STRATEGIC PLAN
FOR THE
RESTORATION
OF ATLANTIC SALMON
TO THE
CONNECTICUT RIVER

Revised July 1, 1998

Prepared By:

Connecticut River Atlantic Salmon Commission

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EXECUTIVE SUMMARY

The Connecticut River Atlantic Salmon Commission (Commission), in this revised *Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River* (Plan), provides a summary of past and current Atlantic salmon restoration efforts and a vision for focusing interagency restoration activities. Strategies have been developed that address the challenges facing future restoration and are the next step to accomplishing the Program's mission: to protect, conserve, restore and enhance the Atlantic salmon population in the Connecticut River basin for the public benefit, including recreational fishing.

The Plan describes how the multi-state/federal, interagency Atlantic Salmon Restoration Program (Program) is guided by the Commission with recommendations from the Technical Committee. The Commission is composed of ten Commissioners from the Connecticut Department of Environmental Protection (CTDEP), Massachusetts Division of Fisheries and Wildlife (MAFW), New Hampshire Department of Fish and Game (NHFG), Vermont Department of Fish and Wildlife (VTFW), a public sector representative appointed by the governor of each State, the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS). The U.S. Forest Service (USFS) and the Massachusetts Division of Marine Fisheries (MAMF) are represented on the Technical Committee in addition to representatives from all of the above agencies.

The need and reason for the Commission and Technical Committee are readily understood given the number of agencies involved, the enormity of the Connecticut River watershed, and the complex and varied life histories of the fish species of the Connecticut River. The Connecticut River is the longest river in New England, stretching from Canada to Long Island Sound and supporting over 60 species of fish, 14 of which are migratory. The unique character of the Connecticut River basin has shaped and defined the Restoration Program. The basin contains 38 tributaries that are of importance to the restoration of Atlantic salmon.

The Atlantic salmon has a complex life cycle in both fresh and saltwater, the requirements for which are not yet fully understood. We do know that, prior to colonization, salmon lived in the Connecticut River in substantial numbers; they are long-lived at about five years per generation; they require clean well-oxygenated water and cobble-bottom river habitat; their life cycle requires suitable marine and freshwater conditions; they migrate thousands of miles to the North Atlantic Ocean and back; and they face many perils including over-harvest, dams, pollution and predation.

The Program, throughout its history, has attempted to address these perils in its efforts to re-introduce the extirpated salmon. The native population was lost in the early 1800s when dams prevented access to spawning habitat. Success of the first restoration initiative in the 1860s was short-lived because of unregulated harvest, limited interstate cooperation, and ineffective fish passage facilities. The current Program was initiated a century later, in 1967, when the states agreed to work cooperatively on restoration. The current Program has been aided by the Clean Water Act which provided for a better environment, the Anadromous Fish Conservation Act which provided states with funding, and the improvement of technology and opportunity for providing access to upstream habitat.

Since initiation of the Program three decades ago, an annual return of sea-run Atlantic salmon, numbering in the hundreds, has been established; a reliable river-specific egg source has been developed; in-stream production of smolts is occurring; upstream passage is in place at the first five mainstem dams providing access as far as the base of Ryegate dam; interim and permanent downstream passage is in place at the lowermost eight mainstem dams including McIndoes Falls dam; and downstream passage is also in place on a number of tributaries including the Salmon, Farmington, Westfield, West, Black, Sugar, Ashuelot, Ammonoosuc, and Passumpsic Rivers. Fish culture, fish health management, stocking and regulation of high seas fisheries have also been improved.

As a result, the Commission is optimistic about the Program and what it can accomplish within the first quarter of the twenty-first century. Accomplishments planned for the Program include: an increase in the number of returning salmon; increased natural in-stream smolt production; improved downstream fish passage; and the beginning of the development of tributary-specific stocks of Atlantic salmon.

However, a number of challenges remain which may impact the speed and degree of success of restoration. These include: increasing annual program hatchery production capability to totals of 10,000,000 fry and 100,000 smolts; managing sea-run salmon returns to perpetuate the Connecticut River stock; facilitating natural in-stream production, research, and education; protecting, maintaining, enhancing, and providing access to quality habitat; improving restoration capabilities through focused research; and, ensuring that the public understands and values the Program and its benefits.

The goals, objectives and strategies outlined in the Plan are designed to guide restoration activities and lead the Program into the twenty-first century. Short-term actions needed to accomplish the objectives outlined in the Plan will be presented later in an Action Plan and that will be updated as needed to ensure that the Program goals and objectives are accomplished.

INTRODUCTION

This document is a revision of a previous *Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River Basin* (Plan), dated 1982. The goals set forth in the previous Plan are reaffirmed in this revision. This Plan, while promoting the concept of a phased approach to restoration, is more focused than the previous Plan in defining areas within the basin important to the restoration of the species. It is broad in scope and flexible, and was developed to direct and coordinate Restoration Program (Program) activities throughout the coming years. It provides a framework that supports actions intended to increase the abundance of Atlantic salmon in the basin, and defines expectations and benchmarks for Program evaluation, a valuable feature for resource managers, industry planners, and the public.

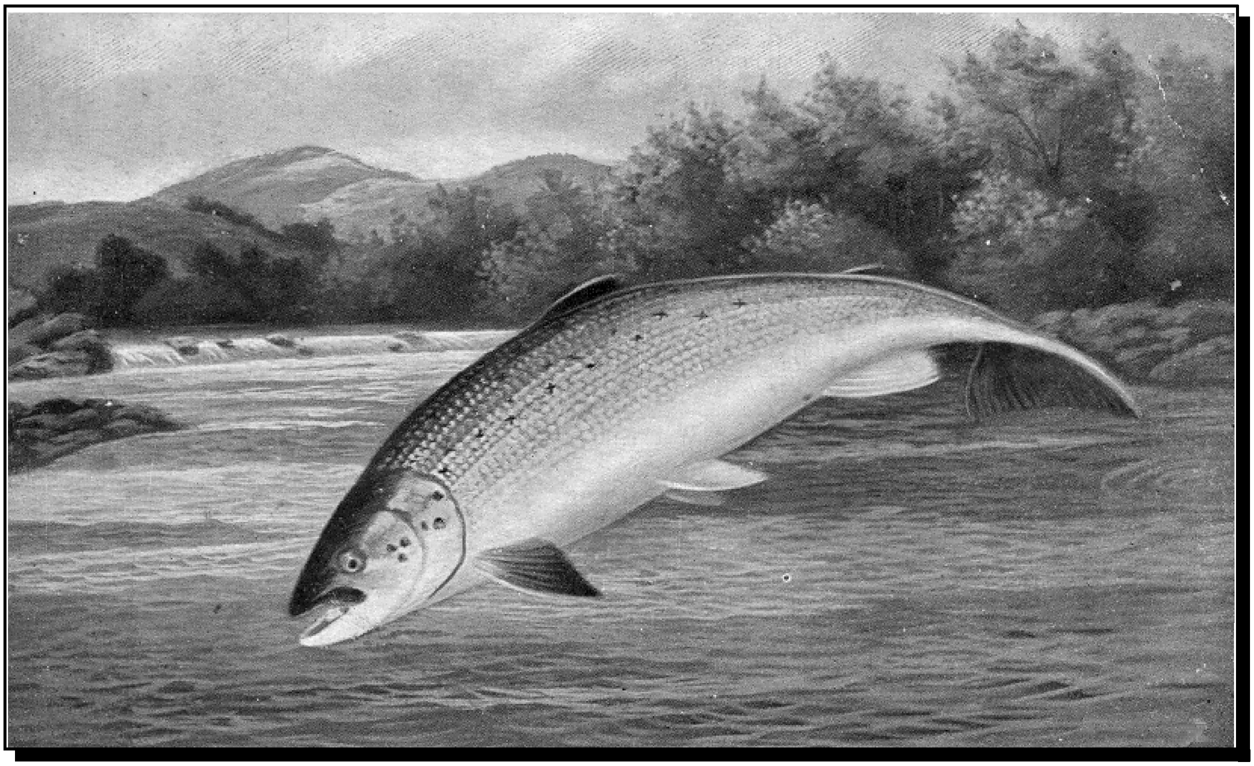
The Plan, in Section I, identifies the Program mission: to protect, conserve, restore and enhance the Atlantic salmon population in the Connecticut River basin for public benefit, including recreational fishing. A description of Program administration and the role of the Connecticut River Atlantic Salmon Commission in guiding salmon restoration activities is provided in Appendix A. Appendix B of the Plan provides general descriptive information on the basin and includes specific information on available salmon habitat, depicting the 38 major tributaries on a map. Numerous fish species are found in the river and its tributaries, and a list of those known to occur in the basin is also provided in Appendix B. The complex life history of Atlantic salmon and their ocean migration routes are shown in Appendix C. A summary of the Program and discussion of future directions is provided in Section II. The history of the salmon Restoration Program in the basin, including past and present efforts relevant to restoration of the species, is presented in Appendix D. This appendix also provides specific historic data on the number and stage of fish stocked and the number of adult returns.

The Restoration Program has progressed from the early years, or Phase I, which developed suitable broodstock for release of salmon at various life stages throughout the basin to establish adult returns to the river. Program activities planned for upcoming years, the second phase of the Program, require development and implementation of strategies presented in Section III and detailed in Appendix E. While a number of these strategies have already been implemented, it is expected that these, and others not yet implemented, will be adapted as necessary to accomplish Program objectives. It is intended that the details of action items for implementing objectives will be stated in future Action Plans.

Many facets of the Plan will remain dynamic. The steps for implementing strategies and initiating actions will be reviewed and updated as needed to accomplish Program objectives. While a number of strategies and actions address fish production, others highlight the need for innovation that will be fostered through continued evaluation and research. The projected increase in abundance of Atlantic salmon discussed in Appendix F will depend on these strategies and actions. Habitat protection and enhancement, provision for access to available habitat (Appendix G), research, and evaluation, in addition to fish production, will be essential to achieving Program goals and objectives. The continued effort to restore Atlantic salmon in the basin will provide numerous public benefits (described in Section II) but it will also require focused efforts, agency commitment, and a sharing of responsibilities in the management of basin resources. Thus, the Plan was first presented to the public as a draft and subsequently finalized with their input (Appendices H & I).

I. PROGRAM MISSION

The Connecticut River Atlantic Salmon Restoration Program mission is:



to protect, conserve, restore and enhance the Atlantic salmon population in the Connecticut River basin for public benefit, including recreational fishing.

II. PROGRAM SUMMARY

History of Atlantic Salmon in the Connecticut River: When Europeans first settled the Connecticut River valley, Atlantic salmon were found throughout the watershed. Historic records indicate that Atlantic salmon ascended the mainstem Connecticut River to its very headwaters (as far north as Beechers Falls, Vermont) and likely entered all major tributaries not blocked by natural barriers. Precise numbers of salmon that entered the river and its various tributary systems are unknown because early settlers did not enumerate the migrating fish as extirpation predated the development of fishery science.

The native salmon population disappeared soon after the construction of impassable dams. The first dam to be built across the mainstem Connecticut River was constructed in 1798 near the present site of Turners Falls, Massachusetts. It blocked the access of salmon to spawning habitat in the upper portion of the watershed, and the species disappeared from the river a few years later.

An interagency state/federal program to restore salmon to the Connecticut River (based on the stocking of fry hatched from eggs taken from Penobscot River salmon) was initiated in the 1860s. This effort resulted in the return of hundreds of adult salmon for several years in the 1870s and 1880s but the program eventually failed due to uncontrolled freshwater harvest of salmon, the failure to construct effective fish passage facilities at dams, and the redirection of state efforts to other priorities. Program history specifics are further detailed in Appendix D.

The Current Restoration Program: The Atlantic Salmon Restoration Program became feasible when the federal Anadromous Fisheries Conservation Act (1965) made funds available for interstate fish restoration programs. Additionally, pollution abatement programs initiated as a result of the Clean Water Act (1967) helped to improve the quality of the river environment. The current Program formally commenced in 1967 when the four basin states, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service signed a statement of intent to restore anadromous fish to the Connecticut River. The combined effects of all these events set the stage for Atlantic salmon restoration. Subsequently, Congress passed the Connecticut River Basin Atlantic Salmon Compact (1983), which formalized the state and federal agreements. This action created the Connecticut River Atlantic Salmon Commission, authorized to guide the restoration of salmon to the basin. Another more recent federal law, The Silvio O. Conte National Fish and Wildlife Refuge Act (1991), recognized past expenditures and reaffirmed the importance of migratory fish restoration. The law established a role for the Refuge in conserving, protecting, and enhancing the salmon, shad, herring, and sturgeon and their habitat, supporting research, and environmental education.

Early in the Program, emphasis was given to stocking smolts. Initial releases were limited in number and comprised of two-year old smolts of Canadian origin reared in federal trout hatcheries. The first adult salmon return from these hatchery-smolt releases was documented in 1974. Between 1974 and 1977, ten more salmon returned from the ocean. Penobscot River salmon smolts became available to the Program and were used to stock the river in greater numbers beginning in 1976. As a result of the 1976 release, 90 adult salmon returned to the river in 1978. Since then, salmon returns have usually numbered in the hundreds (see Appendix D, Table 5). In 1983, hatchery smolt production shifted from a two-year to a one-year rearing regime in an effort to increase the quantity of smolts. Widespread fry stocking was initiated in 1987, in order to add the production of stream-reared smolts to smolts reared in hatcheries. Fry stocking has continued to increase, and, by the spring of 1997, the total number of fry stocked in the basin was nearly 8.5 million.

Providing upstream fish passage at dams on the river has always been an important aspect of migratory fish restoration. Many of the mainstem Connecticut River fishways were constructed to assist in rebuilding depleted populations of American shad which had never been extirpated from the river. The fishlift at the Holyoke Dam, originally built for shad, was expanded in 1975 and 1976. Fishways were built at the next four upstream dams on the mainstem river: Turners Falls, Vernon, Bellows Falls, and Wilder. Passage on tributaries has been constructed at sites including the Leesville Dam on the Salmon River, Rainbow Dam on the Farmington River, and the Decorative Specialties International (DSI) Dam on the Westfield River. These fish passage facilities not only provide access into a large portion of the basin targeted for restoration but also permit enumeration and/or capture of salmon for broodstock. The majority of returning salmon are captured for broodstock though ten percent are released upstream of the Holyoke Dam to spawn naturally. A complete list of existing fish passage facilities and current requirements for Atlantic salmon in the Connecticut River basin is provided in Appendix G.

Downstream passage facilities, designed to safely guide smolts past hydroelectric sites, were not included in the construction of fishways at the seven originally targeted dams, nor were they initially mandated at most of other dams in the watershed. As the number of fry stocked in the basin increased during the 1980s, so did concern about the deleterious effect of hydroelectric turbines on smolts. Efforts to provide downstream fish passage on both mainstem and tributary projects were initiated in the 1980s. In 1990, agreements were signed with two major utility companies that operate six mainstem hydroelectric facilities (New England Power Company and Northeast Utilities Service Company). These agreements established timeframes for downstream passage facility construction and evaluation studies. Passage at these sites will greatly increase the annual number of outmigrating smolts.

The Commission acknowledges the cooperation and genuine commitment of the electric utilities, including Northeast Utilities System and New England Power, to the restoration of salmon in the Connecticut River. They have played a particularly important role on the mainstem and some tributaries, making the effort, in good faith, sometimes at great expense, to ensure the success of the Restoration Program.

Though the USFWS was forced to suspend the rearing of hatchery smolts for the Connecticut River Program after 1994 due to budget constraints, it was determined that the Pittsford National Fish Hatchery could engage in limited smolt production beginning in 1998. Thus, two-year old smolts may again be released beginning in 2000. A summary of salmon stocking in the

Connecticut River basin since the inception of the current Restoration Program is found in Appendix D, Table 5.

One of the major environmental forces affecting salmon restoration involves an increase in oceanic mortality of Atlantic salmon. An historic decline in the size of wild runs of Atlantic salmon, worldwide, has occurred during the same years that the Commission has been attempting to restore a run to the Connecticut River. The reasons for the poor survival of salmon in the ocean are not fully understood. However, during the same period, great strides have been made in fish health management, fish culture, fish passage, fish stocking and regulation of high sea fisheries. As a result, the Commission remains optimistic that the current fortunes of Atlantic salmon can be reversed and that the original goal of the Restoration Program can be accomplished.

Looking to the Future: When the Restoration Program began in the 1960s, it was understood that it would take a long time to completely restore salmon to the basin and allow a recreational fishery. No one had previously attempted a comparable, basin-wide restoration effort on such a large river, and especially a river in which native stocks have been extinct for about 200 years. A rapid increase in numbers of returning salmon from 1978 to 1981 prompted optimistic expectations that progress would be sustained at that pace. However, the number of returning salmon has not changed much during the past ten years for a variety of reasons. Given the difficulties inherent to this Program, the steady numbers are a sign of success but it will still take a long time to restore salmon to the basin.

The Program can be understood as a long-term, multi-phase effort. The first phase of the program has succeeded: the identification of suitable donor stocks, natural spawning, and the establishment of an annual return of sea-run salmon. This Strategic Plan addresses the next phase of restoration. Specific milestones to be reached during this second phase will include: 1) an increase in the number of fry stocked in the watershed to 10 million; 2) an increase in the number of adults returning to the river; 3) an increase in the number of adults released into the river upstream of trapping facilities to support natural reproduction; 4) completion of the construction of downstream fish passage facilities; 5) re-establishment of hatchery smolt production and stocking; and, 6) the beginning of the development of tributary-specific stocks of salmon. This Strategic Plan provides the framework to achieve these milestones. It is not possible to identify a specific time when the second phase will be complete due to the dynamic nature of science, technology, government funding, and the riverine and oceanic ecosystems. It is expected that specific milestones of the second phase will be accomplished sometime within the next thirty years.

The final phase of the Program to be addressed in future Plans is the realization of full restoration as defined by the Commission.

What Does Restoration Mean?
Restoration means different things to different people. The Commission defines restoration as an ongoing process that will always require fisheries management with hatchery support. Successful restoration means:

- *realizing targeted adult returns as defined in this Plan,*
- *having salmon present throughout the basin as defined in the Plan,*
- *having spawning populations in selected tributaries,*
- *having a recreational fishery*

Current returns are in the hundreds, well below the original projections. However, total annual adult returns may reach 1,000 fish in the lifetime of this Plan and eventually may exceed that figure by a magnitude or more in the future. Certainties in making such projections do not exist. To understand the difficulty in making accurate projections and to learn how these figures are derived, please see Appendix F.

<u>Benefits of Atlantic Salmon Restoration</u>

1) Atlantic Salmon--Atlantic salmon are a national birthright. So, the most important benefit of the Restoration Program is the return of Atlantic salmon to the Connecticut River.

2) Angling Opportunities--Atlantic salmon is a premier gamefish. The Restoration Program currently offers anglers the opportunity to fish for domestic Atlantic salmon broodstock. These fish are used to produce eggs for fry stocking and afterwards are released into the region's waters to support recreational fishing. Providing opportunities to fish for sea-run salmon is an as yet unrealized part of the Program mission.

3) Non-angling Recreational Opportunities--Salmon are enjoyed by many non-anglers. Popular activities include watching the fish pass through fishways, seeing the fish in the river, assisting with fry stocking, and visiting various facilities where young salmon are reared and where adults are held prior to spawning. When people observe and learn about salmon, they learn about the inter-relationships between fish, rivers, their personal lives, and our shared environments. Such lessons are important in reinforcing the value of stewardship and responsibility in the Connecticut River watershed, and in helping people understand global management of natural resources.

4) Other Species--Although many of the Program activities are focused on salmon, a variety of other species benefit from the Program, particularly the anadromous species of American shad, alewife, blueback herring, gizzard shad, striped bass, white perch, sea lamprey, shortnose sturgeon, and sea-run brown trout. These species take advantage of fish passage facilities and move into upstream habitat, enabling them to increase their

numbers. Activities to protect and enhance these migratory species produce many of the same public benefits as salmon restoration.

5) Research--Continued support of research into aspects of Atlantic salmon life history, passage requirements, and fish health issues by the Commission will benefit the Restoration Program within and beyond the basin by expanding the body of knowledge and transferring it to other species and programs. Many technologies developed in the Connecticut River Program have already benefitted other programs in New England and throughout the world.

6) Tourism/Economic Benefits--New Englanders have a strong interest in salmon. Atlantic salmon are not plentiful in the United States and there are currently few opportunities to see salmon or fish for them. The establishment of a wild population in the heavily-populated Northeast may generate considerable "eco-tourism" that will, in turn, provide significant contributions to local economies. A 1989 study on the economic value of restoring salmon to several New England rivers set the projected total economic value at $2.6 to 4.3 billion.

7) Intangible Benefits--Many of the aforementioned benefits are easy to describe and quantify. However, this charismatic species holds special meaning to the people of New England that defies easy explanation. One factor is the perception of the salmon as an ecological sentinel of water quality. People remember when the Connecticut River was severely polluted, supporting relatively few fish, and there is great pride that salmon have returned. The yearly salmon run is an indicator that conditions are improving and that the environment we all share is healthier. For most residents, Atlantic salmon are not an issue of personal economics, but they are valuable. People care if salmon are out there, to fish for, look at, and celebrate.

<u>Challenges for the Future:</u> While the future direction and potential benefits of the Restoration Program are clear, the work will not be easy. There are challenges that must be overcome to realize the Program's goals. Perhaps the two biggest challenges are the effect of marine habitat on sea-survival of fish, and the development of stocks that are genetically suited to the Connecticut River ecosystem. Fisheries management can do little to affect the status of the marine habitat. Many researchers believe that the quantity and quality of marine habitat fluctuates cyclically and conditions will soon improve, naturally. Regarding Connecticut River stocks, managers can provide the best conditions by releasing appropriate donor stocks and minimizing artificial selection, but the actual mechanics of developing a river-specific stock is the natural, slow process of evolution. Available data indicate that these two natural factors will proceed in a manner that will be beneficial to the Program.

The Commission has control over many of the remaining challenges to meeting the Program mission. Additional hatchery capabilities are needed to meet production goals. Program biologists have determined that an annual release of at least 10 million fry into the watershed will be necessary to fully stock the available rearing habitat. A level of hatchery smolt stocking is also needed, particularly for the short term. Most production and stocking needs are currently being met at federal and state fish culture facilities. Despite government cutbacks, it is important for agencies to maintain current Program commitments. Additional facilities will be needed to meet the objectives for stocking. There are many creative ways to meet this need, including building new facilities, expanding existing facilities, or sharing facilities with other partners. However this expansion is accomplished, it will be important to fulfilling Program strategies.

There are many potential Program uses for returning adult salmon and often not enough salmon to meet all of the Program needs. Sea-run salmon are very valuable for both captive and in-stream breeding since they possess a proven ability to return to the river. In addition to increasing the quantity of available eggs, sea-run salmon improve the quality of available eggs since they pass on the same genes that allowed them to successfully return to the river. Adult salmon are also needed for research into salmon behavior and fish health, and for education and public relations. The Commission will be challenged in dealing with these potential uses to ensure that returning adult Atlantic salmon are protected and managed to provide maximum benefit to the Restoration Program.

The Program has benefitted from good scientific work being conducted on Atlantic salmon by researchers on both sides of the Atlantic Ocean. However, some information is not transferrable between watersheds or continents. To understand what is happening to salmon in this watershed, research must be conducted on Atlantic salmon in the Connecticut River. To ensure that progress is not limited by a lack of scientific knowledge, the Commission must encourage research whenever possible through cooperation, provision of fish and facilities, and communication with researchers. Researchers need to understand program research needs, managers need to learn the results of the research in a timely fashion, and the results need to be applied to resource management decisions.

The quality and quantity of habitat available to Atlantic salmon today are not as good as they were prior to colonization. Without adequate amounts of suitable habitat (even if all targets for salmon stocking are met), salmon will not prosper. Currently, there is a large amount of salmon habitat that is not accessible to returning adults because of the presence of barrier dams. Providing access around these migratory barriers through dam removal and/or the provision of fish passage will allow salmon to use this habitat. In other cases, important habitat is accessible to salmon but it has been degraded by human land-use practices. Siltation of gravel beds essential for spawning and fry habitat is a frequent cause of habitat degradation. The Commission must continually protect existing salmon habitat from further degradation through existing regulatory processes. Furthermore, agencies, industry, local government and non-governmental partners must take advantage of any opportunities to restore or improve habitat that has been previously degraded.

The resource agencies are restoring salmon to the river for the public benefit, however, it is often difficult to keep the public well informed about the progress, requirements, and status of the Program. Because the Program relies on public support and assistance to accomplish Program objectives, it is of great importance that the public understand and value the Program, its goals, current status, and future needs. The Commission and its member agencies must work to ensure that the public understands and continues to permit and support the Program.

III. STRATEGIC PLAN

The mission of the Atlantic Salmon Restoration Program is to protect, conserve, restore and enhance the Atlantic salmon population in the Connecticut River basin for public benefit, including recreational fishing. The following outline describes the goals, objectives, and strategies that have been developed to achieve this mission.

Goal 1. Manage Atlantic salmon production to produce sea-run Atlantic salmon returns.

Objective 1.A. Produce 15 million Atlantic salmon eggs annually from the Connecticut River strain of fish to fully support the Restoration and Management Program.

Issues/challenges:

- Production capacity for 15 million green eggs needs to be established and maintained.
- Very few effective vaccines and other beneficial drugs are approved for Atlantic salmon culture, increasing the risk of widespread disease.
- Coordination among agencies, volunteers, and distant stations needs to be consistently maintained.

Strategy 1.A.1. Optimize use of sea-run broodstock for egg production.
Strategy 1.A.2. Optimize use of kelt broodstock for egg production to supplement sea-run broodstock eggs.
Strategy 1.A.3. Optimize use of domestic broodstock for egg production.
Strategy 1.A.4. Develop increased egg incubation capacity in cooperation with other agencies and/or private sector.
Strategy 1.A.5. Work with appropriate experts, officials, and organizations to identify alternative/improved forms of treatment to optimize survival of eggs and fish in hatcheries.
Strategy 1.A.6. Continue coordination among agencies and seek improved approaches to managing communication and volunteers to more effectively accomplish spawning and production tasks collectively.

Objective 1.B. Produce and stock 10 million fry annually.

Issues/challenges:

- Existing capacity is insufficient to incubate the number of eggs needed to meet production goals.
- Current limited incubation capacity has necessitated both incubation of eggs at higher than optimum densities and stream-plants of eggs in the tributaries, the effectiveness of which have not been thoroughly evaluated.
- Fry stocking is labor intensive and requires partnerships among agencies and volunteers.
- Detailed habitat surveys are lacking on some tributaries which limits fry stocking effectiveness and flexibility.

Strategy 1.B.1. Increase existing incubation capacity at state and federal fish culture facilities.
Strategy 1.B.2. Identify quantity and quality of all nursery habitat in the 38 tributaries targeted for restoration (Appendix B, Figure 1).
Strategy 1.B.3. Stock all appropriate habitat.
Strategy 1.B.4. Utilize a structured volunteer program to ensure the success of fry stocking.

Objective 1.C. Produce and stock a minimum of 100,000 hatchery smolts annually.

Issues/challenges:

- Hatchery smolts are needed to provide a minimum of 100 returning adults or as many as needed to maintain a genetically viable Connecticut River stock in case of an unfavorable environmental event that greatly reduces wild smolt production.
- Hatchery smolts are needed for research.
- No smolts are currently produced or stocked because of a lack of funding and suitable facilities.
- Food and Drug Administration (FDA) restrictions limit available disease treatments for smolts.

Strategy 1.C.1. Identify a suitable facility (facilities) for the production of smolts.
Strategy 1.C.2. Identify funding sources to enable production of smolts at designated facilities.
Strategy 1.C.3. Produce at least 100,000 smolts annually.
Strategy 1.C.4. Stock at least 100,000 smolts annually.
Strategy 1.C.5. Work with appropriate experts, officials, and organizations to identify alternative/improved forms of rearing regimes and

treatment to optimize smolt survival in hatcheries.

Objective 1.D. Maintain and, when possible, enhance existing genetic variability in the Connecticut River Atlantic salmon population.

Issues/challenges:

- The native Connecticut River Atlantic salmon stock is extinct.
- Limited information exists about the origins of the existing Connecticut River stock and the subsequent contributions of introduced stocks.
- Genetic research and monitoring is important but expensive, and limited funding is available for these activities.

Strategy 1.D.1. Monitor genetic variability of broodstock and progeny.
Strategy 1.D.2. Continue with spawning protocols designed to minimize loss of genetic variability.
Strategy 1.D.3. Assess need, potential, and advisability of importing donor stocks.
Strategy 1.D.4. Review, select, and support related genetic research and monitoring projects.

Goal 2. Enhance and maintain the quantity, quality and accessibility of salmon habitat necessary to support re-established spawning populations.

Objective 2.A. Protect, maintain and restore existing Atlantic salmon habitat in all 38 selected tributaries (Appendix B, Figure 1).

Issues/challenges:

- Most of the historic salmon habitat in the basin has been destroyed, degraded, or rendered inaccessible.
- Lack of public awareness of the importance of habitat to salmon restoration impedes habitat protection and restoration.
- Local commissions control most of the land use decisions that could impair salmon habitat.

Strategy 2.A.1. Continue to utilize local, state, and federal regulatory authorities to protect riparian area buffer strips, instream flows, and salmon habitat.
Strategy 2.A.2. Support establishment of river flows that benefit salmon habitat at hydroelectric dams and flood control structures.
Strategy 2.A.3. Restore and improve habitat where feasible and practical.
Strategy 2.A.4. Work cooperatively with individuals and organizations within the watershed to protect, restore and maintain Atlantic salmon

habitat.

Strategy 2.A.5. Provide information so that the public understands the importance of habitat and is motivated to protect salmon habitat.

Objective 2.B. Provide adult Atlantic salmon access to selected upstream spawning habitat in the Connecticut River and 13 identified tributaries (Appendix E, Goal 2).

Issues/challenges:

- Dams have rendered most of the historic habitat inaccessible.

Strategy 2.B.1. Continue to oppose new dam construction and reconstruction of breached dams that will impact salmon habitat or migration.

Strategy 2.B.2. Support plans to breach or remove old dams that obstruct or impede upstream fish passage.

Strategy 2.B.3. Utilize state and federal regulatory authorities to ensure that fish passage is provided as needed at all licensed and permitted dams.

Strategy 2.B.4. Support manipulation of river flows at hydroelectric dams and flood control structures during key migration periods to improve fish passage success.

Strategy 2.B.5. Continue to share information and work cooperatively with dam owners, other river developers, and nongovernmental partners to resolve fish passage concerns.

Objective 2.C. Minimize passage obstructions, migratory delays and mortality of Atlantic salmon smolts and kelts downstream of areas stocked with fry, parr, smolts or adults.

Issues/challenges:

- Dams cause mortality and delays in migration of emigrating Atlantic salmon smolts.
- Connecticut River flows are highly controlled, impacting Atlantic salmon passage success.
- The regulatory process to implement fish passage is slow.
- Effective downstream passage is sometimes limited by existing technology.
- Smolt entrainment at the Northfield Mountain Pumped Storage Facility has not been resolved.

Strategy 2.C.1. Continue to oppose new dam construction or reconstruction of breached dams that will impact salmon habitat or migration.

Strategy 2.C.2. Support plans to breach or remove old dams that obstruct or impede downstream fish passage.

Strategy 2.C.3.	Continue to utilize state and federal regulatory authorities to ensure that fish passage is provided at all licensed and permitted dams downstream of salmon stocking and spawning areas.
Strategy 2.C.4.	Continue to provide dam owners with an annual schedule for operation of downstream fish passage facilities to ensure that facilities are operated at appropriate times.
Strategy 2.C.5.	Support manipulation of river flows at hydroelectric dams and flood control structures during key migration periods to improve fish passage success.
Strategy 2.C.6.	Remove natural debris obstructions that prevent fish passage on tributaries downstream of stocked habitat.
Strategy 2.C.7.	Continue to work cooperatively with dam owners/operators to address passage needs.
Strategy 2.C.8.	Encourage development and improvement of downstream fish passage technology.

Goal 3. Protect Connecticut River Atlantic salmon from exploitation.

Objective 3.A. Support scientific management of sea-run Atlantic salmon populations.

Issues/challenges:

- Connecticut River Atlantic salmon are harvested and caught as by-catch in distant, coastal and in-river fisheries.

Strategy 3.A.1. Support and participate in the North Atlantic Salmon Conservation Organization process to manage Atlantic salmon harvest and by-catch in the North Atlantic Ocean (> 12 miles offshore).

Strategy 3.A.2. Continue to support the State prohibition on near shore harvest of Atlantic salmon (<3 miles offshore).

Strategy 3.A.3. Support the Atlantic States Marine Fisheries Commission - New England Fishery Management Council prohibition of salmon fishing in coastal waters (3-12 miles offshore).

Strategy 3.A.4. Minimize the by-catch of Atlantic salmon in all fisheries in the Connecticut River, particularly the commercial American shad fishery.

Strategy 3.A.5. Continue to prohibit commercial fisheries for Atlantic salmon in the Connecticut River.

Goal 4. Allocate adult Atlantic salmon to maximize benefits to the Program.

Objective 4.A. Allocate adult sea-run salmon to provide eggs for the Program.

Issues/challenges:

- Sea-run salmon eggs are needed for the production program to allow stock development to benefit from natural selection in the ocean.
- There are many needs for sea-run adult salmon but the numbers are limited.
- A plan is needed to determine how many fish are released to spawn naturally and how many fish are retained as broodstock to support the stocking program.

Strategy 4.A.1. Allocate some of the returning fish for retention as broodstock (to provide eggs to the Program) and some for a spawning escapement using the following plan:

Annual Run Size	Release %	Release #	Retain %	Retain #
0 - 333	10	33	90	300
334 - 450	25	63	75	387
451 - 600	50	138	50	463

601 - 1,600	75	888	25	713
> 1,600	100	> 888	0	~713

Strategy 4.A.2. Retain additional fish beyond what is called for in Strategy 4.A.1 to replace losses of fish that were captured earlier.

Strategy 4.A.3. Use an incremental release strategy to project total run size at the beginning of the run so that, at the end of the season, the intent of strategies 4.A.1 and 4.A.2 are met but not all of the additional fish are released at the end of the season.

Objective 4.B. Allocate adult sea-run salmon for spawning escapement into available habitat to allow for natural reproduction.

Issues/challenges:

- Natural reproduction is desired as an element of restoration.
- Release of all returning sea-run salmon may reduce the production of hatchery smolts and retard the progress of the Restoration Program.
- A plan is needed to determine how many fish are released to spawn naturally and how many fish are retained as broodstock to support the stocking program.

Strategy 4.B.1. Follow the plan outlined in Strategy 4.A.1 to provide for a spawning escapement to the river.

Strategy 4.B.2. Release fish in addition to those targeted for escapement if benefits to the Restoration Program merit such action.

Objective 4.C. Allocate adult sea-run salmon for research purposes.

Issues/challenges:

- Scientific research is needed to support the science-based Restoration Program.
- There are limited numbers of Atlantic salmon in the basin, so if meaningful research is to be conducted, researchers need access to adequate numbers of these fish.
- Research may occasionally preclude some fish from becoming broodstock.

Strategy 4.C.1. Allow research to be conducted on spawning escapement (Objective 4.B) when such research will benefit the Restoration Program.

Strategy 4.C.2. Consider releasing fish for research purposes in addition to those targeted for escapement in Objective 4.B when the benefit to the Restoration Program merits such action.

Objective 4.D. Allocate adult sea-run salmon to support recreational opportunities for the public.

Issues/challenges:

- The establishment of a recreational fishery is part of the mission of the Program.
- Recreational opportunities are an important public benefit of the Program.
- Premature activities (such as a recreational fishery) could retard the progress of the Restoration Program.

Strategy 4.D.1.	Maximize the opportunities for the public to see wild salmon in the streams of the basin, particularly those allowed to continue upstream as part of spawning escapement (Objective 4.B).
Strategy 4.D.2.	Provide opportunities, when possible, for the public to observe salmon retained as broodstock.
Strategy 4.D.3.	Establish a catch-and-release recreational fishery for sea-run salmon when annual runs exceed 1,000 fish.
Strategy 4.D.4.	Allow a recreational fishery harvest of sea-run salmon when annual runs exceed 4,000 fish.
Strategy 4.D.5.	Consider tributary-specific fisheries at lower levels than stipulated in Objectives 4.D.3 and 4.D.4 when local situations merit such consideration.

Objective 4.E. Allocate post-spawned adult sea-run salmon to the kelt reconditioning program for the provision of eggs to the Program.

Issues/challenges:

- There is a need for more eggs than can be expected from sea-run salmon in the foreseeable future, necessitating the use of kelt broodstock.
- There is a need, for genetic reasons, to produce about half of the Program's eggs from sea-run salmon.
- There is a maximum number of eggs that can be produced and incubated.
- The need to reduce the labor intensive activity of kelt reconditioning must be balanced with the need to maximize the release of sea-run salmon (consistent with Objective 4.A) while still producing genetically superior eggs, such as kelt eggs.

Strategy 4.E.1.	Retain appropriate numbers of kelts from each year class of sea-run salmon so that at least 320 fish will be available to produce eggs, annually.

Objective 4.F. Allocate captive/domestic salmon for the provision of eggs to the Program.

Issues/challenges:

- There is a need for more eggs than can be expected from sea-run salmon in the foreseeable future, necessitating the use of captive/domestic broodstock.

- There is a need to produce about half of the Program's eggs from sea-run salmon, for genetic reasons.
- There is a maximum number of eggs that can be produced and incubated.
- As the number of sea-run salmon returns and eggs increase, the number of eggs produced by captive/domestic broodstock can be decreased.

Strategy 4.F.1.	Retain appropriate numbers of fry of pure sea-run origin at designated hatcheries each year so that up to 5,300 are available as adults to provide eggs for the Program.
Strategy 4.F.2.	Develop a plan for reducing domestic egg production as sea-run and kelt egg production increases, consistent with Objective 4.A.

Objective 4.G. Permit additional uses of kelt and captive/domestic broodstock once the fish have fulfilled their original purpose.

Issues/challenges:

- The use of kelt and captive/domestic broodstock creates problems and opportunities for the use of these fish after they have spawned.

Strategy 4.G.1.	Provide fish to researchers to support priority research activities.
Strategy 4.G.2.	Release kelts into rivers to allow their emigration to sea, reconditioning, and return as mature adults, consistent with all disease and federal drug guidelines.
Strategy 4.G.3.	Consider the release of pre-spawned captive/domestic broodstock into streams to supplement the natural reproduction of sea-run fish.
Strategy 4.G.4.	Release post-spawned captive/domestic broodstock to support a recreational fishery, consistent with all licensing requirements and policies of the Commission.
Strategy 4.G.5.	Provide kelts and captive/domestic broodstock to programs or facilities to support public outreach and education relative to the Commission's Atlantic salmon restoration mission.

Goal 5. Assess the effectiveness of the Program by conducting monitoring, evaluation, and research and implement changes when appropriate.

Objective 5.A. Conduct monitoring, evaluation, and research to improve effectiveness of the Program.

Issues/challenges:

- Routine population dynamics and other data are necessary to provide information to make management decisions.
- The need for monitoring will grow and become more important as the Program expands.

- Atlantic salmon habitat must be monitored to facilitate protection and restoration.

Strategy 5.A.1.	Continue to monitor and characterize sea-run salmon returns.
Strategy 5.A.2.	Continue to evaluate and monitor the effectiveness of upstream and downstream fish passage facilities.
Strategy 5.A.3.	Continue to evaluate the effectiveness of the fry and hatchery smolt stocking programs and natural spawning.
Strategy 5.A.4.	Determine annual smolt production from the Connecticut River basin.
Strategy 5.A.5.	Support marine monitoring efforts by cooperators.

Objective 5.B. Identify information gaps, problems and management issues.

Issues/challenges:

- Many of the cooperating agencies are not research agencies and are not funded for research.
- Program information needs must be provided to researchers to ensure that appropriate research will be conducted.
- Without adequate communication of research needs, researchers may focus on lower priority projects.

Strategy 5.B.1.	Communicate information needs and research opportunities identified through Program assessments.
Strategy 5.B.2.	Review research results and identify additional applied research opportunities.
Strategy 5.B.3.	Develop a process to communicate priority needs to researchers.

Objective 5.C. Support priority research projects to address identified information gaps and research needs.

Issues/challenges:

- Researchers need access to fish culture and passage facilities.
- Researchers need Atlantic salmon in various life stages.
- Commission endorsement would lend credibility to research project proposals.

Strategy 5.C.1.	Ensure Atlantic salmon are provided in requested life stages.
Strategy 5.C.2.	Provide researchers with access to fish culture and passage facilities within the basin and as appropriate.
Strategy 5.C.3.	Continue to provide technical expertise on endorsed research projects.

Strategy 5.C.4. Develop an approach and process by which the Commission solicits and expends funds for research.

Strategy 5.C.5. Develop a standardized process for submitting, reviewing and choosing research projects for endorsement by the Commission.

Strategy 5.C.6. Incorporate research results into program management in a timely fashion.

Goal 6. Create and maintain a public that understands and supports salmon restoration efforts and participates whenever possible.

Objective 6.A. Learn more about the people who are affected by the Program.

Issues/challenges:

- People have different expectations of the Restoration Program.
- People who are affected by the Program need to be identified and their opinions need to be understood.
- Current outreach activities may not be effective or may be sending the wrong messages because efforts are not coordinated or evaluated.
- The public is not fully aware of the benefits of the Program.

Strategy 6.A.1. Conduct assessment of public opinion.

Strategy 6.A.2. Identify affected groups and individuals.

Strategy 6.A.3. Develop and communicate coordinated messages to address identified concerns.

Objective 6.B. Promote public interest and involvement in the Restoration Program.

Issues/challenges:

- Accurate Program information needs to be provided to the public in a timely manner.
- Lack of outreach funding, focus, and clarity have hampered basin-wide success of outreach efforts.
- Improved coordination and communication is needed to further interest and involve the public in the Program.
- Expectations and perceptions of the Program are dependent upon public access and understanding of Program information and issues.
- Public interest in volunteering needs to be coordinated with the Program's need for volunteer assistance.

Strategy 6.B.1. Promote public interest in the Restoration Program through information and education initiatives.

Strategy 6.B.2. Utilize volunteers where appropriate to accomplish Program objectives.

Strategy 6.B.3. Develop an outreach plan for improved communication.

Strategy 6.B.4. Integrate existing outreach efforts with similar efforts conducted by other Connecticut River-based conservation groups and agencies to accomplish shared objectives.

Objective 6.C. Include the public in the planning and the decision process to restore Atlantic salmon.

Issues/challenges:

- People are more supportive and involved with programs in which they feel they have a voice in decisions.

Strategy 6.C.1. Continue to maintain active public members on the Commission.

Strategy 6.C.2. Continue to improve opportunities for public involvement in the Commission and in the development and implementation of the operations plan.

Strategy 6.C.3. Develop new opportunities for public involvement through partnerships and other effective means.

Goal 7. Improve administration and operations within the Program.

Objective 7.A. Enhance the Commission's ability to manage the Restoration Program.

Issues/challenges:

- Coordination and cooperation within the Program needs to be strengthened.
- The Program depends on outside sources to fund and conduct monitoring, evaluation, and research.
- Rapidly changing technologies and information must be dynamically incorporated into the Program.
- There is no precedent or model available to guide a program of this magnitude.
- Agency cooperators, faced with increased responsibilities, diminished staffs, and decreased budgets, need additional help and funding to effectively accomplish Program objectives.

Strategy 7.A.1. Complete and routinely update Strategic and Operational Plans.

Strategy 7.A.2. Ensure funding and support exists for Program activities.

Strategy 7.A.3. Incorporate research results into Program management in a timely fashion.

Strategy 7.A.4. Continue to utilize Commission authorities and sub-committees to accomplish Program objectives.

Objective 7.B. Provide for centralized interagency coordination and information management.

Issues/challenges:

- Interagency activities require coordination.
- Coordination of activities requires more than the Program Coordinator and this must be included in agency budgets.
- The public wants accountability from the Commission, member agencies and other cooperating entities.
- The public does not recognize any single standard source for Program information.

Strategy 7.B.1. Continue funding and support for the Connecticut River Coordinator position and office staffing.

Strategy 7.B.2. Maintain centralized databases for Atlantic salmon restoration.

Strategy 7.B.3. Provide routine reporting and advocate Program needs to state and federal legislators.

Strategy 7.B.4. Continue facilitation of interagency cooperation.

Strategy 7.B.5. Centralize and coordinate public information dissemination for the Restoration Program.

Strategy 7.B.6. Increase communication between the Commission, member agencies, other governmental agencies, related groups, organizations and individuals.

Appendix A. Connecticut River Atlantic Salmon Commission

The Connecticut River Atlantic Salmon Commission (Commission) administers the interjurisdictional, cooperative effort to restore Atlantic salmon to the Connecticut River basin. The importance of a formal body to coordinate and regulate the restoration of Atlantic salmon was recognized when Congress approved the Connecticut River Basin Atlantic Salmon Compact, Public Law 98-138, in 1983. This law, passed previously by the four states, created the Commission and demonstrated Congressional support for the interstate restoration of Atlantic salmon to the Connecticut River basin.

The Commission is comprised of ten Commissioners (Table 1). Each of the four basin states is represented by two members: a high-level government employee and a public sector representative appointed by the governor. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service are both represented by their Northeast Regional Directors.

Table 1. Connecticut River Atlantic Salmon Commission Membership.

Connecticut River Atlantic Salmon Commissioners	
Federal	U.S. Fish and Wildlife Service *Director, Region 5*
	National Marine Fisheries Service *Director, Northeast Region*
Connecticut	Connecticut Dept. of Environmental Protection *Director, Fisheries Division*
	Public Sector Representative
Massachusetts	Massachusetts Division of Fisheries and Wildlife *Director*
	Public Sector Representative
New Hampshire	New Hampshire Fish and Game Department *Executive Director*
	Public Sector Representative

Vermont	Vermont Department of Fish and Wildlife *Commissioner* Public Sector Representative

Commissioners are advised on scientific and technical issues by a Technical Committee. The Technical Committee is comprised of senior staff biologists from each Commission member agency, the U.S. Forest Service, and the Massachusetts Division of Marine Fisheries. To address numerous technical issues, the Technical Committee created several standing sub-committees with specific areas of responsibilities, including the Salmon Studies, Downstream Fish Passage, and Genetics Sub-committees. Because salmon restoration and shad rehabilitation and enhancement share common issues, the Shad Studies Sub-committee was formally established under the Commission to ensure full consideration of this important fishery resource. Experts and cooperators from the member agencies, the U.S. Geological Survey/Biological Resources Division, private industry, and conservation groups cooperate with the sub-committees and Technical Committee, as needed, and are invited to participate in meetings.

The Connecticut River Coordinator, an employee of the USFWS, is the Executive Assistant for the Technical Committee and the Commission. The Coordinator organizes meetings, provides Program assessment and planning documents, and maintains contact with interested parties. The Coordinator is also responsible for Program advocacy, data management, interagency technical assistance, and the overall coordination and facilitation of migratory fish restoration activities.

From 1967-1983 (prior to the Commission), the restoration of migratory fish, primarily Atlantic salmon and American shad, was guided by a Policy Committee and a Technical Committee for Fisheries Management of the Connecticut River Basin with structures and memberships that have been carried over to the Commission. These earlier committees remain loosely in place today and act in concert with the Commission through sub-committees to address migratory fish restoration issues not specified in the Commission's enabling legislation.

The Commission meets at least twice each year and the Technical Committee meets more frequently, as needed. Meetings are open to the public and the public is given the opportunity to provide input into the decision-making process. Additionally, local news media are notified of scheduled Commission meetings. Minutes of both Commission and Technical Committee meetings are available and distributed widely.

Appendix B. Description of the Connecticut River Basin

The Connecticut River is the longest river in New England. It begins in the Fourth Connecticut Lake (2,625 feet above sea level), and collects water from several major tributaries as it flows South between the States of New Hampshire and Vermont, and through Massachusetts and Connecticut. After collecting water from the 11,250 square mile drainage basin, the river flows into Long Island Sound at Old Saybrook, Connecticut, over 400 miles from its origin.

The river basin environment varies from highly developed and urbanized stretches in the lower river valley to more rural and forested reaches in the tributary and headwater areas. Atlantic salmon habitat exists throughout the basin (Table 2). Major tributaries of significance to the Connecticut River Atlantic Salmon Restoration Program are shown on the basin map in Figure 1. The natural streambed gradient profiles are interrupted by artificially ponded stretches created by the numerous dams located on the river and its tributaries. Over 1,000 dams in the basin provide for highly regulated flows, particularly in the mainstem. Summer water temperatures in the mid-Connecticut River mainstem average between 70º and 80ºF with temperature peaks sometimes reaching 90ºF in July and August. Tributaries generally have cooler water temperatures and, as such, provide better habitat for juvenile salmon. Water quality throughout the basin supports all freshwater life stages of salmon. However, degraded reaches exist, particularly in the mainstem river in Connecticut and Massachusetts, where 84% of the basin's 2.3 million people reside.

The Connecticut River and its tributaries support a diverse group of fishes (Table 3) and invertebrates. Both intentional and accidental introductions have altered native fish communities within the basin. Currently, at least fourteen species of migratory fish inhabit the Connecticut River, including Atlantic salmon, American shad, alewife, blueback herring and shortnose sturgeon.

Table 2. Atlantic Salmon Habitat in the Connecticut River Basin.

Tributary System	**Location of Mouth**	River Mile[1]	**Rearing Units (100 m^2)** [2]
Eightmile River	Lyme, CT	8	600
Salmon River	East Haddam, CT	18	4,200
Farmington River	Windsor, CT	57	17,200
Westfield River	West Springfield, MA	75	22,000
Manhan River	Easthampton, MA	92	1,100
Mill River	Northampton, MA	92	1,200
Fort River	Hadley, MA	95	200
Mill River	Hatfield, MA	100	300
Sawmill River	Montague, MA	115	1,800
Deerfield River	Greenfield / Deerfield, MA	119	16,600
Fall River	Greenfield / Riverside, MA	122	1,100
Millers River	Millers Falls, MA	126	4,400
Four Mile Brook	Northfield, MA	133	200
Mill Brook	Northfield, MA	140	300
Ashuelot River	Hinsdale, NH	142	4,400
West River	Brattleboro, VT	149	25,100
Cold River	Cold River, NH	172	3,000
Saxtons River	North Westminster, VT	173	4,300
Williams River	Rockingham, VT	176	5,500
Black River	Springfield / Gould Mill, VT	183	7,000
Little Sugar River	North Charlestown, NH	187	700
Sugar River	West Claremont, NH	195	4,100
Ottauquechee River	North Hartland, VT	210	10,700
Bloods Brook	Lebanon, NH	212	400
Mascoma River	West Lebanon, NH	214	1,800
White River	White River Junction, VT	215	32,000
Ompompanoosuc River	Pompanoosuc, VT	225	1,800
Waits River	Bradford, VT	247	5,900
Ammonoosuc River	Woodsville, NH	266	18,900
Wells River	Wells River, VT	266	2,300
Stevens River	Barnet, VT	277	1,000
Passumpsic River	East Barnet, VT	280	17,000
Johns River	Dalton, NH	303	400
Israel River	Lancaster, NH	312	2,500
Upper Ammonoosuc R.	Groveton, NH	325	5,000
Paul Stream	Brunswick, VT	340	1,500
Nulhegan River	Bloomfield, VT	345	2,600
Mohawk River	Colebrook, NH	359	800
Mainstem Connecticut River [3]	Gilman, VT – W. Stewartstown, NH	301- 369	13,100
TOTAL:	243,000		

[1] From mouth of the Connecticut River, starting at Saybrook Breakwater Light, 0.5 mile below Lynde Point; [2] Estimated and surveyed combined; rounded to nearest 100 m^2; [3]Stretch between Gilman Dam and Canaan Dam.

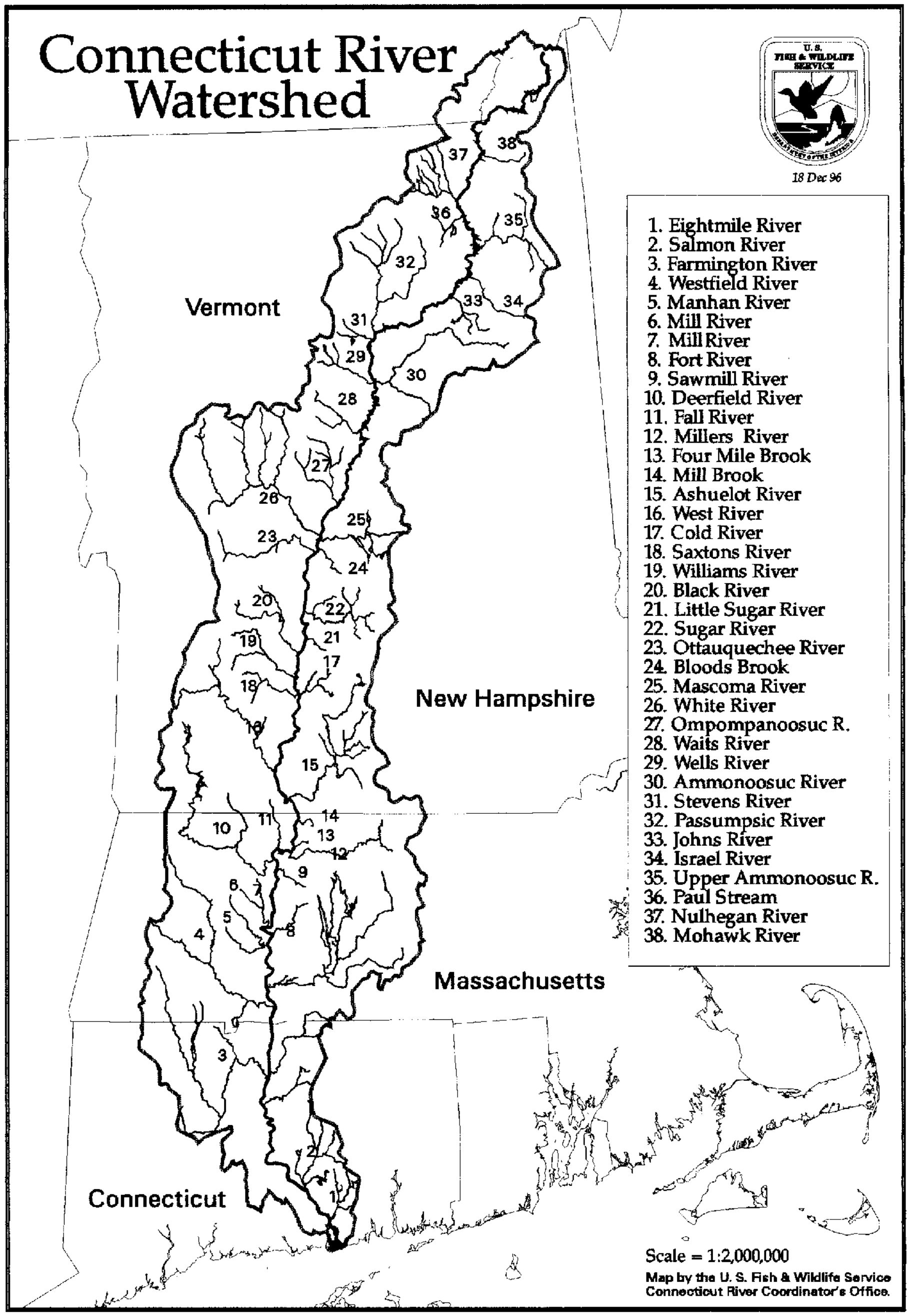


Figure 1. **Major Tributaries in the Connecticut River Atlantic Salmon Restoration Program.**

Table 3. Fishes Within the Connecticut River Basin.

Key to Status and Codes:
▶ = Introduced Species
● = Marine Visitor
FE = Federal Endangered
FT = Federal Threatened
SE = State Endangered
ST = State Threatened
SSC = State Special Concern

Scientific Name	Common Name	Life History	Status
Acipenseridae	**Sturgeons**		
Acipenser brevirostrum	shortnose sturgeon	anadromous	FE
Acipenser oxyrhynchus	Atlantic sturgeon	anadromous	ST (CT)
Amiidae	**Bowfins**		
▶ *Amia calva*	▶ bowfin	freshwater	
Ammodytidae	**Sand Lances**		
● *Ammodytes americanus*	● American sand lance	saltwater	
Anguillidae	**Eels**		
Anguilla rostrata	American eel	catadromous	
Atherinidae	**Silversides**		
Menidia beryllina	inland silverside	amphidromous	
● *Menidia menidia*	● Atlantic silverside	saltwater	
Carangidae	**Jacks**		
● *Caranx hippos*	● crevalle jack	saltwater	
Catostomidae	**Suckers**		
Catostomus catostomus	longnose sucker	freshwater	SSC (MA)
Catostomus commersoni	white sucker	freshwater	
Erimyzon oblongus	creek chubsucker	freshwater	
Centrarchidae	**Sunfishes**		
▶ *Ambloplites rupestris*	▶ rock bass	freshwater	
Enneacanthus obesus	banded sunfish	freshwater	
Lepomis auritus	redbreast sunfish	freshwater	
Lepomis gibbosus	pumpkinseed	freshwater	
▶ *Lepomis macrochirus*	▶ bluegill	freshwater	
▶ *Lepomis microlophus*	▶ redear sunfish	freshwater	
▶ *Micropterus dolomieui*	▶ smallmouth bass	freshwater	
▶ *Micropterus salmoides*	▶ largemouth bass	freshwater	
▶ *Pomoxis annularis*	▶ white crappie	freshwater	
▶ *Pomoxis nigromaculatus*	▶ black crappie	freshwater	
Clupeidae	**Herrings**		
Alosa aestivalis	blueback herring	anadromous	
Alosa mediocris	hickory shad	amphidromous	
Alosa pseudoharengus	alewife	anadromous	
Alosa sapidissima	American shad	anadromous	
● *Brevoortia tyrannus*	● Atlantic menhaden	saltwater	
● *Clupea harengus*	● Atlantic herring	saltwater	
Dorosoma cepedianum	gizzard shad	anadromous	

Cottidae	**Sculpins**		
Cottus cognatus	slimy sculpin	freshwater	
Cyprinidae	**Minnows and Carps**		
▶ *Carassius auratus*	▶ goldfish	freshwater	
Couesius plumbeus	lake chub	freshwater	SE (MA)
▶ *Ctenopharyngodon idella*	▶ grass carp	freshwater	
▶ *Cyprinus carpio*	▶ carp	freshwater	
Exoglossum maxillingua	cutlips minnow	freshwater	
▶ *Hybognathus nuchalis*	▶ silvery minnow	freshwater	
Hybognathus regius	Eastern silvery minnow	freshwater	SSC (MA)
▶ *Leuciscus idus*	▶ ide	freshwater	
Margariscus margarita	pearl dace	freshwater	
Notemigonus crysoleucas	golden shiner	freshwater	
▶ *Notropis anogenus*	▶ pugnose shiner	freshwater	
▶ *Notropis atherinoide*	▶ emerald shiner	freshwater	
Notropis bifrenatus	bridle shiner	freshwater	
Luxilus cornutus	common shiner	freshwater	
▶ *Notropis heterolepis*	▶ blacknose shiner	freshwater	
Notropis hudsonius	spottail shiner	freshwater	
▶ *Notropis lutrensis*	▶ red shiner	freshwater	
▶ *Notropis volucellus*	▶ mimic shiner	freshwater	
Phoxinus eos	northern redbelly dace	freshwater	SE (MA)
▶ *Phoxinus neogaeus*	▶ finescale dace	freshwater	
Pimephales notatus	bluntnose minnow	freshwater	
▶ *Pimephales promelas*	▶ fathead minnow	freshwater	
Rhinichthys atratulus	blacknose dace	freshwater	
Rhinichthys cataractae	longnose dace	freshwater	
Semotilus atromaculatus	creek chub	freshwater	
Semotilus corporalis	fallfish	freshwater	
▶ *Tinca tinca*	▶ tench	freshwater	
Cyprinodontidae	**Killifishes**		
Cyprinodon variegatus	sheepshead minnow	amphidromous	
▶ *Fundulus diaphanus*	▶ banded killifish	freshwater	
Fundulus heteroclitus	mummichog	amphidromous	
Fundulus luciae	spotfin killifish	amphidromous	
● *Fundulus majalis*	● striped killifish	saltwater	
Lucania parva	rainwater killifish	amphidromous	
Engraulidae	**Anchovies**		
● *Anchoa mitchilli*	● bay anchovy	saltwater	
Esocidae	**Pikes**		
Esox americanus	redfin pickerel	freshwater	
▶ *Esox lucius*	▶ northern pike	freshwater	
▶ *E. lucius x E. masquinongy*	▶ tiger muskellunge	freshwater	
Esox niger	chain pickerel	freshwater	
Gadidae	**Codfishes**		
Lota lota	burbot	freshwater	SSC (MA,CT)
● *Microgadus tomcod*	● Atlantic tomcod	saltwater	
Gasterosteidae	**Sticklebacks**		
Apeltes quadracus	fourspine stickleback	amphidromous	
▶ *Culaea inconstans*	▶ brook stickleback	freshwater	
● *Gasterosteus aculeatus*	● threespine stickleback	saltwater	ST (MA)
● *Gasterosteus wheatlandi*	● blackspotted stickleback	saltwater	
Pungitius pungitius	ninespine stickleback	amphidromous	
Gobiidae	**Gobies**		
Gobiosoma bosc	naked goby	amphidromous	

Table 3. Fishes Within the Connecticut River Basin.

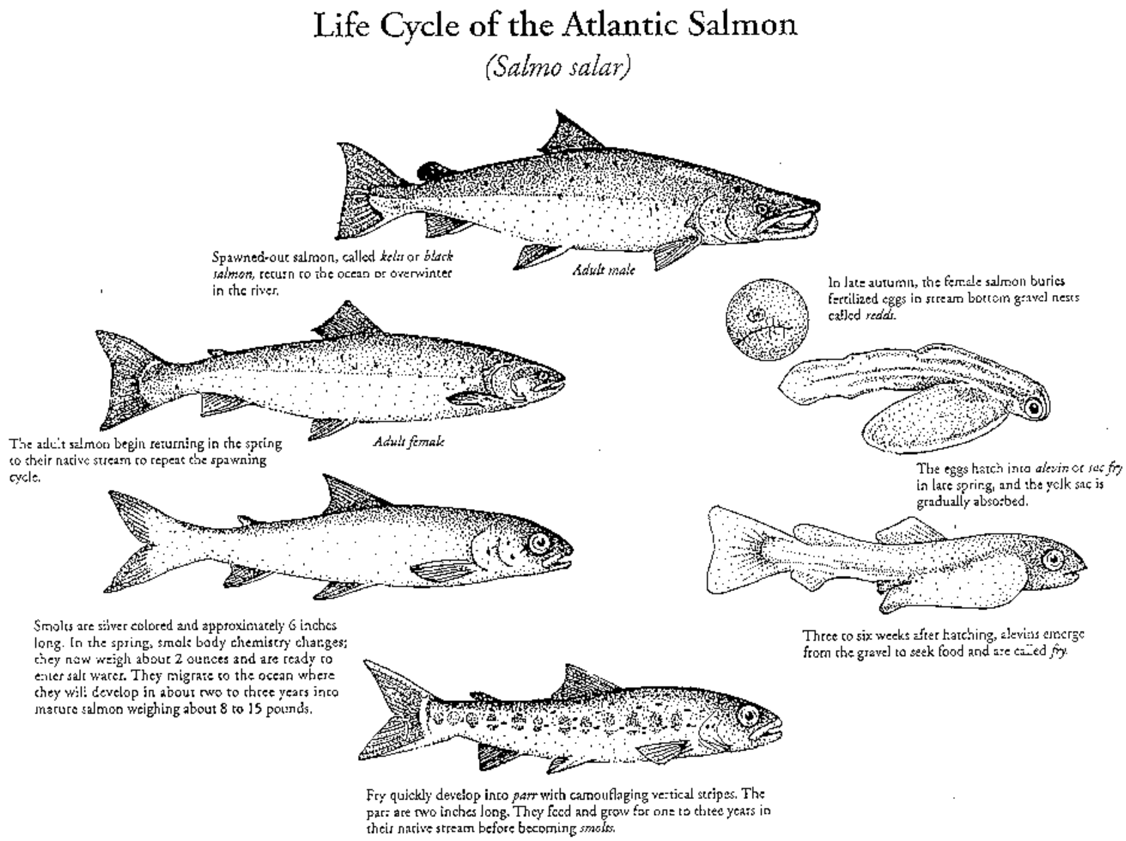
Gobiosoma robustum	code goby	amphidromous	
Ictaluridae	**Catfishes**		
▶ *Ameiurus catus*	▶ white catfish	freshwater	
▶ *Ameiurus natalis*	▶ yellow bullhead	freshwater	
Ameiurus nebulosus	brown bullhead	freshwater	
▶ *Ameiurus melas*	▶ black bullhead	freshwater	
▶ *Ictalurus punctatus*	▶ channel catfish	freshwater	
▶ *Noturus gyrinus*	▶ tadpole madtom	freshwater	
Mugilidae	**Mullets**		
Mugil cephalus	striped mullet	amphidromous	
Mugil curema	white mullet	amphidromous	
Osmeridae	**Smelts**		
Osmerus mordax	rainbow smelt	anadromous	
Percichthyidae	**Temperate Basses**		
Morone americana	white perch	amphidromous	
Morone saxatilis	striped bass	anadromous	
Percidae	**Perches**		
Etheostoma fusiforme	swamp darter	freshwater	
Etheostoma olmstedi	tessellated darter	freshwater	
Etheostoma nigrum	Johnny darter	freshwater	
Perca flavescens	yellow perch	freshwater	
▶ *Stizostedion vitreum vitreum*	▶ walleye	freshwater	
Petromyzontidae	**Lampreys**		
Lampetra appendix	American brook lamprey	freshwater	ST (MA), SSC (CT,NH)
Petromyzon marinus	sea lamprey	anadromous	
Pholidae	**Gunnels**		
Pholis fasciata	banded gunnel	amphidromous	
Pleuronectidae	**Righteye Flounders**		
● *Pleuronectes americanus*	● winter flounder	saltwater	
Pomatomidae	**Bluefishes**		
● *Pomatomus saltatrix*	● bluefish	saltwater	
Salmonidae	**Trouts**		
▶ *Oncorhynchus mykiss*	▶ rainbow trout	freshwater	
▶ *Oncorhynchus nerka*	▶ kokanee	freshwater	
Prosopium cylindraceum	round whitefish	freshwater	
Salmo salar	Atlantic salmon	anadromous	
▶ *Salmo trutta*	▶ brown trout	frhwtr/andrms	
Salvelinus fontinalis	brook trout	freshwater	
▶ *S. fontinalis x S. namacush*	▶ splake	freshwater	
Salvelinus namaycush	lake trout	freshwater	
Soleidae	**Soles**		
Trinectes maculatus	hogchoker	amphidromous	

Table 3. Fishes Within the Connecticut River Basin.

Syngnathidae	**Pipefishes**	
● *Syngnathus fuscus*	● northern pipefish	saltwater
Umbridae	**Mudminnows**	
▶ *Umbra limi*	▶ central mudminnow	freshwater

Appendix C. Atlantic Salmon Life Cycle.

Figure 2. Atlantic Salmon Life Cycle.



Atlantic salmon spawn in October and November, burying their eggs in prepared gravelly-cobble areas in streams called redds. Most females lay a total of 7,000 to 8,000 eggs in two or more redds. A steady supply of clean, well oxygenated water is critical to sustain these eggs. The eggs remain in the gravel throughout the winter before hatching in the spring. Newly hatched salmon, called sac fry, obtain food from their attached yolk sac. The salmon emerge from the redd, primarily from April to June, when the yolk sac has been completely absorbed. Feeding activities begin at this time. Salmon fry, approximately one and one quarter inches long at emergence, quickly set up feeding territories which they defend from other fish. Growing salmon prefer stream habitat lined with cobble-sized stone and clean, cool (60-70º F) water that is free of sediment. Fish are found in riffles and along the interface of fast moving water, under overhanging cover and generally toward the bottom of the water column.

Fry that have spent their first summer in the stream where they hatched are three to four inches long by fall and are called parr. After one full year in freshwater, the parr will have grown to a length of four to six inches. Parr remain in freshwater for a period of one to three years. The freshwater residence period is largely dependent on growth rate. The fastest growing parr, usually from warmer, more productive tributaries, spend only one year in freshwater. Slower growing parr, often from colder, less fertile tributaries, spend three, or rarely, four years in freshwater. Most parr in the Connecticut River basin spend two years in freshwater. During their first fall, parr may disperse widely from their first summer location to seek new habitat.

Parr destined to leave the freshwater environment the following spring begin a process called smoltification during the preceding winter. Pronounced physical changes occur during the spring after salmon reach a size suitable for migration to the sea, six to eight inches or more. These changes allow juvenile salmon to adapt to life in marine waters. Throughout the smoltification process a series of behavioral, physiological, and morphological changes occur that transform young salmon from territorial, bottom-dwelling, freshwater fish to schooling, saltwater fish. Juvenile salmon leaving for the ocean are called smolts. Smolts lose the dark vertical stripes, parr marks, on their sides and become bright silver in color. Smolts migrate to Long Island Sound from April through June. Some smolts may commence pre-smolt movement in the fall to start their long migration. Because the Connecticut River is so long, this is believed to have been an important adaptation of the original upriver stocks of Connecticut River salmon.

Connecticut River smolts move eastward around Cape Cod and begin a long migration northward along the coast after reaching Long Island Sound. The salmon eventually arrive at waters off of the west coast of Greenland where they share feeding grounds with other Atlantic salmon from North America and Europe (Figure 3). Most Connecticut River salmon return to spawn after residing in the ocean through two sea winters (2SW). A few salmon, called grilse, return after spending only one winter at sea (1SW), and others wait until after their third sea winter to return (3SW). The average 2SW salmon grows from six inches long and weighing about two ounces as a smolt entering Long Island Sound to about 30 inches and 10 pounds as a returning mature salmon. Grilse (1SW) average about four pounds and 3SW salmon often weigh more than 15 pounds.

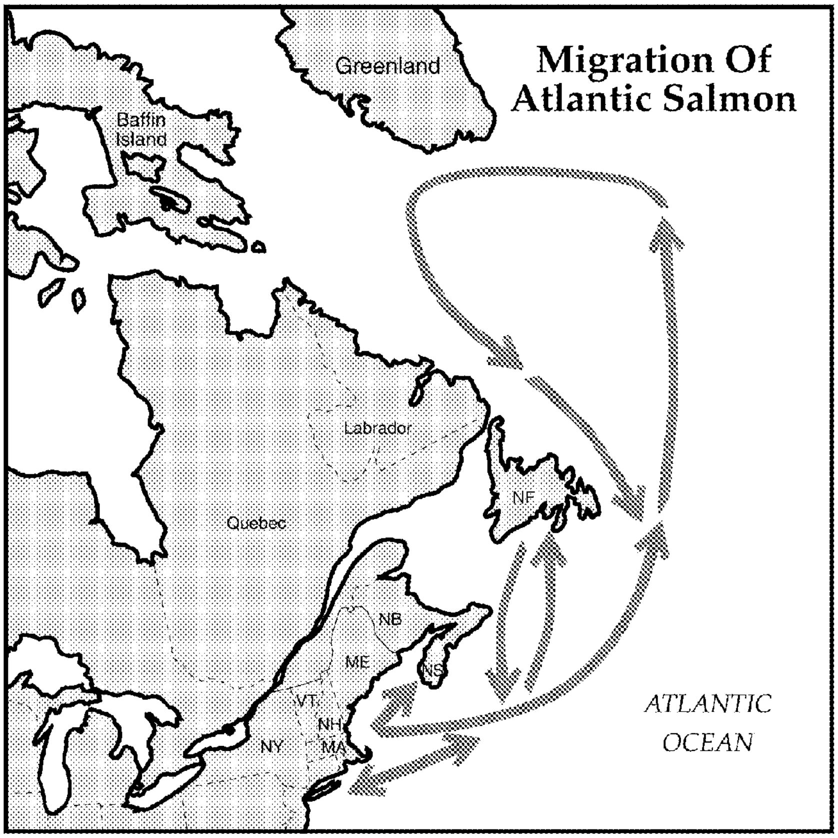


Figure 3. Ocean Migration of Atlantic Salmon.

Adult salmon return to the Connecticut River primarily in May and June. In the freshwater environment, the color of the adult salmon slowly changes from silver to a very dark color. The salmon attempt to reach their natal streams, where they spend the summer holding in deep, cold pools before spawning in the fall. From the time they enter the freshwater until spawning, often six months later, the salmon do not feed; feeding begins after they return to saltwater in the fall or spring. Atlantic salmon, unlike Pacific salmon, do not die after spawning, though many die as a consequence of the rigors of the upriver migration, the spawning effort itself, and not feeding for up to one year while in freshwater. Adults that survive the rigors of migration and spawning are called kelts. Kelts return to the ocean in late fall or early spring, at which time they regain their silver color. A small percentage of salmon survive several spawning runs, alternating between freshwater and marine environments. Repeat spawners and grilse are valuable to the salmon population for maintaining genetic variability and providing a buffer for all sources (fresh and salt water) of mortality affecting the predominant 2SW year class.

Appendix D. History of Atlantic Salmon in the Connecticut River And Status of the Connecticut River Atlantic Salmon Restoration Program

The historic North American range of Atlantic salmon extended at least as far south as western Connecticut. The Connecticut River not only hosted one of North America's southern-most salmon runs but also its longest salmon run. Salmon once ascended the mainstem Connecticut River to its very headwaters (as far north as Beechers Falls, Vermont, nearly 400 miles upstream from the river mouth at Long Island Sound) and entered all major tributaries not blocked by natural barriers such as waterfalls. Precise numbers of fish that entered the various tributary systems are not available because the date of extirpation predated the development of fishery science and the ability to enumerate fish migrating upstream.

Recently, the size of, and even the presence of the historic Connecticut River Atlantic salmon run have been challenged in some archeological papers because of the failure of researchers to find salmon remains at archeological sites. Lack of evidence at such sites has fueled speculation that early colonists deliberately exaggerated stories of salmon abundance in the river. However, the assumptions about salmon habitat requirements used in the analysis of results have been questioned by salmon biologists who have refuted the theory that the salmon run was small or non-existent. Biologists speculate that failure to find salmon remains is due to the deterioration of such remains over time and/or inappropriate sampling techniques. Though some individuals, both colonial and contemporary, have likely been guilty of exaggerating the size of the salmon run, it is generally accepted that salmon existed in significant numbers though their numbers were never as great as those for Pacific salmon in the Northwest. Biologists have concluded that Atlantic salmon returned to the Connecticut River and its tributaries by the thousands when Europeans first arrived in this watershed. This is based on evidence from first person historical accounts, current understanding of salmon biology and habitat requirements, and present day salmon populations in Spanish rivers located at the same latitude as the mouth of the Connecticut River.

The native salmon population declined upon colonization by Europeans and development of water power sites throughout the basin. The major cause of the decline was the construction of dams that blocked salmon migration to upstream spawning habitat. Initially, dams for sawmills and gristmills were constructed across small tributaries. By the mid-1700s, major spawning tributaries such as the Salmon and Farmington Rivers were dammed, reducing the number of adult salmon returning from the sea. By the late 1700s, all of the tributaries in the lower portion of the watershed were devoid of salmon. All returning salmon had originated from and were destined for tributaries in the northern portion of the watershed where the human population was still very low. The first dam across the mainstem Connecticut River was constructed in 1798 near the present site of Turners Falls, Massachusetts. It blocked the access of salmon to the spawning habitat in the upper portion of the watershed and the species disappeared from the river within a few years.

An interagency state/federal program to restore salmon to the Connecticut River based on the stocking of fry hatched from eggs taken from Penobscot River salmon was initiated in the 1860s. Although the effort resulted in the return of hundreds of adult salmon for several years in the 1870s and 1880s, the program eventually failed due to uncontrolled harvest of fish in Connecticut waters, the failure to construct effective fish passage facilities at dams in Massachusetts, and the redirection of state efforts to other priorities.

Though interest in restoring salmon to the basin continued, no action was taken for decades. The condition of the river environment continued to deteriorate as a result of widespread pollution and dam construction. By the late 1960s, some tributary dams were removed or washed away and never re-built, and pollution abatement programs were initiated.

Long term cooperative restoration programs became feasible with the passage of the federal Anadromous Fisheries Conservation Act of 1966 (Public Law 89-304) which made funds available for interstate fish restoration programs. The combined effects of all these events set the stage for Atlantic salmon restoration.

The current Atlantic Salmon Restoration Program formally commenced in 1967 when the four basin states, USFWS, and NMFS signed a statement of intent to restore anadromous fish to the Connecticut River. Early stocking was comprised of two-year old smolts of Canadian origin reared in federal trout hatcheries that had recently been converted to salmon production. The first adult salmon return from these hatchery-smolt releases was documented in 1974. Between 1974 and 1977, twelve more salmon returned from the ocean. Penobscot River salmon smolts became available to the Program and were used to stock the river starting in 1976. As a result of this release, 90 adult salmon returned to the river in 1978. Since then, salmon, usually numbering in the hundreds, have returned to the river annually (see Table 4).

Early in the Program, emphasis was given to stocking smolts. The USFS joined the effort in 1979 because of the impact of that agency's land-based holdings on salmon habitat. Shortly thereafter, the USFWS built a large, modern salmon hatchery in Bethel, Vermont, and the CTDEP and MAFW converted trout hatcheries for salmon production. In 1983, hatchery-smolt production shifted from a two-year to a one-year rearing regime in an effort to increase the quantity and quality of smolts. Early experimental stockings of salmon fry into nursery habitat showed the potential for natural, instream rearing of high-quality smolts (referred to as "stream-reared" smolts) which are comparable to wild smolts. Evidence from the Farmington River indicated that stream-reared smolts produced from fry stocking yielded substantially greater adult return rates than hatchery-reared smolts. Production of stream-reared smolts was combined with smolts produced in hatcheries to increase total smolt emigration from the river. A major effort began in 1987 to stock as many fry as were available into appropriate habitat in the basin. Although numbers of fry stocked to date have been inadequate to fully stock all habitat, stream-reared smolts produced from those releases have contributed substantially to adult returns. Stocking totals are shown in Table 5.

Action to provide upstream fish passage on the river began prior to the salmon project when, in 1955, a fishlift was constructed at the dam in Holyoke, Massachusetts, to pass American shad.

The Holyoke facility was expanded in 1975 and 1976 when a second lift, a flume, and a trap were built. Other fishways were built between 1974 and 1987 at the next four upstream dams on the mainstem river, Leesville Dam on the Salmon River, Rainbow Dam on the Farmington River, and later at the DSI Dam on the Westfield River. These fishways allowed returning salmon access to a larger portion of the basin targeted for restoration. Although most salmon are currently captured at the lowermost dams and retained for broodstock, fishways constructed at the upstream dams pass released salmon, and American shad and other species (which migrate upstream by the thousands). Fish passage at dams above Vernon Dam have been built specifically for salmon. A listing of fish passage requirements for Atlantic salmon in the Connecticut River basin is provided in Appendix G.

Downstream passage facilities, designed to safely guide smolts past hydroelectric sites, were not included in fishway construction at the seven originally targeted dams nor were they mandated at most of the other dams in the watershed. As the number of fry stocked in the basin increased during the 1980s, concern grew for the deleterious effect of hydroelectric turbines on outmigrating smolts. Responding to that concern, releases of most hatchery-reared smolts were moved downstream of the lower-most dam. Stream-reared smolts, however, were still forced to pass through turbines at numerous hydroelectric generating stations as they emigrated downstream to the ocean. Efforts to provide downstream fish passage on both mainstem and tributary projects were initiated in the 1980s. In 1990, memoranda of agreement were signed with two major utility companies that operate six mainstem hydroelectric facilities. These agreements established timeframes for downstream passage studies and construction. Efforts to provide effective fish passage at these projects and throughout the basin are ongoing.

Table 4. Documented Adult Atlantic Salmon Returns To The Connecticut River

As of 11/7/97

Year	Documented Returns	Leesville Dam Trap Catch Salmon River	Rainbow Dam Trap Catch Farmington River	DSI Dam Trap Catch Westfield River	Holyoke Dam Trap Catch Connecticut River	Miscellaneous	Documented Angling	Number of Adult Salmon Documented Passing Upstream of the Following Dams: Holyoke (Mile 86)	Turners Falls (Mile 123)	Vernon (Mile 142)	Bellows Falls (Mile 174)	Wilder (Mile 217)	Townshend (West River)
1974	1	—	—	—	1	0	0	0	—	—	—	—	—
1975	3	—	—	—	1	1	1	0	—	—	—	—	—
1976	2	—	—	—	2	0	0	0	—	—	—	—	—
1977	7	—	0	—	2	2	3	0	—	—	—	—	—
1978	90	—	56	—	23	10	1	0	—	—	—	—	—
1979	58	—	32	—	19	5	2	0	—	—	—	—	—
1980	175	1	26	—	126	18	4	0	1	—	—	—	—
1981	529	118	62	—	319	17	13	0	9	8	—	—	—
1982	70	11	41	—	11	5	2	0	0	0	—	—	—
1983	39	0	14	—	25	0	0	0	0	0	—	—	—
1984	92	11	6	—	66	4	5	0	0	0	—	—	—
1985	310	5	9	—	285	7	4	5	5	4	2	—	—
1986	318	12	39	—	260	5	2	13	10	4	2	—	—
1987	353	10	126	—	208	9	0	18	13	10	7	3	—
1988	95	5	14	—	72	4	0	7	7	5	3	2	—
1989	109	3	24	—	80	2	0	8	2	0	—	—	—
1990	263	36	37	—	188	2	0	18	16	10	5	1	—
1991	203	11	33	—	152	7	0	15	4	6	3	1	—
1992	490	18	97	2	370	3	0	36	14	13	4	1	—
1993	198	0	14	10	169	5	0	17	8	7	0	—	1
1994	326	12	42	7	262	3	0	25	5	8	3	1	1
1995	188	7	22	6	151	2	0	14	4	5	0	—	0
1996	260	4	29	21	202	3	1	18	3	9	3	*	1
1997	199	3	60	39	96	1	0	9	2	4	0	—	0
TOTAL	4378	267	783	85	3090	115	38	203	103	93	32	9	3

Notes:

– Data designated with a dash indicate that trapping facilities and/or upstream passage were not available or operational during that year.
– '96 Wilder operated but not monitored; CRASC closed the mainstem to fishing in '86, all subsequent documented angling was illegal.
– '86 5% sea runs released upstream, '87 to present 10% sea runs released. '96 Turners Falls count is incomplete. IntInterim '97 totals

Table 5. Connecticut River Atlantic Salmon StockingTotals by Year and Lifestage.

Year	Fry	UFry	FFry	1+Parr	1Parr	1+Parr	2Parr	3Parr	4Parr	1Smolt	2Smolt	3Smolt	4Smolt	Total
1967	3,100				1,900									5,000
1968			50,000								5,000			55,000
1969							6,700				10,300	300		17,300
1970	50,000						2,300	300			43,000	4,300		99,900
1971	60,000			15,000	7,800		2,900			5,600	12,400			103,700
1972					2,700		500		1,800	4,600	10,500		2,600	22,700
1973				15,000	1,000		21,100			1,400	31,900			70,400
1974	16,000				9,400		11,600	4,000		10,400	31,300	12,700		95,400
1975	31,900				1,700		16,400			2,800	70,000			122,800
1976	26,600				5,000		24,200			4,000	30,500			90,300
1977	49,500						15,100	300			92,800	6,400		164,100
1978	50,000						36,600				94,300			180,900
1979	24,500	29,000					38,400				145,100			237,000
1980	89,000	196,700					11,500				51,800			349,000
1981	112,500	17,600	38,200	182,650	1,900		3,600			5,300	73,300			435,050
1982	127,600	166,300		9,400	25,100		9,500			28,100	178,700			544,700
1983	24,700	156,700	45,000	115,400	293,800		400			89,100	8,900			734,000
1984	364,200	219,700		178,600	241,200	11,400				312,300				1,327,400
1985	112,700	200,200	109,400	130,500	110,700					255,000				918,500
1986	7,800	79,200	88,900	188,400	267,100					290,500				921,900
1987	227,800	642,900	298,600	383,200	345,200					205,900				2,103,600
1988	100,000	685,000	524,600	72,200	75,200					395,300				1,852,300
1989		622,600	620,800	268,700	76,800					217,700				1,806,600
1990		831,800	514,500	341,300	25,400					476,300				2,189,300
1991		1,007,200	717,400	306,200	33,100					349,700				2,413,600
1992		1,193,300	815,200	313,900	11,500					313,300				2,647,200
1993		3,419,500	727,600	237,100	28,700					382,800				4,795,700
1994		5,104,600	874,400	37,000	2,300	10,600				375,100				6,404,000
1995		6,015,600	802,500	4,500						1,300				6,823,900
1996		5,966,700	708,600	12,400		3,600				11,500				6,702,800
1997		7,769,000	757,600							1,400				8,528,000
Total:	1,477,900	34,323,600	7,693,300	2,811,450	1,567,500	25,600	200,800	4,600	1,800	3,739,400	889,800	23,700	2,600	52,762,050

"Fry" are an unrecorded mix of fed and unfed fry; "UFry" are unfed fry; "FFry" are fed fry to 8/14 of the year of hatching; "0+Parr" are 8/15-12/31 the year of hatching; "1Parr" are 1/1-8/14 one year after hatching; 1+Parr are 8/15-12/31 one year after hatching; "2Parr", "3Parr", "4Parr" are two, three, and four years after hatching, respectively, and less than 150 mm in length; "1Smolt", "2Smolt", "3Smolt", and "4Smolt" are one, two, three, and four years after hatching, respectively, and at least 150 mm in length.

Appendix E. Narrative Descriptions of Goals, Objectives, and Strategies.

GOAL 1. MANAGE ATLANTIC SALMON PRODUCTION TO PRODUCE SEA-RUN ATLANTIC SALMON RETURNS.

When the Restoration Program was initiated in 1967, there were no Atlantic salmon in the Connecticut River. Salmon restoration activities depended on bringing stocks into the system from other rivers. The first eggs were imported from salmon in Canadian rivers and later from salmon in the Penobscot River in Maine. As the numbers of adults returning to the Connecticut River increased, the number of eggs required from outside sources decreased. Maine eggs have not been used since 1995. Currently, the Program is managed so that millions of eggs are produced annually without the need for imported eggs. The Commission must continue to successfully manage the resident Atlantic salmon population (eggs, fry, smolts, adults) as outlined in the following objectives and strategies.

Objective 1.A. Produce 15 million Atlantic salmon eggs annually from the Connecticut River strain of fish to fully support the Restoration and Management Program.

It is necessary to develop a new strain of salmon that is well-adapted to the Connecticut River. The development of this strain can be expedited by introducing progeny from fish that have returned to the river. Importing salmon eggs from other geographic areas can be counterproductive to the development of such a strain, unless it is done in a deliberate manner to infuse the existing Connecticut River strain with specific traits.

Because there is currently no significant natural reproduction of salmon occurring in the Connecticut River watershed, modern fish culture techniques must continue to be employed to support the Connecticut River salmon population. Approximately 15 million eggs must be produced, annually, by fish culture facilities in order to achieve Program goals. A great deal of coordination among cooperators is needed to reach the 15 million egg target. The tasks of rearing fish, producing, and incubating eggs are complicated by the fact that some facilities are particularly suited for only specific types of broodstock. The Commission must ensure that all available facilities are used in a way that provides maximum benefit to the Program.

There are three types of broodstock that provide eggs to the Connecticut River Program: sea-run broodstock (adult salmon that are spawned the same year that they return to the river), kelts (sea runs that are retained and spawned again, after their return year), and domestics (progeny from sea runs that are raised to maturity in hatcheries). Sea runs are the best genetic source for eggs, however, because their numbers are limited, they do not provide enough eggs to meet Program goals. Eggs from kelts carry important genetic identity and are used to supplement sea-run egg production. Domestic broodstock eggs are used to supplement sea-run and kelt egg production. Domestic eggs can be less ideal because artificial selection in the hatcheries can affect their genetic identity. However, the use of only the first generation of sea-run progeny for domestic broodstock production helps to increase the genetic value of domestic eggs.

Producing eggs from any type of Atlantic salmon broodstock has facility limitations. Facility managers must continue to work closely with fish health professionals to manage for fish health in cultural practices. This includes the use of effective preventive and therapeutic drugs and chemicals to combat diseases, when needed. Cooperation with experts regarding fish health will maximize the survival of eggs, fry, and parr.

Another facility limitation in egg production is that the work load can be enormous at critical times of the year (such as spawning time). Effective coordination among Commission member agencies and assistance from volunteers are essential if all of the egg production is to be accomplished. The facilities currently employed in the program are listed in Table 6.

Table 6. State and Federal Facilities Contributing Atlantic Salmon Eggs and Fry to the Connecticut River Program.

Facility	Maintained Egg Source	Released Fry
Berkshire National Fish Hatchery[1] (BNFH)	—	—
Hogback Dam Incubation Facility (HDIF)	—	Unfed
Kensington State Salmon Hatchery (KSSH)	Domestic	Fed
North Attleboro National Fish Hatchery (NANFH)	Kelt	—
Pittsford National Fish Hatchery (PNFH)	—	Unfed
Richard Cronin National Salmon Station (RCNSS)	Sea Run, Kelt, Domestic	—
Roger Reed State Fish Hatchery (RRSFH)	Domestic	Fed, Unfed
Roxbury State Fish Hatchery (RSFH)	Domestic	Fed, Unfed
Warren State Fish Hatchery (WSFH)	—	Unfed
White River National Fish Hatchery (WRNFH)	Domestic	Unfed
Whittemore Salmon Station (WSS)	Sea Run, Kelt	—

[1] Hatchery placed in caretaker status in 1994.

Objective 1.B. Produce and stock ten million fry annually.

Before 1987, fry releases, a major component of the 1982 Strategic Plan, were limited due to chronic egg shortages. Over time, additional egg production capabilities allowed the Program managers to increase the production and release of salmon fry. In 1987, about 1.2 million fry were released into the watershed. Since then, releases have increased steadily, with close to 8.5 million fry stocked in 1997.

Full implementation of the fry stocking plan requires the stocking of all appropriate habitat in the

Connecticut River basin. Determining which habitat is appropriate and how much of it can be stocked is based on criteria such as the availability of habitat inventory information, the production potential of the habitat, and the amount of available fry. Areas are prioritized based on the quantity and quality of rearing habitat, the ability of the appropriate agency to stock the fry, the timing and availability of fry, and the timing of suitable stream conditions. This planning process is hampered by incomplete habitat inventories in certain tributary drainages. Efforts to obtain needed data are ongoing, but are limited by funds and available staff time.

Current estimates indicate that at least ten million fry are needed to stock available habitat at light to moderate densities. In order to stock this many fry, 15 million eggs must be produced then incubated. Whereas the Program has the ability to produce 15 million eggs, it does not have enough facilities to incubate them. More incubation space is necessary if this objective is to be fully realized. The next challenge is physically distributing the 10 million fry into the streams of the basin. The logistical aspect of coordinating fry stocking is very complex, because large numbers of volunteers from local communities are needed. To date, over 500 volunteers per year have successfully stocked fry. As the total annual number of fry approaches ten million, more volunteers in more towns will be needed, requiring even more coordination.

Objective 1.C. Produce and stock a minimum of 100,000 hatchery smolts annually.

Most of the initial effort of the Program was devoted to the production and release of smolts, which provide a quick return of adults to the river. During the late 1980s and early 1990s, smolt production at the White River National Fish Hatchery (WRNFH) reached relatively stable levels and smolt quality improved significantly. In 1992, the WRNFH also initiated a domestic broodstock program designed to meet the egg needs of the expanding fry stocking program. However, potential for high losses to disease during high water events combined with budget constraints has precluded the use of the WRNFH for both smolt production and domestic broodstock production. The Commission placed a higher priority on the domestic broodstock program and, in 1994, the smolt program was eliminated. As a result of the Commission's decision, hatchery smolts have not been stocked since 1994. Adult returns will result exclusively from fry stocking beginning in 1997, until two years after smolt stocking resumes.

The Commission has been actively searching for opportunities to resume smolt production. Smolt releases would provide an important buffer against a potential, natural catastrophic event that might severely affect the fry program. A release of about 100,000 smolts annually would provide sufficient numbers of adult returns to ensure genetic integrity of the next generation of eggs even in the absence of any adult returns from fry-stocked fish. This estimate is based on the assumption that these fish would experience return rates typical of those experienced in the past.

Furthermore, there is an annual need for smolts to be used in research and facility evaluation. It is difficult to capture stream-reared smolts (produced by fry stocking), which means that adequate numbers are often unavailable. The production of 100,000 hatchery-reared smolts will meet most high-priority research needs, in addition to enhancing adult returns.

When smolt production is resumed, it will be important to use smolts to the best advantage of the program. First, great effort must be expended to ensure they are of the highest quality possible. Hatchery workers must coordinate their activities with other experts regarding the physical condition, behavioral conditioning, and the health of the fish. Once produced, the smolts must be marked and released in a manner that will enhance survival and maximize the information that can be gained from the release. The Commission must consider all of these relevant factors and develop a smolt stocking plan when smolt releases are utilized in the future.

Objective 1.D. Maintain and, when possible, enhance existing genetic variability in the Connecticut River Atlantic salmon population.

Thousands of years of natural selection ensure that North American Atlantic salmon stocks are well-adapted to the river systems in which they live. Even if the river ecosystem changes over time, salmon respond very quickly, often adapting to the changes genetically. If even a few of the Connecticut's native salmon survived today, the process of producing a run of thousands of salmon would be much easier as a result of this genetic specificity. However, the Connecticut stock has been extinct for approximately 200 years. Managers must now develop a new Connecticut River stock without the benefit of having thousands of years to do so.

When the Program began in the 1960s, there was no universally accepted procedure for restoring salmon stocks. In fact, early stockings and matings were not well documented, so it is uncertain which imported stocks are represented in the current Connecticut River stock of salmon. Nonetheless, the stocked salmon return to the river. The Program can, therefore, be considered successful; additional stock introductions are now considered to be less desirable. The challenge to the Commission is to preserve the existing stock, improving it if necessary with imported stocks, to ensure that salmon are able to successfully continue their natural adaptation process in the Connecticut River.

When attempting to breed a wild species in captivity, certain deleterious genetic impacts may result, including: inbreeding depression, outbreeding depression, low effective breeding numbers, and genetic bottlenecks. These impacts can result in animal populations which are unfit to survive in the wild. As a result, the Program must work to eliminate activities that have potentially negative genetic impacts. Program biologists have consulted with fish geneticists and designed a breeding and management protocol to guard against these genetic problems. Features include: using all returning adults for breeding, maximizing the number of parents, using only sea-run progeny for domestic broodstock, and maximizing fry stocking. In addition to an effective management protocol, the salmon used in the Restoration Program must possess suitable genetic traits to successfully adapt to the Connecticut River. The Commission should periodically review and monitor the broodstock management protocol and its implementation to ensure that it is achieving its objectives.

The field of conservation biology has expanded enormously within the last decade, particularly advancements in the understanding of genetics and the development of genetic analysis methodologies (such as identification of DNA microsatellites). The intense interest in Atlantic salmon due to the growing aquaculture industry and the possibility of some Maine stocks being listed under the Endangered Species Act have also contributed to the rapidly expanding knowledge of Atlantic salmon genetics. This has begun to benefit the Connecticut River Program and will continue to do so in the future. It is important that the Commission continues to seek the best genetic advice from around the world to guide the development of a new Connecticut River stock of Atlantic salmon.

Goal 2. Enhance and Maintain the Quantity, Quality and Accessibility of Salmon Habitat Necessary to Support Re-Established Spawning Populations.

Dams constructed on the mainstem Connecticut River and its tributaries were largely responsible for the extirpation of salmon in the basin. Dams continue to interfere with both upstream and downstream salmon migration. Human activities, including industrial, residential and agricultural development, have also had a pronounced impact on the quantity and quality of Atlantic salmon habitat throughout the basin. Salmon habitat has been destroyed by inundation behind dams, water diversion, channelization, sedimentation, loss of riparian cover and water pollution.

One of the first fishery management actions undertaken in the Restoration Program was to inventory suitable salmon habitat throughout the basin. This effort has been refined over time to provide a more precise accounting of habitat availability. Because a significant amount of habitat has already been permanently lost, protection of remaining habitat from pollution, flow diversion and other deleterious impacts is critical to the success of the Restoration Program. In addition, opportunities exist to increase available salmon habitat by implementing habitat enhancement or restoration measures. Lack of public awareness of the importance of habitat to salmon restoration is also an obstacle to habitat protection and restoration.

Another important initial step in the Restoration Program was identification of upriver fish passage needs in order to provide returning adults with access to spawning habitat and to facilitate adult capture for hatchery production purposes. When the Restoration Program began, virtually all salmon spawning and rearing habitat was inaccessible to returning adults due to numerous impassable barriers on both the mainstem and tributaries. Barriers with hydroelectric projects also presented obstacles to safe and effective downstream migration of salmon smolts. The utilities have played an important role in the process of re-establishing access up and downstream in the basin and, as such, have a unique relationship to the Program.

Objective 2.A. Protect, maintain and restore existing Atlantic salmon habitat in all 38 tributaries.

Participating Commission agencies have conducted detailed habitat surveys on significant portions of the basin and have conservatively estimated the habitat available in the remainder. These habitat surveys also identify the adverse impacts that effect the quantity and quality of salmon habitat, thereby identifying opportunities for habitat enhancement. The current estimated total of identified Atlantic salmon habitat in the Connecticut River Basin is 243,000 habitat units (Appendix B, Table 2), where one habitat unit equals 100 square meters (119.6 square yards) of habitat. Additional habitat is available in tributaries that are not targeted at this time. The total identified habitat may increase and additional rivers may be added as habitat surveys continue in the future.

Fry stocking evaluations have demonstrated that much of the existing habitat is capable of producing Atlantic salmon smolts. Protecting the critical elements of Atlantic salmon habitat (including water quality) should be pursued through state and federal regulatory programs. Adequate river flows are critical to successful spawning, the incubation of eggs, and the rearing of fry and parr. The Commission opposes manipulation of natural river flows detrimental to fisheries management initiatives. Salmon habitat in the basin must also be protected from: adverse conditions associated with diversion for hydropower generation, excessive flows and fluctuations from hydro peaking and storage releases, water supply withdrawals, snow-making withdrawals, and other consumptive or industrial uses. Protection should be pursued through active participation by Commission member agencies in state and federal regulatory processes.

In establishing standard minimum flows, the Commission supports the USFWS guidelines in the "Interim Flow Regional Policy for New England Streamflow Recommendations". This policy establishes flow setting techniques based on drainage area for determining necessary minimum flows for the spring and summer, and for fall and winter spawning and incubation periods. As an alternative, the Commission also supports site specific habitat assessment methods such as the Instream Flow Incremental Methodology. This or other methods should be used to assess habitat impacts of excessively high or low flows and flow fluctuations. The Commission and member agencies should use the output from these assessment methods to develop recommendations that protect and enhance existing habitat where possible.

Over the past 200 years, land management activities, dam construction, and extensive development throughout the Connecticut River basin have left salmon habitat altered or degraded. Efforts to restore and improve the habitat and develop management strategies for protecting riparian area buffer strips should be implemented by Commission member agencies. These efforts should be both encouraged and supported, utilizing the participation of individuals and organizations within the watershed. Evaluation of some of this work is underway and will continue as habitat improvement activities expand. This effort has the potential to enhance stream sections degraded by past activities and increase the production of stream-reared parr and smolts. In addition, the public must be provided with information to help them understand the importance of habitat and to encourage them to act to protect that habitat. Beyond this work, watershed-based management is an important tool to better manage Atlantic salmon and other fish species within the entire Connecticut River basin.

Objective 2.B. Provide adult Atlantic salmon with access to selected upstream spawning habitat in the Connecticut River and 13 identified tributaries.

Many dams throughout the watershed have made historically available habitat inaccessible. It is anticipated that once upstream fish passage is provided at all appropriate sites, approximately 75 percent of the total available habitat will be accessible to spawning adults. The remainder of the available rearing habitat will only produce smolts when stocked with fry.

Areas where a substantial portion of the tributary is targeted for spawning include:

- Ammonoosuc River and tributaries
- Connecticut River mainstem
  (between Gilman Dam and Canaan Dam)
- Deerfield River and tributaries
- Eightmile River and tributaries
- Farmington River and tributaries
  Johns River and tributaries
- Millers River and tributaries
- Nulhegan River and tributaries
- Passumpsic River and tributaries
- Paul Stream and tributaries
- Salmon River and tributaries
- West River and tributaries
- Westfield River and tributaries
- White River and tributaries

Natural spawning is also anticipated in several smaller tributaries and below the first barrier on some larger tributaries.

A substantial portion of spawning or nursery habitat exists upstream from barriers where fish passage or plans are currently lacking. To fully utilize those areas, Commission member agencies must address fish passage concerns using state and federal regulatory authorities at all licensed and permitted dams. Other measures may also be utilized to improve fish passage success such as the manipulation of river flows at dams during key migration periods. The successful resolution of passage issues also requires the transfer of information and the cooperation of dam owners and other river developers.

The first dam on the Connecticut River encountered by returning sea-run adults is the Enfield Dam. This low-head dam is currently passable by salmon and other anadromous species due to breaches that have developed in recent years. The Commission opposes any reconstruction, or raising, of this dam that may modify the current zone of passage. The breaches at Enfield Dam and completion of upstream passage facilities at the next five dams (Holyoke, Turners Falls, Vernon, Bellows Falls, Ryegate and Wilder) now allow salmon to access spawning habitat in portions of the White and West Rivers, as well as lower reaches of other tributaries. Upstream from Wilder, a trap and truck approach is foreseen as an interim measure to allow for the transport of pre-spawning adults to upstream habitat above the next four mainstem dams (McIndoes, Moore, Comerford, and Gilman). Possible alternatives to this approach include standard fish passage facilities at Ryegate and McIndoes and a trap and truck facility at Comerford Dam. Actual needs will be established subsequent to field investigations.

Major Connecticut River tributaries also have fish passage needs. Passage and trapping facilities at Rainbow Dam on the Farmington River, Leesville Dam on the Salmon River and the DSI Dam on the Westfield River and a trap and truck facility at the U.S. Army Corps of Engineers Townshend Dam on the West River are currently in place. Trapping facilities at the Number 2 Station dam on the Deerfield River are expected as part of relicensing proceedings of the Deerfield River Hydroelectric Project. These facilities will provide for passage, or the capture and transport of adults to upstream spawning habitat or to hatcheries.

Upstream passage at dams on tributaries targeted for natural reproduction will be needed when sufficient numbers of salmon have access to these dams. The Commission supports the implementation of upstream passage measures at White River tributary dams following the passage of 50 or more adults at the Bellows Falls fish ladder for two successive years or earlier, if the adults are observed below specific dams. Passage facilities at Ryegate and dams on the Ammonoosuc River will be needed after the passage of 20 or more adults at the Wilder Project for two successive years. Upstream passage or trapping facilities in other tributaries with obstructing dams are not currently scheduled, but will be sought by the Commission when needed based on evaluation of spawning habitat and the status of the restoration. Current upstream fish passage needs for mainstem and tributary dams are presented in Appendix G.

In addition to denying uprunning adult salmon access to spawning habitat, dams, even when fitted with upstream passage facilities, create delays to upstream and downstream migration and contribute to incremental losses of adults (and juveniles). Construction of additional dams or reconstruction of breached dams would be detrimental to the Restoration Program and is opposed by the Commission. The Commission supports reasonable efforts to breach or remove dams that obstruct or impede passage if it is determined that this would provide benefits to the Program.

Objective 2.C. Minimize obstructions to passage, migratory delays and mortality of Atlantic salmon smolts and kelts downstream of areas stocked with fry, parr, smolts or adults.

Safe and effective downstream fish passage is critical to the success of the Restoration Program and at times is limited by existing technology. Mortality, injury, and/or delay to migration of Atlantic salmon smolts associated with hydroelectric projects and non-hydro dams are significant areas of concern to the Restoration Program. Mortality and injury present obvious impacts. Delay is also a concern since the temporal window for safe and effective downstream migration is limited. Smolts that are delayed may: 1) lose the ability to survive the transitional phase to salt water; 2) stop migrating; 3) be subject to passage under lower late-spring flow conditions without necessary spill at hydro dams; 4) be exposed to increased river or estuarine temperatures; or, 5) be exposed to increased risk from predators.

Therefore, passage needs to be provided and evaluated at all projects that have potential to delay or kill smolts or kelts and that lie downstream of areas that are stocked with fry, parr, or adults. Improvements to current passage technology should be encouraged and supported. The expansion of fry stocking to more tributaries and river reaches has resulted in a dramatic increase in the number of projects that need passage facilities. Downstream fish passage status and needs for mainstem and tributary dams are presented in Appendix G.

The Commission and its member agencies have been pursuing downstream passage at hydro and flood control projects throughout the basin. Downstream passage measures are now in place at the Holyoke, Turners Falls, Bellows Falls, Vernon, Wilder and Ryegate Dams. The facilities installed at Wilder and Bellows Falls have been proven effective and the others are being evaluated and modified, as needed. Facilities are also in place at Ryegate. An annual notification letter is issued by the Commission to the utility companies each spring to specify the timing of downstream fish passage operations required at each project for Atlantic salmon, American shad, and river herring. In addition, special studies have been undertaken at the Northfield Mountain Pumped Storage Project to investigate the impacts of the project on salmon smolts and to develop techniques to prevent smolt entrainment, a concern that remains to be resolved.

Efforts to implement downstream passage measures at tributary projects have also been ongoing by Commission member agencies. In 1988, 13 hydro projects in the basin needed downstream passage facilities to protect emigrating salmon smolts. As of 1997, 46 hydro projects need passage facilities. When all rearing habitat is stocked, additional hydro projects will require downstream passage facilities. Downstream passage needs and current status are presented in Appendix G.

As of 1997, final, permanent facilities have been installed at 11 tributary projects. Most others have implemented interim or experimental measures pending further studies and/or construction of permanent facilities. Some still have no facilities in place. Efforts to implement passage through state and federal regulatory processes must, therefore, continue until all fish passage concerns are resolved.

The success and rate of downstream passage is affected by river flow conditions during the migration season. Since the Connecticut River basin is highly regulated by government owned flood control structures and seasonal storage at hydroelectric dams, the implications of seasonal and daily flow regulation from hydropower generation and flood control should be investigated. Providing more natural river flows could increase passage success and decrease emigration time. Manipulating river flows during key migration periods also has the potential to improve passage success. Although not yet pursued, these issues should be investigated further in coordination with dam operators.

Goal 3. Protect Connecticut River Atlantic Salmon from Exploitation.

In 1987, the United States New England Fishery Management Council (NEFMC) formalized domestic protection measures for U.S. salmon stocks through the preparation of a Fishery Management Plan (FMP). The FMP prohibits the possession of Atlantic salmon in waters contiguous to the U.S. Coastal Zone (within 12 miles). Yet, because of their migratory nature, U.S. salmon stocks have continued to be the target of commercial exploitation through foreign intercept fisheries in international waters. The exploitation of U.S. Atlantic salmon stocks continues to occur in oceanic waters because of their highly migratory nature.

Objective 3.A. Support the scientific management of sea-run Atlantic salmon populations.

Resource managers remain concerned with the level of fishing mortality suffered by U.S. salmon stocks in both directed and inadvertent foreign fisheries. Until recently, the largest commercial Atlantic salmon fisheries existed in the near-shore waters of West Greenland and Newfoundland/Labrador, Canada. The exploitation of combined U.S. stocks of salmon in this fishery was estimated at a minimum of 35% to 50%, which equated to the capture of approximately one fish for every one returning to its natal stream. Additionally, characterization of the harvested migrants revealed that the largest proportion of these fish were 1SW, destined to return to home waters the next year as 2SW salmon.

The International Council for the Exploration of the Sea and the North Atlantic Salmon Working Group assessed the marine exploitation rates of tagged salmon of Maine origin taken in the West Greenland and Newfoundland Fishery. Using the abundance of the Maine component of captured Atlantic salmon, the United States Fish and Wildlife Service and the National Marine Fisheries Service developed a theoretical relationship (including natural mortality) for the ratio of returning Maine salmon verses Connecticut, Merrimack and Pawcatuck River returns. Projected returns averaged 2.5 times the observed rate of return for these river systems. Consequently, it was estimated that in the absence of the West Greenland and Labrador fisheries, returns of spawners to U.S. rivers could potentially increase 2.5 fold.

Continued exploitation from commercial harvest will inhibit management efforts to achieve required levels of spawning escapement for restoration of discrete river stocks.
Fortunately, in 1993, the Canadian government agreed to regulatory measures that implemented a five-year closure of the Newfoundland fishery and a license buy-out in both Newfoundland and Labrador. Although commercial salmon fishing still continues in Labrador, the existing catch quota has been reduced in proportion to the number of fishermen accepting the buy-out. As part of this agreement, scientifically-based quotas developed by the North Atlantic Salmon Conservation Organization (NASCO), combined with buy-outs of the quota in some years by private salmon conservation groups, have resulted in a dramatic reduction in the salmon catch in Greenland.

Despite the curtailment of these intercept fisheries, sea-run returns to the Connecticut River have not increased dramatically, as expected. The cause of lower than expected returns is unknown, but several potential contributing factors have been identified. Suggested factors are the capture in non-directed fisheries (by-catch), resumption of limited commercial harvest, the continuation of subsistence fishing, and unfavorable ocean climate conditions that have reduced post-smolt survival and caused changes in maturation rates among U.S. salmon stocks. It is possible that the reduction in commercial exploitation, simultaneous with low marine survival, prevented even lower returns than those actually observed.

Consequently, it is of particular importance that monitoring of remaining harvests (direct and indirect) in Newfoundland/Labrador and West Greenland continue so that we may estimate the rate of exploitation to Connecticut River salmon. This data will provide the U.S. Commissioners of NASCO with information that is necessary to negotiate future marine harvest quotas to achieve desired levels of spawning escapement for restoration purposes.

There is some evidence that Connecticut River salmon are incidentally caught and kept in U.S. coastal waters. This harvest is illegal and should remain so. Monitoring of this incidental by-catch should continue. Some Atlantic salmon are incidentally caught and released in the commercial American shad fishery in the State of Connecticut. By-catch monitoring of incidental catch in this fishery is not conducted scientifically but the catch is known to be limited. The Commission has reviewed the impact of the shad fishery on returning salmon and concluded that it is not a great threat. The effort in this fishery is declining, catch of salmon is believed to be low and fishermen are required to release any salmon caught. Monitoring of the shad fishery should continue, to ensure that the by-catch remains low and that all salmon are released. The Commission does not object to the traditional Connecticut River shad fishery but does oppose any management changes to the fishery which could increase by-catch of salmon.

The Commission supports efforts to make Atlantic salmon a non-commercial species with allowances for recreational fishing, when practical. The Commission will also continue to provide representatives to the U.S. Atlantic Salmon Assessment Committee to ensure that Connecticut River salmon data will be available to the international community for guiding marine harvest management.

Goal 4. Allocate Adult Atlantic Salmon to Maximize Benefits to the Program.

Program managers must decide how to best use adult Atlantic salmon to support the various needs of the Restoration Program. Adult Atlantic salmon, annually available to the Program, include sea-run returns, domestic broodstock, and reconditioned kelts. These fish will be allocated to provide: eggs for the Program, in-river spawning escapement, recreational fishing, and specimens for research. Adults will also be used to increase public awareness and understanding of the Restoration Program. Returning numbers of salmon are not great enough to fully meet all of these needs at the present time, so managers will prioritize fish allocations based on the strategies set forth in this Plan.

Objective 4.A. Allocate adult sea-run salmon to provide eggs for the Program.

At present return levels, most returning sea-run adults are captured for egg production needs, and the rest are released to allow for natural spawning (spawning escapement). As the run size increases, the percent of the run taken for hatchery broodstock purposes will decrease. It is important to have a plan to capture enough broodstock to meet existing hatchery production goals while allowing for natural spawning during the course of the run. The strategies outlined under this objective allow releases to be determined as the run develops so that releases may be increased or decreased as the run occurs, based on the predicted runs size.

Objective 4.B. Allocate adult sea-run salmon for a spawning escapement into the habitat to allow for natural reproduction.

Releasing returning sea-run adults into the wild, for natural spawning purposes, has both costs and benefits. Wild spawning is a primary restoration objective, however, capturing fewer adults for egg production will reduce the production of juveniles from sea-run parents. Presently, ten percent of the adult salmon reaching the Holyoke fishlift are released upstream for this purpose. The rest of the Holyoke sea runs and all other sea-run salmon returning to the fishways on the Salmon, Farmington, and Westfield Rivers are captured for broodstock purposes. As the run size increases, the number of returning adults released to spawn naturally will also increase, based on the schedule outlined in Objective 4.A, or when it is determined that the release of additional fish at a specific location for natural spawning will benefit the Program.

Objective 4.C. Allocate adult Atlantic salmon for research purposes.

It is sometimes necessary to provide adult salmon for research that directly benefits the Restoration Program. This objective outlines strategies regarding the allocation of adult salmon for research purposes.

Objective 4.D. Allocate adult sea-run salmon to support recreational opportunities for the public.

It is important to develop a variety of public recreational opportunities as part of the Restoration Program. Opportunities need to be created to allow the public to view salmon in the wild and in captivity. Existing salmon fisheries, by-products of the Restoration Program, also provide for public recreation. When the sea-run population has reached target levels, sea-run recreational fisheries will also be created. Program managers need to respond to local conditions when managing these fisheries so that they do not adversely affect the overall restoration effort.

Objective 4.E. Allocate post-spawned adult sea-run salmon to the kelt reconditioning program for the provision of eggs to the Program.

Unlike their Pacific counterparts, Atlantic salmon do not always die after spawning. Hatchery managers have developed techniques to recondition sea-run salmon, allowing managers to spawn captive fish for a number of years after their return. A portion of the sea-run salmon will be retained each year for the kelt reconditioning program to produce eggs in following years. This will reduce the number of sea-run fish which must be collected each year to meet hatchery needs.

Objective 4. F. Allocate captive/domestic salmon for the provision of eggs to the Program.

Currently, sea-run salmon and kelts do not provide enough eggs for the Program. Therefore, a domestic salmon production program has been developed to provide more eggs. This program will be continued into the future to meet projected egg needs. However, the domestic program will be the first eggs source program to be reduced or eliminated as sea-run returns increase in number.

Objective 4.G. Permit additional uses of kelt and captive/domestic broodstock once the fish have fulfilled their original purposes.

The Commission has established an hierarchy of priority uses for salmon broodstock and it will also establish criteria for uses within these priorities. The priorities are: highest priority will be given to uses that meet the direct needs of the Restoration Program within the basin; second highest priority will be given to uses that assist the cooperating agencies with restoration efforts in other basins within the four basin states; third priority will be given to uses that accomplish other fishery goals held by the cooperating agencies which are directly linked to and benefit the Connecticut River Restoration Program; lowest priority will be given to uses by other restoration programs that are not directly linked or do not benefit the Restoration Program. The Commission will establish criteria that define what constitutes a benefit to the Program and will hold cooperators responsible for demonstrating that those benefits are realized through periodic reviews.

Goal 5. Assess Effectiveness of Program by Conducting Monitoring, Evaluation and Research and Implement Changes When Appropriate.

The strategies utilized in the Restoration Program must be evaluated to determine if they are effective steps in bringing salmon back to the Connecticut River. Assessments and evaluations must be undertaken to address both short-term and long-term issues facing the Program. These activities will include research and monitoring projects by cooperators, other agencies, universities, private companies, and non-governmental organizations.

Objective 5.A. Conduct monitoring, evaluation, and research to improve effectiveness of the Program.

As the Program has expanded, the need for monitoring, evaluation, and research to improve Program effectiveness in various areas has increased in importance. Protection and restoration of habitat necessitates habitat assessment. Population dynamics and smolt survival data are critical to sound decision making in fisheries management. Genetics information and fish health monitoring are both important in broodstock management and hatchery production. Evaluation in these and other areas is time consuming and sometimes costly, but also key to improving returns and other Program successes.

Monitoring of sea-run returns is conducted primarily at fish passage facilities on both the mainstem and lower basin tributaries. Salmon are enumerated and most are captured at traps on four fishways: Holyoke Dam on the Connecticut River, Leesville Dam on the Salmon River, Rainbow Dam on the Farmington River, and DSI/West Springfield Dam on the Westfield River. The majority of these fish are transported to hatcheries for artificial spawning in the fall. All captured fish are measured for length and weighed, and scale samples are taken to determine age, growth and origin information. The majority of adult returns to the Connecticut River consist of two sea winter fish, with an occasional one or three sea winter fish. Runs in past years were primarily adults released as hatchery produced smolts. Over time, an increasing percentage of returning adults were of fry stocked origin. Ninety-nine percent of the 1997 run was of fry origin. Since the smolt program was curtailed, no future smolt-origin returns are expected until two years after smolt stocking resumes.

Once fish passage facilities are constructed, it is necessary to monitor their effectiveness to assure they function as designed. The monitoring may include two components: a formal evaluation upon project completion, and continued monitoring to assess passage efficiency under varied river and operating conditions. Upstream passage is already in place at five mainstem dams and four tributary dams. Currently, eight mainstem hydroelectric projects have completed or are in the process of taking measures to provide safe downstream passage. In addition, many smaller hydroelectric projects on tributaries have also constructed downstream fish passage facilities and utilized modifications or have provided operational changes to facilitate downstream passage.

Studies have shown that competition is minimal between existing fisheries (trout) and stocked salmon. Though additional research may be warranted, it is important to note that native species in the basin have been greatly altered by human activities. The only two original salmonid species are Atlantic salmon and brook trout. All other salmonids have been introduced and are not native to the Connecticut River.

Juvenile instream, production is annually monitored by fall sampling of juvenile salmon by electrofishing at established index sites basin-wide. Index site data provides information on year-class survival, growth, and pre-smolt production. This work enables managers to adjust fry stocking densities to optimize smolt production. It also helps provide an indication of the number of smolts produced in the streams. Combining index site data with habitat assessment and monitoring information helps managers adjust fry stocking strategies.

Past evaluation of the hatchery smolt stocking program consisted primarily of assessing physical and fish health parameters at hatcheries. Additionally, adult return rates have been monitored. These assessments are important. They have shown that hatchery smolts shorter than about seven inches in length return at a much lower rate than longer fish. Eroded fins and disease are also known to reduce return rates. In recent years there has been an increase in physiological studies of hatchery smolts to determine if fish physiology can be manipulated to improve smolt survival rates. When hatchery smolt production is resumed, a priority action, these evaluation and monitoring activities will likewise be resumed.

Evaluation of the performance of salmon during their growth and development in both freshwater and marine environments is vital to the effective management of the Restoration Program. Most hatchery smolts stocked from 1982 to 1994 were marked with coded-wire tags (CWTs). This tagging allowed monitoring of the interception of Connecticut River origin salmon in the high seas fisheries (see Objective 3.A.). In addition, CWT data provided information on release location, time of release, and other variables that enabled evaluation of the smolt stocking program. Future smolt releases should be evaluated similarly through the use of CWTs or other available marks.

Because fry are too small for CWTs and other conventional marking methods, the shift in Program emphasis from smolt to fry releases requires new evaluation techniques. Evaluation techniques are needed that allow managers to distinguish tributary of origin for both fry-stocked smolts and fry-stocked returning adult salmon.

Comprehensive estimates of the extent and timing of the annual smolt emigration should be completed each year to provide managers with information on timing of migration, basin-wide smolt production estimates for calculating return rates, stocking effectiveness, and tributary production. The recent completion and use of fish sampling stations at mainstem and tributary fish passage facilities also provide critical data that had been lacking until the 1990s.

The factors that affect the survival of salmon during the post-smolt/early marine stage are not yet well understood. Researchers have deduced that this life stage is critical for determining future adult returns of U.S. stocks. Potential factors affecting survival include predation, migration timing, and environmental conditions. It is important to identify the sources of mortality so that concerns can be appropriately addressed whenever possible.

Recent research has shown statistical correlations between U.S. adult returns and ocean temperatures. Reduced ocean temperatures in the feeding grounds off Greenland seem to result in diminished adult returns to U.S. coastal waters. More information needs to be gathered and analyzed to further refine and identify parameters that influence marine survival of salmon stocks in order to more fully understand fluctuating return rates.

Objective 5.B. Identify information gaps, problems and management issues.

The Connecticut River Atlantic Salmon Restoration Program is the first of its kind in the world, owing to the watershed's unique characteristics and size. Many restoration methodologies have been developed and/or improved through research as the Program evolved in disciplines including fish culture and fish passage.

Nutritional requirements of Atlantic salmon, for example, were unknown early in the Program's history. Managers and researchers worked together to develop diets that resolved identified deficiencies. Fish passage and fish health management have also been the focus of considerable effort, leading to improved habitat accessibility and the ability to manage captive life stages. Nevertheless, many aspects of Atlantic salmon life history and management still remain poorly understood, necessitating continued study and research to ensure further Program success. The Commission must ensure that research needs are communicated to researchers and that adequate support is provided to address priority research needs in a timely manner.

In the past, the Commission identified Program research needs through the Commission, the Technical Committee, the agencies, and the U.S. Atlantic Salmon Assessment Committee. This process was most effective in resolving concerns directly at the manager to researcher level. Beyond that level, needs and resulting research have been less productive. Moreover, limited communication has resulted in misunderstandings and duplication of effort. Effectiveness can be improved by increased communication, enhanced by a formal, annual process for identifying needs and reviewing research results.

Commission and Technical Committee members as well as other agency staff need to be regularly informed of the results of research projects. In 1997, a special Technical Meeting was held that was devoted solely to presentations on current or recently completed research projects. This should become an annual event with more opportunity for discussion of the projects and future research.

Past prioritization of research needs has been done primarily through the U.S. Atlantic Salmon Assessment Committee. This prioritization has been helpful, but often research is not directed at the highest Program priorities for a variety of reasons. The Commission should develop a process to communicate specific priority needs to researchers to ensure that research needs and priorities are clearly understood by researchers.

Objective 5.C. Support priority research projects to address identified information gaps and research needs.

Research projects can be facilitated by the Commission in a variety of ways. The Commission can provide researchers with Atlantic salmon at various life stages and access to Program facilities. Additionally, technical advice from Program staff can be a valuable contribution to research projects.

Traditionally, the Commission has honored Atlantic salmon requests from researchers, agencies and consultants. Use of eggs and fish in research and management work has helped to improve fish passage efficiency, fish health protocols, and other critical efforts. The Commission and its members should provide up to 1% of the eggs and fry produced, and other life stages as available, to support endorsed research and management work when production is excess to Program needs. In addition, access to wild fish should be facilitated to support endorsed research and management work when wild fish are available, essential to the study, and when this will not negatively impact the Restoration Program.

Priority research projects often require access to fish culture facilities for research involving hatchery production or simply to house salmon being used for research. Fish passage facilities provide research opportunities on the fishways themselves and serve as fish collection points. The Commission should continue to provide researchers with access to its facilities where appropriate and encourage the continued cooperation of fish passage facility owners in allowing access to researchers.

Agency staff have provided their technical expertise to researchers by reviewing and commenting on research proposals, serving on graduate student committees, facilitating state permitting requirements, and providing technical knowledge to researchers. These contributions should continue to insure the highest possible quality of research to benefit the Program.

To date, the Commission has not solicited or expended funds on research, though it has authority to do so. Direct Commission funding would help to insure that high priority research would be conducted. The Commission and its members should solicit funding for the Commission to expend on priority research projects.

Though the Commission reviews much of the Atlantic salmon research conducted in the basin and frequently provides suggestions for improving study plans in order to ensure that identified Program needs will be met, there is no formal process in place to ensure that this will occur. The Commission and its members should develop a standardized process wherein proposals are reviewed annually against established criteria for endorsement and then endorsed by the

Commission. These endorsements could be expected to lend credibility to the proposed project thereby enhancing prospects for outside funding. The process could also be utilized for identifying and selecting priority projects for direct funding from the Commission.

Goal 6. Create and Maintain a Public That Understands and Supports Salmon Restoration Efforts and Participates Whenever Possible.

All member agencies of the Connecticut River Atlantic Salmon Commission currently conduct outreach activities designed to promote the Atlantic Salmon Restoration Program. In the past, outreach activities have typically been conducted on a piecemeal basis with limited coordination between agencies. Moreover, the activities have rarely been evaluated or designed specifically to accomplish Program objectives. This is of particular concern at a time when there is an increased need to utilize resources more effectively within the Program.

Outreach can be an effective tool in accomplishing defined management objectives. Outreach objectives, when clearly linked to Program objectives, focus efforts and enhance the potential for accomplishing Program goals, thus enhancing the value of outreach to the Program. Conducting strategic, coordinated outreach is key to ensuring that outreach efforts culminate in tangible, beneficial results.

Objective 6.A. Learn more about the people who can affect or who are affected by the Program.

The USFWS commissioned a survey, *The Economic Benefits of the Restoration of Atlantic Salmon to New England Rivers,* in 1987. The survey assessed public opinion on whether to continue the Program. The results indicated that New Englanders had a "strong and widespread interest" in salmon restoration. Their relative value for the Program was estimated to exceed the cost of the Program, indicating that restoration programs should be continued. The results of this survey were assumed to reflect sentiments in the Connecticut River watershed, but little effort has ever been made to corroborate this conclusion. A more current and local measure of public sentiment toward the Program is needed. It would serve to assist cooperators with outreach efforts if it was designed to identify the benefits and concerns expressed by specific groups. Such information would guide cooperators to supporters as well as to those with important issues regarding the Program. The information gained through this survey would enable cooperators to better and more directly address concerns through appropriate media, language, or activities. It would also help cooperators to more clearly realize the public value of the Program and emphasize these aspects in public outreach.

People have different expectations of the Restoration Program. The difference between their expectations and actual Program accomplishments determines how they perceive the success of the Program. It is therefore of great importance that cooperators understand public perception of the Program. Information about public perceptions, as measured in surveys, can be used to help cooperators realign public perception to fit the actual reality of what the Program will accomplish. Successful realignment of public expectations will measurably improve public perception and satisfaction with the Program.

It is not enough to know what public perceptions of the Program are, it is also important that cooperators identify and understand people who can affect or who are affected both positively and negatively by the Program. This understanding is critical if cooperators are to fully benefit from supporters and alleviate concerns and negative perceptions of those who are less supportive of the Program.

Once there is an understanding of who is affected by the Program, how those people feel about the Program and why they feel that way, it will be easier for cooperators to develop and deliver clear and effective messages. Delivery of those messages can then be coordinated to ensure that specific concerns are addressed and benefits realized. Cooperators can identify whether the messages were effective by surveying public opinions.

Objective 6.B. Promote public interest and involvement in the Restoration Program.

Public outreach conducted by the Commission and its member agencies has traditionally been educational, directed at both adults and students through speaking engagements, printed materials, interviews and classroom presentations. While individual efforts have been strong, the overall effect of this outreach for the Program as a whole has been limited, particularly in the northern reaches of the watershed where there is less agency presence. Future efforts should be strategically focused to effectively utilize available staff time, ensure consistent and accurate information transfers, coordinate efforts, create realistic public expectations, and ensure that Program objectives for public involvement are accomplished.

Coordination of outreach efforts in the multi-state/agency Program will benefit from the development of a clear, concise plan detailing steps for cooperators to take in order to maintain and develop the level of public interest and involvement required to accomplish restoration activities.

One of the current ways in which cooperators use outreach to accomplish Program goals is by eliciting volunteer help. Agencies have become dependent upon volunteer labor to accomplish fry stocking and egg production objectives due to expansion of the Program coupled with static or reduced agency staffing and funding levels. It is now essential that the Commission and its members, through coordinated efforts, ensure that volunteers will be available to accomplish important restoration activities throughout the basin.

Public expectations and perceptions of the Program are dependent upon public access and understanding of Program information and issues. It is of great importance that accurate information is available and that it be delivered in forms that are appropriate to specific publics. Effort must be made to tailor outreach to specific groups to maximize on their individual interests. Specific efforts should be made to reach those who can greatly affect the Program or who are greatly affected by the Program. Prioritizing efforts strategically will permit cooperators to choose how to spend limited time on outreach. Integrating common messages and themes in public presentations will help to ensure that these people are particularly aware of Program needs, successes, critical issues and concerns. This awareness should help to provide the motivation required to develop sustained interest and support for the Program.

Program effectiveness can be maximized if cooperators continue to support and develop partnerships and alliances with key private sector interests in the watershed, when common or complimentary objectives are shared. An example of this is in the classroom, where Program related curricula can be franchised to partners for presentation to increase public awareness, link the studies to Program concerns, and develop Program-specific support from constituencies. The opportunities for partnership are, however, endless and cooperators should work to develop innovative ways to reach out to common constituencies with new partners.

Objective 6.C. Include the public in the planning and the decision process to restore Atlantic salmon.

Public involvement in the decision-making process of the Program has been ensured by the appointment of Public Sector Commissioners from each of the four basin states to the Commission. Additionally, meetings of the Commission and its Technical Committee are open to the public from whom comments and questions are routinely addressed. Involvement at this level is important to ensure that public interests are considered in Commission business.

The Commission and its members should make efforts to continue to involve the public through traditional as well as innovative processes too ensure that the Program is adequately addressing public concerns and input.

Goal 7. Improve Administration and Operations Within the Program.

Complexities in the Program to restore Atlantic salmon to the Connecticut River are sometimes as much administrative as biological. Managing and coordinating the activities of seven state and federal agencies while addressing the concerns and interests of private industry, individuals and organizations is a challenging but important task faced by the Connecticut River Atlantic Salmon Commission. Traditionally, this has been successfully accomplished through the Commission, the Technical Committee, various sub-committees, and the Connecticut River Coordinator, employed by the U.S. Fish and Wildlife Service.

Objective 7.A. Enhance the Commission's ability to manage the Restoration Program.

Increased responsibilities, diminished staffs, and decreased budgets, coupled with lack of related Program precedents and rapidly changing technologies have sometimes strained Commission and agency capabilities and responsiveness with respect to Program administration and operations. Ideally, administrative functions are limited to those absolutely required to accomplish Program objectives, thereby maximizing time, energy and efforts available for on-the-ground restoration activities.

Clarifying Program focus and direction is of critical importance to Program cooperators, further necessitating completion and routine revision of both Strategic and Operational Plans. Quality planning documents will assist cooperators in developing a shared vision and in coordinating ongoing restoration activities.

The Commission can support Program needs by using its authorities to endorse and recommend activities designed to accomplish documented Program goals and objectives. It has additional authority to raise and expend funds for the same purposes. The Commission's fiscal capability is an important though rarely utilized tool that could alleviate new and continued funding concerns for monitoring, evaluation and research. This power will be especially valuable if further developed to assist agency cooperators in stretching limited Program funding to accomplish restoration activities.

It has sometimes been difficult to incorporate new technologies and research quickly and consistently. Strategic and Operational Plan revisions will help to provide needed guidelines and will also advance the Program through a more systematic application of current and ongoing research and technologies.

The Commission can help to ensure that the Program workload is fairly distributed and designed to accomplish Program goals through appropriate delegation of duties at the Technical Committee and sub-committee levels. This will not only result in equitable distribution of work but will also facilitate the inclusion of expert opinion and advice from outside sources.

Objective 7.B. Provide for centralized interagency coordination and information management.

The day-to-day management and administration of this multi-state/agency Restoration Program has been conducted primarily by the Connecticut River Coordinator's Office under the guidance of the Commission and with support from all of the Program cooperators. With such a diverse assemblage of agencies, groups and individuals working toward the common goal of bringing back Connecticut River populations of Atlantic salmon, effectiveness is enhanced by good coordination and communication. Strong Program accountability, availability of accurate information, commitment to public outreach and Program advocacy are all cornerstones of good communication. Focus on these priorities is best maintained by a single source, usually the Coordinator. When focus and accountability have been less centralized, Program effectiveness in this regard has been diminished.

The USFWS, through base-budget allocations, and cooperating states, through Dingle-Johnson Fisheries Restoration funds, have provided funding in support of central Program coordination. This type of multi-agency funding promotes an interest in and need for coordination activities. Activities and responsibilities in the Coordinator's Office have grown over the years to include coordination, data management, Program outreach and advocacy, and technical assistance. All of these activities are important both to the Program, ensuring that the public understands that the Program is viable and valuable. Over the years, operation costs and increased responsibilities have increased the cost of coordination. The USFWS has sometimes had difficulty meeting these increased obligations because of agency downsizing and budget short-falls. The states have also had difficulty increasing funding for coordination. These funding concerns have resulted in staff reductions through this period which have sometimes negatively impacted coordination activities.

The Coordinator's Office serves as a central library for large amounts of current and historic program data and information. Data are collected, maintained and distributed to support Program goals and the needs of four state and three federal agencies. The annual reporting of data to the Coordinator is the responsibility of cooperating agencies and offices. In some cases data collection and reporting have not been fully standardized between agencies and offices, complicating the comparability, evaluation and reporting of information. Other times, reporting delays are experienced. It is important to have a single location where data is managed, in a timely way, for the entire Program to facilitate information dissemination and Program accountability, within and outside of the Program.

Program accountability to date has been limited to the Commission meeting minutes and Strategic Plan, and individual state and federal reporting requirements including Federal Aid Progress Reports, Station Annual Reports, and U.S. Atlantic Salmon Assessment Committee Reports. Few documents have been printed and distributed expressly for the public. Documents designed to target public interest while providing accountability for Program expenditures and activities could help cooperators to maintain and develop support for the Restoration Program. Similarly, advocacy for Program values and public benefits have often been decentralized and reactive rather than proactive, especially in appeals to legislators. More strategic, frequent and routine contacts with decision makers, supporters and opposition will enhance their awareness of Program issues and will likely increase the Program support base.

Public outreach is an activity that has been conducted independently by all Program cooperators. The objective of sharing information is to inform and educate people about the Program so that they may value and support the Program. The public tends to receive Program information enthusiastically. However, consistent messages about the Program are not necessarily delivered because Program cooperators do not always have access to the same information. Additionally, there is no common goal or theme and no clearly defined spokesperson for the Program. Centralizing and coordinating public information dissemination in the Coordinator's Office will help to alleviate these concerns. This will help to improve public perception of the Program while helping to maintain and develop Program constituencies.

Biannual meetings of the Commission have served to keep member agencies aware of Program activities. The public has, at the same time, been able to participate in all of these open meetings. Yet, it is difficult to ensure that agencies, industry, groups and individuals, that can impact or are impacted by the Program, have adequate input to the Commission's decision-making process. Increased communications among and between these groups would likely benefit the Program while benefitting a variety of other public interests.

The Connecticut River Restoration Program has been blessed through the last three decades with a common work ethic focused on bringing salmon back to the river. Finding ways to make it easier for agencies, groups and individuals to work together to restore salmon to the Connecticut River is an important key to Program success. Utilization of Commission authorities and communication through the Coordinator are appropriate steps to continue facilitating such cooperation.

Appendix F. Projected Sea-Run Salmon Returns

Restoration Program activities, to date, have successfully returned Atlantic salmon to the Connecticut River in annual runs that average in the hundreds. This is the first phase of salmon restoration. The second phase will involve activities to increase the rate and number of returning salmon. Though this goal is part of this Plan, it is difficult to estimate the exact amount of increase or to project the exact timing of such increase. A precise projection or estimate is difficult to develop because the size of the run is dependent upon many factors. Past projections that proved inaccurate were based on a variety of factors including historic run size, hatchery production and releases, and projected stream production. Problems with each of these factors affect the accuracy of any projections.

Future estimates, for example, are not safely based on historic run sizes. Loss of native stocks, loss and degradation of salmon habitat, construction of dams, and large-scale exploitation of salmon at sea and in freshwater are factors that may have permanently reduced the potential size of salmon runs in the Connecticut River, with respect to the magnitude of pre-colonial runs.

Additionally, it is difficult to accurately estimate instream smolt production and outmigration survival, complicating interpretation of rates of return for stocked fry. Existing data indicate that adult returns from stocked fry will be more variable than return rates observed in the past for hatchery stocked smolts, due to naturally variable instream mortality. Because rates for fry stocked fish survival are less predictable, projections are less reliable.

Finally, smolt productivity rates in streams in Canada and Europe cannot be used to estimate the levels of expected production in the Connecticut River basin. New England streams are not as pristine as those in Canada or Norway nor are they as biologically productive as those in Spain or the United Kingdom. Connecticut River projections must be based on data collected within the basin. However, Connecticut River data cannot yet be used to predict production rates with a high level of confidence because the amount of data is limited to only a few years.

The number of adult salmon returning to the river is determined by several key factors: the number of smolts leaving the river, the natural mortality of those smolts, and the commercial harvest at sea. Each of these factors is influenced by many other variables. For example, the number of smolts leaving each year depends on the number of fry stocked years earlier, the weather during the subsequent growing seasons, the impact of predation during the seaward migration, the number of smolts killed by hydroelectric turbines, and the river flow during the smolt migration. Even in a native salmon population, all of these environmental factors vary, resulting in naturally fluctuating adult salmon runs from one year to the next, regardless of human influences.

A mathematical model has been developed to provide a very simplified idea of the potential of the Restoration Program. This model uses only two variables: the smolt production of the habitat and the marine survival rate of the smolts. In the Connecticut River basin, the total amount of habitat available for instream salmon smolt production is estimated at 243,000 rearing units.

Average smolt production is estimated to be two smolts per unit. If all available habitat in the basin were fully stocked, multiplying these two figures results in a projected annual smolt run of 486,000. Production naturally varies from year-to-year and between tributaries, so the basin's total smolt output can be expected to vary by at least 25%, or within an annual range of 364,500 to 607,500. The marine survival rate of smolts also varies widely by an estimated range of 0.25% to 2.5%. The lower end of this range has been observed in Connecticut River smolts and the upper end of the range has been observed in other U.S. salmon stocks. Table 7 provides the results of this simple model and displays the wide range of sizes of adult runs that may ultimately be possible in the future. Though it is unlikely the higher return figures will be experienced in the Connecticut River, the upper survival range (2.5%) is included to demonstrate the long-term potential for a river, given the described variables.

Table 7. Potential Adult Salmon Returns Based on Smolt Production at a Range of Smolt Survival Rates, Assuming Fully Stocked Habitat.

Potential Smolt Production with Fully Stocked Habitat	Smolt-to-Adult Survival Rates	
0.25%	2.5%	364,500
911	9,113	486,000
1,215	12,150	607,500
1,519	15,188	

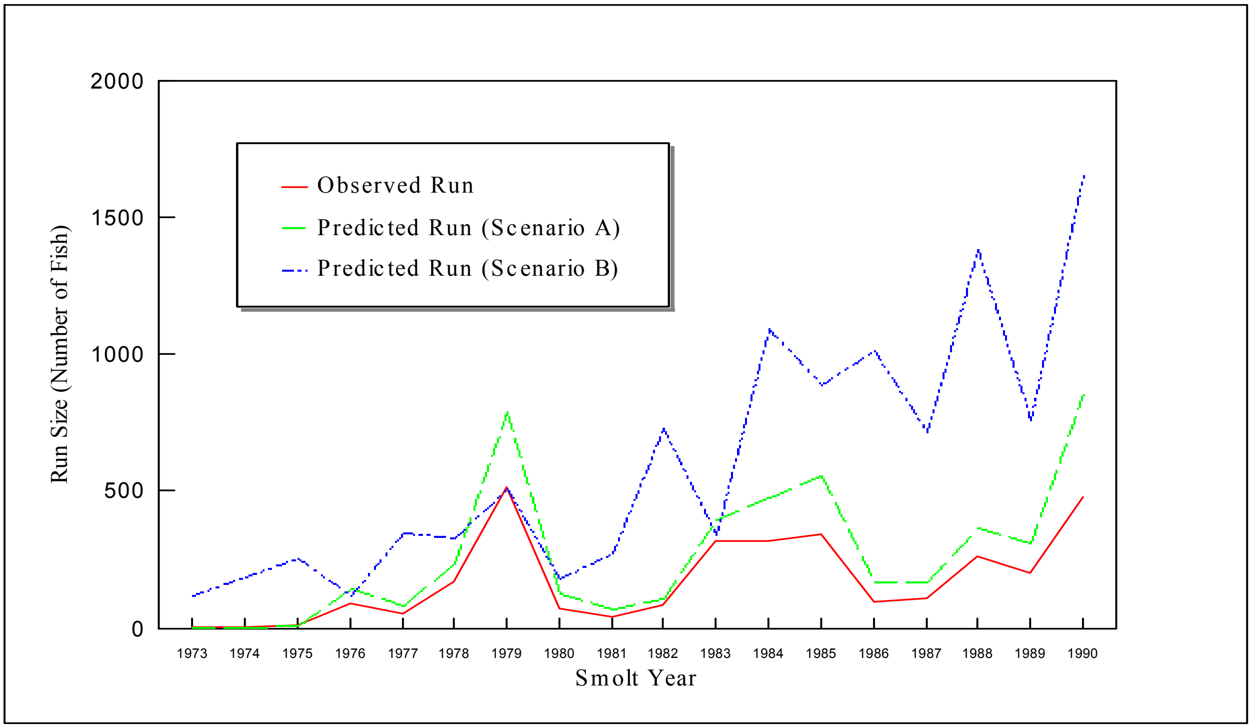
The Restoration Program is described in the Program Summary, section II of this Plan, as a multi-phase Program. Phase I has already established a Connecticut River stock of salmon and a small annual run of adult salmon. Phase II, described in section III, involves the building of the run size from the current average of a several hundred fish per year to over 1,000 fish, the lower range of projected runs in Table 7. If Phase II can be accomplished early in the 2000s, a clearer picture can be obtained about the full potential for the river in Phase III. Phase III will address further increases in returns (which may correspond to the upper range of returns shown in Table 7) as part of full restoration.

There are many uncertainties as to how quickly the current phase of restoration, Phase II, can be accomplished, including: funding levels, hatchery capabilities, downstream bypass performance, changes in climate, and the status of the Greenland fishery. However, there are two major factors that will determine the rate of restoration success.

Since salmon in the Connecticut River can be expected to adapt to the river ecosystem slowly, results will be slow in arriving. The current stock of salmon originated mostly from Penobscot River salmon. As the young salmon are stocked into the Connecticut River basin, natural selection takes over. The poorly adapted fish (in a genetic sense) perish prior to reproducing and their genes are not inherited. The better adapted salmon survive and pass on their genes. Slowly, population traits evolve that are necessary to survival, such as: a well-timed smolt migration, the best average date for adult migration, increased tolerance to warmer water temperatures, and the new development of defense mechanisms against non-native predators, such as rainbow trout, brown trout, largemouth bass, and smallmouth bass. Over time, as the new Connecticut River stock gradually develops, these necessary traits, survival rates in the ocean and production rates in freshwater will increase. Adaptation in salmon is always slow, but occurs at different rates in different tributaries. There are no data with which to predict the rate of adaptation in the Connecticut River because there are no other restoration programs of comparable scale.

Researchers have recently defined what constitutes one parameter of suitable Atlantic salmon habitat in the ocean: water at temperatures between 39 and 46^{o} Fahrenheit. Examination of oceanographic data reveals that the amount of such habitat in the northwest Atlantic Ocean had steadily decreased during the 1980s and 1990s (when the major effort at restoration has taken place). This means that the Restoration Program has been subjected to inhospitable marine conditions throughout much of its history. Analyses of stocking data and survival rates by the National Marine Fisheries Service have concluded that if marine habitat and survival in the northwest Atlantic Ocean had remained at the levels observed during the 1970s, the Restoration Program would most likely have produced adult runs exceeding 1,000 fish for at least four years prior to 1996 (Figure 7). Recent evidence indicates that the condition of marine habitat in the northwest Atlantic Ocean may be cyclic and that minor improvements beginning in 1995 may foreshadow an upturn in the cycle. If the marine climate does indeed improve, better survival rates may be realized in the upcoming years, providing that this is a primary limiting factor to improved return rates.

The increase of fry stocking to all habitat in the basin, combined with improvements in downstream fish passage should result in increased numbers of adult salmon in future years. Stock development through natural selection and improvement in marine habitat conditions should further increase returns. Under these circumstances, adult runs between 900 and 1,500 fish should be achievable in the next 10 to 20 years with higher returns possible. Once Phase II is accomplished, managers will continue working with the population to maximize run size to the full potential of the basin.



Scenario A uses a conservative estimate of extant exploitation of non-maturing stocks under the hypothetical condition of no intercept fishery. Scenario B assumes the same no-fishing condition as Scenario A but is adjusted to reflect the higher range of the 1970s survival rates observed for the Connecticut River.

Figure 4. Observed and retrospectively predicted 2SW runs in the Connecticut River under two scenarios of fishing and survival.

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

River Name [1]	Dam (Name or Owner)	Location (Town, State)	Use(s)	FERC Project Number [2]	Upstream Passage	Downstream Passage	Stock-ing Status [5]
			Need[3]	Functional Status [4]	Need[3]	Functional Status [4]	
Suffield, CT	Industrial (hydro	11577A	NN	NP (breach,	NN	No need/ no hydro	Current
Holyoke, MA	proposed)			1984)			
"		2004A	N		N	I (bypass, 1991)	Current
"	Hydropower	2004 / others	NN	O (fish lifts,	N	O (louver/bypass, 1993)	Current
Turners Falls,	Hydropower, Industrial	1889A	N	1955,1976)	N	I (bypass, 1993)	Current
Northfield, MA	Hydropower	2485A	NN	NP	N	P(testing underway)	Current
Vernon, VT	Pumped Storage	1904A	N	O (two ladders,	N	O (bypass, 1994)	Current
Rockingham, VT	Hydropower	1855A	N	1980)	N	O (bypass, 1995)	Current
Hartford, VT	Hydropower	1892A	N	Not needed -	N	O (spill, 1993)	Current
Ryegate, VT	Hydropower	8011A	D	not barrier	N	O (bypass, 1993)	Current
Barnet, VT	Hydropower	2077A	D	O (ladder,	N	I (spill, 1993)	Current
Barnet, VT	Hydropower	2077B	D	1981)	N	NP	Planned[7]
Littleton, NH	Hydropower	2077C 2392A	D	O (ladder,	N	NP	
Lunenburg, VT	Hydropower		D	1984)	N	NP	Planned[7]
	Hydropower			O (ladder,			Planned[7]
				1987)			
				P			
				NP			
				NP			
				NP			
				NP			
Lyme, CT	Hydropower, Aesthetic	Unlicensed	N	O (fishway, 1998)	P	O (bypass, 1998)	Current
East Haddam, CT	None	None	N	O (fishway,	N	O (spill, 1980)	Current

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

				1980)			
Colchester, CT	None	None	D	NP	N	O (spill, 1980)	Current
Windsor, CT	Hydropower	None	N	O (ladder,	N	O (bypass, 1994)	Current
Avon, CT	None (hydropower	10822A	N	1976)	N	P (with hydro)	Current
Canton, CT	proposed)	10823A	N	P (with hydro)	N	P (with hydro)	Current
Hartland, CT	None (hydropower	4297A	U	P (with hydro)	U	NP	Future
Colebrook, CT	proposed)	None	U	NP	U	NP	Future
	Hydropower			NP			
	Flood Control						
Winchester, CT	Hydropower	Unlicensed	D	NP	N	NP	Current
Winchester, CT	Flood Control	None	NN	NP	N	O (spill, 1980)	Current
W. Springfield	Hydropower	2608A	N	O (ladder&	N	I (1995), O (1996)	Current
Woronoco, MA	Hydropower	2631A	D	trap, 1996)	N	I (1998)	Current
Woronoco, MA	None (hydro off line '93)	unlicensed*	D	NP	NN	No need/no hydro	Current
Huntington, MA	Hydropower	2986A	D	NP	N	O (bypass, 1994)	Current
				NP			
Easthampton, MA	None	None	D	P	D	NP	Planned

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

Northampton,MA	None	None	D	NP	NN	No need/no hydro	Current
Northampton,MA	None	None	D	NP	NN	"	Current
Northampton,MANo	None	None	D	NP	NN	"	Current
rthampton,MA	None	None	D	NP	NN	"	Current
Northampton,MA	None	None	D	NP	NN	"	Current
Northampton,MA	None	None	D	NP	NN	"	Current
Northampton,MA	None	None	D	NP	NN	"	Current
Northampton,MA	None	None	D	NP	NN	"	Current
Williamsburg,MA	None	None	D	NP	NN	"	Current
Williamsburg,MA	None	None	D	NP	NN	"	Current
Williamsburg,MA	None	None	D	NP	NN	"	Current
—	—	—	—	—	—	—	Current
Hatfield, MA	None	None	D	NP	NN	No need/no hydro	Current
Whately, MA	Water supply	None	D	NP	NN	"	Current
Conway, MA	None	None	D	NP	NN	"	Current
Montague, MA	None	11545A	NN	Not needed/breache d	NN	No need/no hydro	Current
Shelburne, MA	Hydropower	2323A	N	P (trap,	N	I(1996),O(1999)	Current
Shelburne, MA	Hydropower	2334A	D	w/trigger)	N	I(1996)O(1999)	Current
Shelburne, MA	Hydropower	2323B	D	NP	N	I(1996),O(1999)	Current
Buckland, MA	Hydropower	2323C	D	NP	N	I(1996),O(1999)	Current
				NP			

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

Greenfield, MA	None	None	D	NP	NN	No need/no hydro	Current
Greenfield, MA	None	None	D	NP	NN	"	Current
Greenfield, MA	None	None	D	NP	NN	"	Current
Greenfield, MA	None	None	D	NP	NN	"	Current
Leyden, MA	None	None	D	NP	NN	"	Current
Guilford, VT	None	None	D	NP	NN	"	Current
Conway, MA	None	None	D	NP	NN	"	Current
Colrain, MA	None	None	D	NP	NN	"	Current
Charlemont, MA	None	None	D	NP	NN	"	Current
Rowe, MA	Hydro	None	D	NP	NN		Current
Bernardston, MA	None	None	D	NP	NN	No need/no hydro	Current
Orange, MA	Hydropower	6096A,B	D	NP	N	NP	
Athol, MA	Hydropower	Unlicensed	D	NP	N	NP	Current
Athol, MA	Hydropower	10163A	D	NP	N	NP	Current
Athol, MA	Hydropower	10163B	D	NP	N	NP	Current
Winchendon, MA	Hydropower	8895A	D	NP	D	NP	Current
Winchendon, MA	Hydropower	8012A	D	NP	D	NP	Future Not Planned

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

Hinsdale, NH	Hydropower	8615A	U	NP	N	O(1998)	Current
Hinsdale, NH	Water Diversion	None	U	NP	NN	NP	Current
Winchester, NH	Hydropower	7791A	U	NP	N	I(1997)	Current
Winchester, NH	Hydropower	8235A	U	NP	N	I(1997)	Current
Winchester, NH	None	8915A*	U	NP	NN	NP	Current
Winchester, NH	None	None	NN	NP (breached	NN	NP (breached ?)	Current
Winchester, NH	Storage	None	U	?)	NN	NP	Current
Swanzey, NH	Storage	None	U	NP	NN	NP	Current
Keene, NH	Storage	None	U	NP	NN	NP	Future
Surry, NH	Flood Control	None	U	NP	NN	NP	Future
Surry, NH	None	None	U	NP	NN	NP (breached ?)	Future
Marlow, NH	Hydropower	3309A	U	NP (breached	NN	NP	Future
Marlow, NH	Storage	None	U	?)	NN	NP	Future
Washington, NH	Storage	None	U	NP	NN	NP	Future
Washington, NH	Storage	None	U	NP	NN	NP	Future
Washington, NH	Storage	None	U	NP	NN	NP	Future
				NP			
				NP			

Keene, NH	Flood Control	None	U	NP	N	NP	Current

Townshend, VT	Flood Control	None	N	O (trap &	N	O (spill, 1992)	Current
Jamaica, VT	Flood Control	8433A*	N	truck, 1993)	N	O (drawdown, 1990)	Current
Londonderry, VT	Fire Protection	None	N	O (trap &	NN	NP	Current
Weston, VT	Light Industrial	None	N	truck, 1993)	NN	NP	Current
				O (trap &			
				truck, 1993)			
				O (trap &			

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

				truck, 1993)			
Alstead, NH	None (natural barrier)	None	U	NP	NN	NP	Current
—	—	—	—	—	—	—	Current
Rockingham, VT	Hydro (not operating)	3131A	D	NP	N	No need-hydro not operating	Current
Springfield, VT	Hydropower	9649A	U	NP	N	O (1999)	Current
Springfield, VT	Hydropower	8014A	U	NP	N	O (bypass, 1995)	Current
Springfield, VT	Hydropower	7888A	U	NP	N	I (bypass, 1995)O(1996)	Current
Springfield, VT	Hydropower	9650A	NN	NP (passable)	N	I (1997)	Current
Springfield, VT	Hydropower	9648A	U	NP	N	O (1999)	Current
Springfield, VT	Flood Control	None	U	NP	N	O(spill, 1995)	Current
Weathersfield VT	None	7932A*	U	NP	NN	No need/no hydro	Current
Weathersfield VT	None	None	U	NP	NN	No need/no hydro	Current
Cavendish, VT	Hydropower	2489A	U	NP	N	I ('95), O('96 - testing)	Current
—	—	—	—	—	—	—	Current
Claremont, NH	Hydropower	10898A	U	NP	N	I (bypass, 1995)	Current
Claremont, NH	None	None	U	NP	NN	No need -no hydro	Current
Claremont, NH	Hydropower	9088A	U	NP	N	O (bypass, 1996)	Current
Claremont, NH	Hydropower	6756A	U	NP	N	I (bypass, 1995)	Current

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

Claremont, NH	None	7049A*	U	NP	NN	No need - no hydro	Current
Claremont, NH	None	None	U	NP	NN	No need - no hydro	Current
Claremont, NH	None	7045A*	U	NP	NN	No need - no hydro	Current
Newport, NH	Hydropower	3320A	U	NP	D	NP	Future
Hartland, VT	Hydropower	2787A	U	NP	D	NP	Future
Hartland, VT	Hydropower / Flood Control	2816A	U	NP	D	NP	Future
Hartland, VT	Hydropower	5313A	U	NP	D	NP	Future
Hartland, VT	Hydropower	5195A	U	NP	D	NP	Future
Taftsville, VT	Hydropower	2490A	U	NP	D	NP	Future
Lebanon, NH	Hydropower	8405A	U	NP	D	NP	Future
Lebanon, NH	Hydropower	9403A	U	NP	D	NP	Future
Lebanon, NH	Storage	None	NN	NN (breached ?)	NN	NN (breached ?)	Future
Royalton, VT	None	None	D	NP	NN	NP	Current
Tunbridge, VT	Hydropower	11090A	D	P	N	P (with hydro)	Current
Bethel, VT	Hydropower	9826A	D	NP	N	P	Current
Randolph, VT	Water Supply	None	U	NP	NN	NP	Current
Thetford, VT	Flood Control	8692A*	D	NP	NN	NP	Current
Thetford, VT	None	9085A*	U	NP	NN	No Need/no hydro	Current
West Fairlee, VT	None	7614A*	U	NP	NN	No Need/no hydro	Current
Bradford, VT	Hydropower	2488A	U	NP	D	NP	Future
Woodsville, NH	Hydropower	5307A	D	P	N	O (1990)	Current
Bath, NH	Hydropower	4609A	D	P	N	O (1988)	Current
Lisbon, NH	Hydropower	3464A	D	P	N	O (1988)	Current
Littleton, NH	Hydropower	11313A	D	P	N	I(1995),O(1998)	Current
Bethlehem, NH	Hydropower	7860A	D	P	N	NP	Current
Newbury, VT	Hydropower	5261A	U	NP	N	NP	Current
Newbury, VT	Hydropower	4770A	U	NP	N	NP	Current
Barnet, VT	Hydropower	5702A	U	NP	N	O (?)	Current

Appendix G: Fish Passage Requirements Within the Connecticut River Basin

Barnet, VT	Hydropower	3051A	D	NP	N	I(1996),O(1998)	Current
Barnet, VT	Hydropower	2400A	D	NP	N	I (1995) ,O(1997)	Current
St. Johnsbury VT	Hydropower	2397A	D	NP	N	I (1995),O(1997)	Current
St. Johnsbury VT	Hydropower	2399A	D	NP	N	I (1995)	Current
St. Johnsbury VT	Hydropower	2396A	D	NP	N	I (1995)	Current
Lyndon, VT	Hydropower	2839A	D	NP	N	P	Current
Lyndon, VT	Hydropower	3090A	D	NP	N	I (1997)	Current
Burke, VT	Fire Protection	None	D	NP	NN	No need	Current
St. Johnsbury VT	Hydropower	7809A	U	NP	N	NP	Current
St. Johnsbury VT	None	#6649A*	U	NP	NN	No need/no hydro	Future
Whitefield, NH	None	None	?	?	?	?	Future
Lancaster, NH	Hydropower	8733A	U	NP	D	NP	Future
Lancaster, NH	Hydropower	7391A	U	NP	D	NP	Future
Groveton	Hydropower	7833A	U	NP	D	NP	Future
Groveton	Hydropower proposed	11128A	U	NP	D	NP	Future
Groveton	Hydropower proposed	11128B	U	NP	D	NP	Future
—	—	—	—	—	—	—	Future
—	—	—	—	—	—	—	Future
Mohawk River	None	—	—	—	—	—	—

[1] Mainstem Connecticut River or Primary Tributary
→ Secondary Tributary
→ Tertiary Tributary

[2] Asterisked (*) License numbers have been terminated.

[3] Need: Status of the current need for passage facilities designated by the following:

N = Needed. Fish passage is needed based on management objectives and stocking program.
D = Deferred. Fish passage facilities will be required in the future when conditions (e.g., the presence of anadromous fish above or below the dam) merit. Construction of facilities is not mandated at this time.
NN = Not needed. Fish passage facilities are inherent due to dam structure or operation, or stocking is not

planned for river stretches above the dam.
U = Unscheduled. Fish passage facilities are not required at this time but the federal and state agencies reserve the right to reconsider this finding in the future based on changing conditions.

4 Functional Status:

O = Operational final facility.
I = Interim facilities in place. Final facilities under study, in planning, or yet to be pursued. Interim facilities may or may not be fully effective.
P = Planned. Facilities being planned or under construction.
NP = Not planned. Facilities may or may not be required in the future.

5 Status of fry stocking upstream of listed barrier.

6 Northfield Mountain Pumped Storage Facility is not a dam but significantly impacts smolt survival during the water withdrawals from the river.

7 Experimental fry stocking initiated in 1997

APPENDIX H. SUMMARY OF PUBLIC COMMENTS ON DRAFT PLAN AND COMMISSION RESPONSES

The Connecticut River Atlantic Salmon Commission solicited comments on the draft revision of the *Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River* through four public information meetings, the Internet, and direct mailings. Plans were also made available for review at many local libraries. Over 400 hard copies of the draft Plan were distributed for comment. Additionally, over 1,500 people visited the Web site where the Plan was served, with over 250 of them actually taking the time to look at the Plan.

A variety of comments were received from about 50 respondents. These ranged from simple editorial corrections and clarifications of factual information to recommendations for increased innovation and change in Program direction. Generally, those who commented provided insight on perceived benefits and problems and frequently suggested specific actions or directions to address those issues.

The Draft Strategic Plan Subcommittee reviewed all of the comments, keyed them to appropriate references in the draft Plan, and developed recommended responses for the Commissioners to review and approve.

Particular attention was given to comments that spelled out specific recommendations for actions or Program direction. Frequently, public proposals broached topics that had been discussed and even debated in the course of developing the draft Plan. The draft Plan was designed to provide comprehensive direction to the Program. There remains some confusion among the public as to both the specificity appropriate to the Plan and the role of the Action Plan in the implementation of the Strategic Plan. Flexibility was intentionally built into the long-term goals, objectives, and strategies described in the draft Plan. This can be explained when the Action Plan process is finalized, publicized, and implemented.

A summary of the comments and responses follows:

COMMENTS	PLAN REFERENCE	CRASC RESPONSE
▸ Editorial comments and updates	Various sections	CRASC has reviewed the editorial comments and made appropriate changes.
▸ Let sea runs have run of river	Goal 4	CRASC agrees to this concept: Strategic Plan calls for increased releases in Strategy 4.A.1; adults are being released experimentally in the Westfield River; but, releasing all returns would be irresponsible while we are still developing river specific broodstock genetics.
▸ Stock Passumpsic River with fish native to the region	Goal 4	CRASC agrees to this concept: Atlantic salmon are native to the Passumpsic; Strategic Plan includes a strategy (Strategy 4.G.4) that would permit a broodstock fishery; and, broodstock fisheries currently exist outside the river in CT, MA and VT; stocking other native fishes is outside the scope of this Plan and is the role of state fishery management agencies.
▸ Stock excess domestics into streams for fishing	Goal 4	CRASC agrees to this concept: Strategic Plan includes a strategy (Strategy 4.G.4) that would permit a broodstock fishery; and, broodstock fisheries currently exist outside the river in CT, MA and VT.

▸	Conduct an independent assessment of the project	Outside the scope of this document	CRASC deems this unnecessary and outside the purpose of the revised Plan: the Program is a cooperative effort already deriving input from at least 7 state and federal agencies throughout the watershed, researchers from throughout the nation, and professionals outside this Program but within the U.S. Atlantic Salmon Assessment Committee; Public Commissioners are appointed by the Governors to serve citizen interests on the Commission; the public has always been welcome to participate in CRASC and Technical Committee meetings as well as through comment solicitations like this one; CRASC has demonstrated an intent to constantly improve the Restoration Program and has included Goal 5 to ensure that the process will invite change; CRASC members and advisors have demonstrated technical competence; funds are limited and must be expended efficiently; and, the Plan provides a comprehensive vision for the future.
▸	Better define goals and time lines	Various sections	CRASC agrees on the need for specific goals and means for evaluation of accomplishments; many of the goals and objectives of the Plan are specific and measurable. It is equally valid to recognize that all goals cannot be easily evaluated or enumerated. The Action Plan will be focused more on short-term accomplishments and will necessarily be more specific, tangible and measurable.
▸	Take care not to bias public	Goal 6	CRASC agrees that public surveys should be professionally conducted;

	opinion/support in future surveys		Strategy 6.A.1 makes reference to the need for a public survey.
▸	Enhance local fishery habitats	Goal 2	CRASC recognizes the need for protecting and enhancing salmon habitat in Strategies 2.A, 2.B, and 2.C; these efforts also benefit other resident fish species; protection of habitat solely for other species is outside the scope of this Plan and is the role of state fishery management agencies.
▸	Provide local economic uplift through increased recreational use of river (for anglers) by the people of the Northeast Kingdom and visitors	Program Summary & Goal 4	CRASC agrees to this concept: One of the long-term goals of the program is a fishery; the Strategic Plan includes a strategy (Strategy 4.G.4) that would permit a broodstock fishery; and, broodstock fisheries currently exist outside the river in CT, MA and VT (in Lakes Seymour and Willoughby in VT); and, economic studies have shown the potential value of restoring salmon to New England rivers to be $2-4 billion.
▸	Eliminate water quality and physical barriers to migratory fish passage and reproduction in the Ashuelot River and tributaries	Goal 2	CRASC supports and promotes habitat protection and enhancement (Objectives 2.A, 2.B, and 2.C); interim fish passage is available on all 3 of the Ashuelot's dams with final facilities under design; CRASC has no authority to set water quality standards for the states.

▸	Add redear sunfish to species list	Table 3	CRASC recognizes the redear sunfish as a new resident species in the Connecticut River basin.
▸	Accept assistance from Trout Unlimited to stock fry and recruit stockers; involve the Vermont Chapters of the National Audubon Society; use the Student Conservation Association as a source of inexpensive assistance	Goals 1 & 6	CRASC acknowledges need and gratefully accepts support and assistance from non-governmental organizations and individuals in accomplishing the Program goals.
▸	Stress striped bass & shad success to counter Program cost argument	Program Summary	CRASC participates in the basin's shad restoration program much of which drove the need for fish passage below Bellows Falls; activities conducted for salmon have benefitted shad and other species resulting in great fishing, especially below Turners Falls.
▸	Major improvements in fish passage and increased fry stocking have not improved adult returns	Program Summary	CRASC agrees that realization of projected return results has been frustrated despite successes at increasing fish passage efficiency and at approaching fry stocking goals; we have yet to realize the benefit of these improvements since impacted year classes have not yet returned;

			also these are not the only controlling factors: other things like marine survival and predation impact run sizes.
▸	Evaluate temperature tolerance in cage tests for smolts	Goal 5	CRASC and its member agencies do not have a direct research role in their mission but can recommend research to benefit the Restoration Program; CRASC has reviewed studies conducted in the past by USGS/BRD on this subject; needs for additional research will be forwarded to BRD for additional consideration.
▸	Evaluate water quality relative to freshwater survival	Goal 5	CRASC and its member agencies do not have a direct research role in their mission but can recommend research to benefit the Restoration Program; CRASC will refer needs for research to USGS/BRD for consideration.
▸	Include a map with dams, river miles	Appendix G	CRASC recognizes the value of such maps and has added an appendix, Appendix J, with an additional map to the Plan; additionally the Connecticut River Coordinator has printed a very detailed report depicting basin dams "The Status of Migratory Fish Passage and Barriers to Passage in the Connecticut River Watershed"; the report is available upon request.
▸	Keep the information coming	Goal 6	CRASC recognizes the importance of public support for the Program and has increased public outreach even serving the draft Plan on the

			Internet; a specific strategy (Strategy 6.B.1) has been developed to further such initiatives.
▸	CRASC should provide an accounting of all money spent on the Program to date including state, federal, and industry expenditures	Outside the scope of this document	CRASC recognizes the importance of public review and accountability. It remains to be understood that costs for fish passage are not borne by tax payers. CRASC cannot account for these non-member expenditures. The majority of state agency expenditures are derived from specific user taxes not general income tax. Only federal activities are borne by the tax payer. Both state and federal government agency expenditures are difficult to attribute solely to the salmon program as both state and federal agencies have worked simultaneously to restore both the aquatic environment and depleted populations of other migratory species including American shad.
▸	Describe links with the Silvio O. Conte NFWR	N/A	CRASC agrees that the refuge and its role through its legal mandate to restore anadromous fish should be mentioned as a key change in the basin since the 1982 Plan was written. Lines to this effect will be added to the Program Summary.
▸	Identify impact of NEPCO sale on goals, objectives, and agreements	Outside the scope of this document	Impacts of utility divestiture are unknown though CRASC has been assured that passage agreements and requirements have been made known and were transferred as part of the purchase commitment.

▸ Focus efforts below high dams; evaluate need and options for downstream fish passage at high dams prior to establishing a construction requirement at these facilities; conduct no expansion of stocking in Northern tributaries above Fifteen Mile Falls	Goals 1 & 5	CRASC has traditionally focused Program efforts on areas below the Fifteen Mile Falls projects. To date, only 0.15% of the stocked salmon have been stocked above these dams despite the fact that the salmon's historical range extended to Stewartston. Limited hatchery production capabilities precluded expansion until the domestic program was initiated at White River NFH. Even with White River, fry production falls short of the Program goal. Consequently, the focus has been on maximizing utilization of habitat below Fifteen Mile Falls. It has been CRASC's intent to stock all available habitat in the basin since the Program was initiated in 1967. Only through utilization of all available habitat can adult returns be maximized. Interim downstream fish passage is currently in place at McIndoes Falls and the Fifteen Mile Falls agreement requires construction of permanent facilities at McIndoes. The agreement also calls for studies to determine passage needs at the other dams. It is in CRASC's best interest to see that these studies are conducted to determine the merits of passage before establishing if passage is warranted. Per agreement, these studies have been initiated. Details specific to a dam or a tributary will be placed in the Action Plan (to be developed).
▸ Prioritize and target efforts to those areas that will be most productive and cost effective	Goal 5	CRASC has long recognized the need for focus on a project of the magnitude of this Program. Objectives 5.A.2, 5.A.3, and 5.A.4 are designed to ensure that Program activities are evaluated, monitored, and

			altered as needed to achieve the mission.
▸	Assess impact of stocking salmon on existing fisheries and vice versa especially with respect to impact on recreational benefits of existing fishery	Program Summary, Goal 5	CRASC agrees that additional information should be included in the Plan. Native species in the basin have been greatly altered by human activities. The only two original salmonid species are Atlantic salmon and brook trout. All other salmonids have been introduced and are not native to the Connecticut River. Studies have shown that competition is minimal with regard to existing fisheries (trout) from stocking salmon and vice versa though additional research may be warranted. Management of resident fisheries is the role of state fishery management agencies and is outside the scope of this document.
▸	Identify potential/available spawning habitat in the tributaries to promote cooperative habitat conservation	Goals 2 & 6	CRASC recognizes the importance of habitat and public protection of habitat. Habitat conservation is a key element to the restoration of Atlantic salmon (Goal 2). Salmon habitat is generally identified in Appendix B (Table 2 & Figure 1). Protection of habitat necessitates support and cooperation from the public and this is emphasized in Strategies 2.A.4 and 2.A.5, and 6.B.4. Specifics are generally available in various reports and publications but will be emphasized in the Action Plan.
▸	Cite references	N/A	CRASC elected to omit cumbersome citations in the Plan (which primarily served Program biologists) and instead developed a more

			public friendly document.
▸	Provide a review of scientific work conducted 1982-1997	Outside the scope of this document	CRASC member agencies have limited research capabilities and rely heavily on academic researchers and outside agencies (USGS). Summaries of research conducted are provided annually in the U.S. Atlantic Salmon Assessment Committee Report. The 1997 report is available on the Internet (www.fws.gov/cneafp/index.html).
▸	Cite assumptions and plans to test their validity	Various sections	CRASC does not deem this prudent. This revision was developed as a comprehensive plan to guide the Program in recognition of the many variables that impact results. Many assumptions made in the 1982 Plan were based on best available information, often erroneously. Today, CRASC recognizes that many variables remain unknown defying reasonable assumptions. Consequently, various benchmarks are necessarily less specific (quantifiable) than those in the previous revision.
▸	Exclude recreational fishing from the mission statement	Executive Summary, Program Mission	CRASC disagrees with this recommendation.
▸	Resume use of out-of-basin	Goal 1	CRASC has recognized a potential benefit and has established a strategy

	stocks		(1.D.3) to determine the need for importing donor stocks to improve genetic variability and correct a skew in the sex ratio. Population size is adequate and does not dictate a need for donor stocks at this time.
▸	Evaluate application of NESA's single river theory	Various sections	CRASC has incorporated positive aspects of the single river theory into the Plan. Example includes release of broodstock and sea runs in the Westfield River with subsequent success in natural spawning.
▸	Focus efforts on limiting factors that can be addressed including eradicating non-native predators	Various sections	CRASC already focuses on factors that can be addressed including freshwater habitat restoration and stock enhancement. Eradicating non-native predators is not a viable option given the many changes to the fish community and environment. Localized control measures for such predators is the role of state fishery management agencies.
▸	Acknowledge fish passage improvements at Northfield and Holyoke; and, acknowledge benefits of and access to sampling stations at Cabot and Holyoke	Program Summary, Goal 2	CRASC acknowledges the cooperation and genuine commitment of the utilities including NUSCO and NEPCO to the restoration of salmon in the Connecticut River. The big dam owners play a particularly important role on the mainstem and some tributaries: making great effort, in good faith, sometimes at great expense, to ensure that the Program can succeed. Modification of text in the Program Summary and Goal 2 will generally provide additional acknowledgment of this special relationship.

▸	Restoration definition needs work	Program Summary	CRASC has noted this comment.
▸	Include rivers below Holyoke in plan for sea run releases when releases exceed 10% at Holyoke	Goal 4	CRASC recognizes the need for flexibility in managing sea run releases and offers this general option in Strategy 4.A.1. Nothing in this strategy precludes releases below Holyoke. Specific release plans are more appropriately expected in the Action Plan.
▸	Basin description should reference geographic applicability; include life stage definitions and cite references in life history section	Appendix B & C	CRASC is providing a brief, public friendly summary of basin characteristics and salmon life history rather than a definitive scientific treatise. In a document of this kind, it is necessary to strike a balance between detail and readability. Life history definitions are included in Figure 2.
▸	Free flowing rivers should be identified, emphasized and protected; include the Sawmill as a priority river	Appendix B & Goal 2	CRASC agrees. Free flowing rivers including the Sawmill River are identified as priority rivers in Appendix B.
▸	Impetus for the expansion of the	Program	CRASC agrees. A text change has been made to reflect this fact.

	Holyoke fishlift was shad	Summary	
▸	Volunteers should be recognized as integral to the egg production program	Goal 1	CRASC recognizes the value and necessity of volunteers to the hatchery production program, the need to coordinate and communicate information to ensure that volunteers and cooperating agencies are available to get the job done Strategy 1.A.6.
▸	Provide annual reports addressing pre-established budget and Program milestones	Goal 7	CRASC recognizes the need to establish public accountability in Strategies 7.B.3, 7.B.5, and 7.B.6. Many reports are already completed annually (including Federal Aid reports and the U.S. Atlantic Salmon Assessment Committee Report). Consideration will be given to producing an annual report for the Program.
▸	Salmon bycatch in the commercial shad fishery should be better addressed	Goal 3	CRASC has reviewed the impact of the shad fishery on returning salmon and concluded that this is not a great threat. A text change will be included in the narrative indicating that bycatch monitoring is limited but not conducted scientifically.
▸	Speed of post-smolt movement, as described, is misleading	Appendix C	CRASC agrees that available evidence is sparse and has made a text change to generalize the time required for salmon to reach the west coast of Greenland.

▸	Repeat spawners and grilse provide a buffer for all sources of mortality	Appendix C	CRASC has noted this point.
▸	The title of Appendix D could be improved	Appendix D	CRASC agrees. The title has been changed to “History of Atlantic Salmon in the Connecticut River and Status of the Connecticut River Atlantic Salmon Restoration Program”
▸	From 1992-1995, Westfield River returns were netted below the DSI dam, there was no fishway or trap at that time	Table 4	CRASC agrees. A footnote has been added to the table.
▸	It is unclear what the value of the 13 listed rivers is in Goal 2	Goal 2	CRASC agrees and has provided a text change in the Goal 2 narrative below the list of 13 tributaries to indicate that natural spawning is also anticipated in several smaller tributaries and below the first barrier on some larger tributaries.
▸	Text should indicate that downstream fish passage has been constructed at some	Goal 5	CRASC agrees. A text change has been made in the narrative for Goal 5.

	tributary dams		
▸	Figure 4 should be extended through smolt year 1993	Figure 4	CRASC disagrees. Data is unavailable.
▸	Provide more detail on how the Plan will be implemented through the Action Plan - timetable, public involvement, etc.	Executive Summary	CRASC disagrees. The Action Plan process has not been finalized. Once this Plan is finalized, the next planning process will be developed with a timetable for completion and future revisions.
▸	Increase opportunity for natural selection in development of broodstock by collecting future broodstock from streams as 1^+ parr	Goal 1	CRASC has noted this comment for future consideration. This process may be useful in addressing the existing skewed sex ratio. The drawback is that only about 10% of the stocked fry are of the preferred sea run origin.
▸	Amend the license for Northfield to require seasonal	Outside the scope of this	CRASC is currently working cooperatively with NUSCO to resolve passage concerns at this site. Regulatory authority will only be used as a

	safe passage	document	last resort.
▸	Pro-actively participate and promote the Program, volunteer, and education opportunities to increase support and available volunteer assistance	Goal 6	CRASC agrees that public support and involvement is important to the Program.
▸	Link agencies and NGOs to schools through education programs	Goal 6	CRASC agrees. Linking efforts is the part of Strategy 6.B.4. Educational activities are already linked in Connecticut to the Connecticut River Atlantic Salmon Association, in Massachusetts to Trout Unlimited, and in Vermont to the Quebec Labrador Foundation.
▸	Scientific lingo is unclear, define escapement, released, and escaped	Various sections	CRASC will review and add definitions to the text as needed.
▸	Fishways should be operated through all seasons to ensure	Goal 2	CRASC agrees. Fishways should be operated through a broad window of time extending past that when returns are seen in Connecticut and at

	that seasonal runs are not excluded		the Holyoke dam. Currently, fishways are not operated at Turners Falls or Vernon in the fall. Studies planned on the Deerfield River may help shed light on this issue. Off-season operation of fishways may also benefit other resident and migratory species like sturgeon and freshwater mussels.
▸	Looking for research results and plans for the future on the Westfield River	Outside the scope of this document	CRASC agrees that research results should be available. Currently, summaries are provided in the U.S. Atlantic Salmon Assessment Committee Report. This information might also be included in the proposed Annual Report, currently under CRASC consideration.
▸	Provide a tour of the Conte Research Center, fishway and hatchery to the Westfield River watershed Association; make authorized public access to the fishway available at DSI	Outside the scope of this document	CRASC agrees that public awareness is an important objective (Goal 6). Specific activities will be addressed in the Action Plan. Appointments are best arranged directly with facility supervisors.
▸	Want a canned educational program with respect to the Restoration Program	Goal 6	CRASC agrees. Curricula are currently available from the Atlantic Salmon Federation (Fish Friends) and The USFWS (Adopt-A-Salmon). Specifics are appropriate to the Action Plan.

▸	Want more meetings like the public info meeting, and better press coverage	Goal 6	CRASC agrees.
▸	Want more public involvement	Goal 6	CRASC agrees and encourages public interest and participation.
▸	Want follow-up meeting to the public information meeting	N/A	CRASC disagrees. The summary of comments and responses will be provided to all who commented in writing on the Plan. It will also be provided as an appendix to the final Plan.
▸	Want to see agency and CRASC Commissioners at these meetings	N/A	CRASC acknowledges this point.
▸	Initiate more education programs (grades 7-12) in cooperation with the Conte NFWR	Goal 6	CRASC agrees. This point will be discussed with Refuge staff when the Action Plan is developed.

►	Post fish passage data on the Internet	Goal 6	CRASC agrees. This information is currently available at the Connecticut River Coordinator's Web site (http://www.fws.gov/r5crc).
►	Get kids involved	Goal 6	CRASC agrees. Specifics are appropriate to the Action Plan.
►	Define how the fry stocking target was selected	Goals 1, 2, & 5	CRASC answers this question in the Plan. Salmon habitat has been identified using field assessments and estimates. Based on the total available habitat, and averaged stocking density, a total fry stocking target of 10 million fry was calculated (Goals 1 & 2). This target may be adjusted up or down as additional and new habitat is stocked and juvenile survival assessed (Goal 5). It is necessarily a dynamic target based on best available information.
►	Define whether CRASC's policy on opposing new dam construction is new or a continuation of an old policy	Goal 2	CRASC addresses this issue twice in the Plan - once in Objective 2.B for upstream passage and again in Objective 2.C for downstream passage. This is an ongoing objective and confirmation of an existing policy.
►	Include a strategy in Goal 3 to address the New England Fishery Management Council's Atlantic Salmon Fishery	Goal 3	CRASC agrees. Text will be changed to include a strategy under Objective 3.A (3.A.5) supporting the Council's fishery prohibition in federal waters (3-12 miles).

Management Plan

	Comment	Goal	Response
▸	How will the broodstock release strategy defined in Strategy 4.A.1 work	Goal 4	CRASC has provided a table for projecting broodstock allocations given various run sizes in Strategy 4.A.1. Since total run cannot be known until the end of the run, retention and release is a dynamic process keyed to various run caps at 333, 450, 600, and 1600 returns. The figures are incremental. The targets may be adjusted once the Plan is implemented as appropriate to meet Program needs.
▸	Combine Objectives 4.A and 4.B	Goal 4	CRASC has noted this comment.
▸	Recreational opportunities noted in Objective 4.D may be associated by the public only with recreational fishing unless there is better definition	Goal 4	CRASC has noted this comment. Strategies listed under Objective 4.D and benefits defined in the Program Summary should preclude misunderstanding by the public.
▸	Include a strategy in Goal 5 to use data from monitoring, evaluation and research to implement needed changes in	Goal 5	CRASC agrees. Additional text will be provided to address this concern in a strategy. This text may be transferred directly from Strategy 7.A.3.

	the Program		
▸	The single strategy identified under Objective 6.C may be inadequate since there may be other opportunities for involving the public	Goal 6	CRASC agrees. This is a good comment meriting further consideration and perhaps better definition derived directly from the public.
▸	Draft lacks time frames, resource needs, and priorities for each objective	N/A	CRASC is aware that the Plan is general under some goals though it is more specific under other goals. The Plan is written to provide long-term and visionary guidance for comprehensive planning and decision making. Further, recognition is given to those areas over which we have little control (sea survival, predation...) and which necessarily remain less specific. Timing, resource needs, and priorities will all be more clearly addressed in the Action Plan.
▸	Change the title	N/A	CRASC disagrees with a need for a title change.
▸	Some Program objectives have been achieved and should not be included in the Plan	N/A	CRASC has included both ongoing and needed objectives in the Plan. Annual accomplishment reporting should be keyed to the Plan through an Action Plan. The Action Plan will define measurable goals and objectives against which progress should be evaluated on an ongoing

			basis.
►	Program changes and accomplishments should be evaluated in this Plan	N/A	CRASC developed this document by revising the 1982 Plan. This Plan does not depart significantly in substance from that Plan but differences are briefly summarized in the Introduction and Program Summary.
►	A Strategic Plan should be developed for each goal addressing timing, resource needs and priorities	N/A	CRASC agrees and has already identified the need to develop an Action Plan and process to address this need.
►	Upstream passage and Program activities are warranted at Fifteen Mile Falls as salmon numbers rebound	Goal 2	CRASC agrees. Furthermore, this is built into the Fifteen Mile Falls Settlement Agreement.
►	A strategy should be added: Provide information on methods to enhance, maintain and protect habitat - target municipal land use commissions in priority	Goal 2	CRASC agrees with this concept. It may be implemented through outreach (Goal 6) and/or technical assistance (Goal 2).

	tributaries		
▸	Include land use concerns in the issues and challenges.	Goal 5	CRASC agrees.
▸	Clarify origin of hatchery smolts, with they be derived from CT River stocks?	Goal 1	CRASC recognizes the need to develop a CT River stock of salmon adapted specifically to this river system and is striving to attain this goal. CRASC will do everything necessary to maintain and improve the CT River stock even if this means importing gametes from outside this basin to maintain and improve genetic variability of CT River stocks.
▸	Promote value and use of partnerships as a component of fisheries conservation efforts	Goals, 2, 5, & 6	CRASC agrees.
▸	Educate the public on the benefits of the Program beyond just getting fish back and educate anglers on the benefits to the angling community	Goal 6	CRASC agrees. The Action Plan should cite specific actions to this end.

▸	Identify critical salmon habitat to facilitate protection through partnerships	Goal 2	CRASC agrees. The Action Plan should cite specific actions to this end.

APPENDIX I. LIST OF COMMENTERS

Written Comments:

Angus C. Black, Jr., Cricket Hill, Peru, Vermont 05152-0123

Kenneth C. Mason, Manager, Village of Lyndonville Electric Department, 20 Park Avenue, P.O. Box 167, Lyndonville, Vermont 05851

Don Blake, Chair, Tom Loomis, Tim Gaskin, Donna Edwards, & John Lawler, Board of Trustees Village of Lyndonville, Lyndonville, Vermont 05851

Roger H. Sweet, Chair, Ashuelot River Local Advisory Committee, Southwest Region Planning Commissioners, 20 Central Square, Second Floor, Keene, New Hampshire 03431

Michelle Babione, Connecticut River Coordinator's Office, 103 East Plumtree Road, Sunderland, Massachusetts 01375

Guy Crosby, Board of Directors, Upper Valley Chapter, Trout Unlimited, P.O. Box 1194, White River Junction, Vermont 05501

John Kalafut, 9 Clark Street, Lebanon, New Hampshire 03766

Jon Truebe, Lakeside Engineering, Inc., 4 Tuftonboro Neck Road, Mirror Lake, New Hampshire 03853

Chris Collman, Franconia, New Hampshire 03580

Michael Parker, Westfield River Basin Team Leader, Massachusetts Department of Environmental Management, Hampton Ponds State Park, 1048 North Road, Westfield, Massachusetts 01085

Gary W. Moore, Moore Lane, Box 454, Bradford, Vermont 05033

Wallace M. Elton

Peter H. Richardson, Chair-Vermont Commission, & J. Cheston M. Newbold, Chair-New Hampshire Commission, Connecticut River Joint Commissions, P.O. Box 1182
Charlestown, New Hampshire 03603

Cleve Kapala, Director of Relicensing, New England Power Company, 4 Park Street
Concord, New Hampshire 03301

R.G. Chevalier, Vice President - Fossil/Hydro Engineering and Operations, Northeast Utilities System, Holyoke Water Power Company, Western Massachusetts Electric Company, P.O. Box 270, Hartford, Connecticut 06141-0270

Don Pugh, 10 Old Stage Road, Wendell, Massachusetts 01379

Charles V. Olchowski, Secretary, Deerfield/Millers Chapter of Trout Unlimited, 28 Smith Street Greenfield, Massachusetts 01301-2018

Tim Hess, Vermont Department of Fish and Wildlife

Ed Parker, Chief, Bureau of Natural Resources, Connecticut Department of Environmental Protection, 79 Elm Street, Hartford, CT 06106-5127

Ron Lambertson, Regional Director, U.S. Fish and Wildlife Service, 300 Westgate Center Drive, Hadley, MA 01035-9589

CT Public Information Meeting, April 14, 1998 (Hartford, CT):

Dick Bell, 75 Ridgewood Ave., North Haven, CT 06473, 203/288-2386

Ed Ruestow, 23 High Gate Lane, West Hartford, CT 06107, 860/521-1426

Robert A. Jones, 76 Deming St., Windsor, CT 00074, 860/644-0159

Tom Maloney, CT River Watershed Council, 1 Ferry St., Easthampton, MA 01027

Joseph N. Ravita, CTDEP, Whittemore Salmon Station, Riverton, CT 06065

Marguerite Smith, CTDEP Hartford, CT

Robert Lowe, Middleton, CT

Thane Grauel, Journal Inquirer

Frank McKane, Connecticut Post Newspaper, 14 Beverly Place, Bridgeport, CT 06610
203/371-6615

Dan DeGruttola, South Glastonbury, CT

Ben Lenda, 99 Cedar Isl. Rd., Narragansett, RI

Bruce Williams, CTDEP/Fisheries, 860/434-6043

Stephen B. Lewis, 654 Cypress Rd., Newington, CT 06111, 860/667-2515

VT Public Information Meeting, January 21, 1998 (Norwich, VT):

Dan McKinley, RR1, Box 148, Rochester, VT 05767, 802/767-4511

Mike Gray, 29 Hitchcock Ave., West Lebanon, NH 03184

Mark A. Coutereuarch, North Hartland, VT 05052, 802/295-6567

Ken Fogg, North Hartland, VT 05052, 802/295-2783

Nell Hamlen, RR1, Box 145, Reading, VT 05062, 802/484-9554

Jerry Cartier, RR1, Box 54A, Thetford Center, VT 05075, 802/785-9815

Norm Cartier, Hartford, VT

Robert Derochers, 27 Summer St., St. Johnsbury, VT

Danton Gandie, Ammonoosuc Trout Unlimited, 268 Sym Noyes Rd., Landoff, NH 03585

Terry Boone, PO Box 885, Norwich, VT 05055-0885

Gary Moore, Box 454, Bradford, VT 05083

Pete Richardson, PO Box 1005, Norwich, VT 05055, 802/649-5250

Leanne Klyza-Linck, 100 Greensboro Rd., Hanover, NH 03755, 603/643-7794

Mr. Fay Young, Box 588, Lyndonville, VT 05851

Len Gerardi, VTFW, 184 Portland St., St. Johnsbury, VT

Keith Nislow, Dartmouth College, Hanover, NH 03755

John Kalafut, 9 Clark St., Lebabonon, NH 05053

Peter J. Meuh, HCGBX22, North Pomfret, VT 05053

Ernest Cobb, 5 Magnolia Circle, White River Junction, VT 05001

Betsy and Mike Sylvester, PO Box 343, Norwich, VT 05055

Tim Hess, VTFW, Waterbury, VT

Brian Kennedy, Dartmouth College, Dept. of Biology, Hanover, NH 03755

MA Public Information Meeting, January 20, 1998 (Westfield, MA):

Jim Terrett, 9 Dickinson Place, Westfield, MA 01085, 413/568-5468

Jack Teahan, Conservation Officer, Pioneer valley Chapter of Trout Unlimited

Dan Call, Director Special Projects, Westfield River Watershed Association
PO Box 1764, Westfield, MA 01086-1764

NH Public Information Meeting, January 26, 1998 (Keene, NH):

John Warner, 26 Highland Drive, Henniker, NH, 603/428-3844

Ron Howey, 90 Russell Street, Sunderland, MA , 413/665-7290

Rose and Warren Fisher, 154 Monadnock HWY, East Swanzey, NH, 603/352-6507

Steve Shepard, Gomez and Sullivan Engineering, Dunbarton, NH 03045, 603/774-3323

Tim Brush and Lynn DeWald, Normandeau Assocates, 224 Old Ferry Road, Brattleboro, VT 05301, 802/257-5500, 802/257-0955, TDBrush@aol.com, LCDeWald@aol.com

Appendix J. Dams on the Connecticut River Mainstem.