysis

The loci used to classify brood fish as either North American or non-North American stock will be: Ssa85, Ssa171, Ssa197, and Ssa202 (O'Reilly *et al.* 1996); SSOSL311 and SSOSL438 (Slettan *et al.* 1995, 1996) and Ssa289 (McConnel *et al.* 1995).

PCR conditions for the selected loci will essentially follow that of King *et al.* (2001) and Patton *et al.* (1997), with possible minor modifications for optimization of products of individual loci. The loci will be labeled with the dyes, Ned, Hex, and 6-Fam by ABI or any other comparable commercial supplier of labeled oligonucleotides. The size standard to be used will be 400 HD Rox (ABI). Microsatellite analysis will be performed using the ABI 3100 autosequencer or any other commercial system providing equivalent results. Fragment analysis will be accomplished using a combination of GENESCAN and GENOTYPER software packages from ABI, or any other commercial system providing equivalent results. The permittee will present electronic data tables from the GENOTYPER program to the Services in spreadsheet format in Excel or any other commercially-available program providing equivalent results that allow the data to be easily reformatted for subsequent analyses. The output files (gel tracings) from GENESCAN and GENOTYPER will also be provided by the permittee at the same time to help the Services assure data quality. Data provided must be complete at all loci for all fish.

Size verification of allelic products

To ensure accurate sizing of allelic products from the aquaculture fish relative to the designations developed in the King laboratory (see King *et al.* 2001), Dr. King will provide samples for use as controls. The Services will provide an adequate supply of DNA samples from representative fish of known genotypes to enable calibration of equipment throughout the term of the controlling license conditions. Control samples will be used at the inception of the study to set the automated allele designation/binning parameters of the GENOTYPER software so that all subsequent calls made for aquaculture fish will be automatically sized relative to the standards originally provided by Dr. King.

Genetic screening

Identification of North American aquaculture stock will be based on assignment tests performed with the software GeneClass, which can be downloaded at http://www.montpellier.inra.fr/URLB/geneclass/geneclass.html. Aquaculture fish will be compared to two reference groups. The first group will be comprised of samples from North America, including samples from Maine (Dennys, Ducktrap, East Machias, Machias, Narraguagus, Penobscot mainstem, Pleasant, Sheepscot), Canada (Conne, Gold, Gander, Michaels, Miramichi, Saguenay, Sand Hill, St. Jean, St. John, Stewiacke) and aquaculture strains derived from St. John and Penobscot populations. The second group will be comprised of non-North American samples from Iceland (Ellidaar, Vesturdalsa), Norway (Lone, Vosso), Finland (Tornionjoki), Scotland (Shin, Nith), Ireland (Spaddagh, Blackwater), and Spain (Eo, Esva, Bidasoa, Sella); and the Landcatch aquaculture strain. Genetic data for the two reference groups are available upon request from the Northeast Fishery Center of the U.S. Fish and Wildlife Service, (570) 726-4247.

The likelihood for assigning any given fish to each reference population will be calculated using the program GeneClass. If the ratio of the likelihood scores indicates that North American origin is at least twice as likely as non-North American origin, that fish will be considered to be of North American origin. All other fish will be classified as non-North American stock. The Services will promptly report the results to the permittee.

Literature Cited

King, T.L., S.T. Kalinowski, W.B. Schill, A.P. Spidle and B.A. Lubinski. 2001. Population structure of Atlantic salmon (*Salmo Salar* L.): a range wide perspective from microsatellite DNA variation. Molecular Ecology 10: 807-821.

McConnel, Stewart K., Patrick O'Reilly, Lorraine Hamilton, Jonathan M. Wright and Paul Bentzen. 1995. Polymorphic microsatellite loci from Atlantic salmon (*Salmo salar*): genetic differentiation of North American and European populations. Can. J. Fish. Aquat. Sci 52: 1863-1872.

O'Reilly, Patrick T., Lorraine C. Hamilton, Stewart K. McConnell and Jonathon M. Wright. 1996. Rapid analysis of genetic variation in Atlantic salmon (*Salmo salar*) by PCR multiplexing of dinucleotide and tetranucleotide microsatellites. Can. J. Fish. Aquat. Sci. 53: 2292-2298.

Patton, J.C., B.J. Gallaway, R.G. Fechhelm and M.A. Cronin. 1997. Genetic variation of microsatellite and mitochondrial DNA markers in broad whitefish (*Coregonus nasus*) in the Colville and Safavanirktok rivers in northern Alaska. Can. J. Fish. Aquat. Sci. 54(7): 1549-1556.

Slettan, A., I. Olsaker and O. Lie. 1995. Atlantic salmon, *Salmo salar*, microsatellites at the SSOSL25, SSOSL85, SSOSL311, SSOSL417 loci. Animal Genetics 26: 281-282.

Slettan, A., I. Olsaker and O. Lie. 1996. Polymorphic Atlantic salmon, (*Salmo salar* L.), microsatellites at the SSOSL438, SSOSL429, and SSOSL444 loci. Animal Genetics 27: 57-58.

Attachment 2

Escape Reporting Form

The permittee shall report any known or suspected escape of 50 or more adult fish at two kg or larger, within 24 hours.

Aquaculture Permit No: ______________________

Name of Permit Holder: ______________________

Accident site/location: ______________________

Date of occurrence: ______________________

Time of occurrence: ______________________

Species / Strain of Fish: ______________________

Average Size/Weight/Age of Fish Lost (if more than one year class, provide separate details):

____

Number of cages on site: ______________________

Number of cages subject to loss: ______________________

Number of fish lost: ______________________

Medication profile: ______________________

Please describe the circumstances of the escape incident:

Please describe any recapture attempts:

Submitted by:

______________________ ______________________

Signature Title

Date: ______________________

FAX to each of the following offices:
USFWS, 207-827-6099; NOAA Fisheries, 207-866-7342; ACOE, 207-623-8206