

INTRODUCTION

The Northeast Fishery Center presently consists of the Lamar National Fish Hatchery and the Fish Technology Center. Legislative authority for establishing the Fish Hatchery is contained in 46 Statute 371 (White Act), dated May 21, 1930. The station was officially established in 1933 and in the ensuing years has produced and distributed to Federal, State, and private waters, largemouth bass, smallmouth bass, bluegill, catfish, walleye, muskellunge, rainbow trout, brook trout, brown trout, and striped bass. Water to operate the facility is supplied by Washington Spring and Big Fishing Creek. The Fish Hatchery has taken a lead role in supporting the Technology Center programs dealing with Atlantic sturgeon and Atlantic salmon as well as Hatchery Product Evaluation. Production of catchable rainbow trout was greatly reduced at the Fish Hatchery beginning in 1994, but a small number are still produced for the annual fishing derby which remains a valuable public outreach program.

The Lamar Fish Cultural Development Center was created in 1965 on the grounds of the Lamar Fish Hatchery. In 1984, the name was changed to the Fish Technology Center and its mission was modified. The mission was again modified in 1993 and current emphasis is on developing new cultural and management technology for threatened and endangered (T&E) aquatic species and species of special concern in the nation's interjurisdictional rivers, and implementing a hatchery product evaluation program. The Northeast Fishery Center is the lead facility in development of culture technology for Atlantic sturgeon, which has been identified by the Atlantic State Marine Fisheries Commission as a species of concern. In addition, the Center takes a progressive role in Atlantic salmon restoration efforts. One of the Center's highlights of 1995 was to receive the John S. Gottschalk Partnership Award. This is the first time a fisheries station has been recognized with the award which was largely a result of forming partnerships with private individuals, state agencies, and other federal offices to perform field and laboratory work with Atlantic sturgeon.

The Northeast Fishery Center is located 0.5 mile south of Highway 64 on the Tylersville Road in Lamar, Porter Township, Clinton County, Pennsylvania.

Facilities at the Center include an Intensive Culture building for striped bass and sturgeon, an office/hatchery building complex, technology laboratory, coldwater experimental building, maintenance shop, two garages, a fish storage building, twenty concrete raceways, five hypalon-lined earthen ponds, and ten other earthen ponds in need of rehabilitation.

STATION OPERATIONS

Fiscal Year 1995 at the Northeast Fishery Center (NEFC) will be remembered as one of diversity with a demanding schedule of technology development experiments and activities. As was the case with many other stations, NEFC took on just as much work as the previous year but had fewer workers. Cathy Johnson, assistant hatchery manager, relocated to West Virginia to work as an education specialist at the Leetown, WV training center. Fortunately, the Center was able to use three previous volunteers (Kim King, Dean Kirkendahl, and Wade Jodun) who recently graduated with biology degrees from Lock Haven University. Funding received through a cooperative agreement with Aquatic Ecosystems Engineering and the Electric Power Research Institute made it possible for them to work at the Center and gain valuable experience while providing excellent quality help. Major Center activities in FY95 were as follows:

1. Third year in a row - Captured and spawned adult Hudson River Atlantic sturgeon, Acipenser oxyrhynchus oxyrhynchus, and successfully hatched 169,000 fry.
2. Developed echo sounding techniques for locating spawning adult sturgeon.
3. Searched for adult Atlantic sturgeon in the Hudson and Delaware Rivers, and the Chesapeake Bay.
4. Cooperated with private commercial fishermen and the state of New Jersey to capture Atlantic sturgeon off the coast of New Jersey for genetic and reproductive study.
5. Actively engaged in public outreach/advocacy activities.
6. Obtained funding and began construction of water degassing and tempering system to be installed at the cold water experiment lab (holding house) building.
7. Conducted field experiments at other federal fish hatcheries involving Atlantic salmon egg transportation and spawning.
8. Continued development of technology for mass marking Atlantic salmon fry as a tool for better hatchery product evaluation
9. Cooperated with Abernathy Fish Tech Center, Univ. of Calif.- Davis, and NBS - Leetown on fish health issues
10. Served as Regional aquaculture coordinator
11. Provided recreational fishing opportunities
12. Cooperated with a private trout hatchery on capture and relocation of blue herons as a means to control fish deprecation.
13. Conducted a volunteer program
14. Served on ecosystem management teams
15. Reviewed technical papers
16. Provided culture information worldwide
17. Shipped Atlantic sturgeon to various groups for research on culture, disease, management, and fish passage.
18. Provided Atlantic sturgeon tissue samples for genetic analyses.
19. Submitted a manuscript to Progressive Fish Culturist on Atlantic sturgeon feed trials.
20. Completed two projects on Atlantic sturgeon using Atlantic Coastal Fisheries Cooperative Management Act funding.

Other activities involving the Technology Center are summarized as follows:

"PENNSYLVANIA OUTDOOR LIFE EXPOSITION"

WNEP studio in the Scranton/Wilkesbarre, Pennsylvania invited NEFC to participate in their annual outdoor exposition which was held in the Lycoming Mall, Muncy, PA. NEFC decided to exhibit a live, 6½-foot long, mature Atlantic sturgeon inside the mall. Our combination dual-wheel pickup and custom hauling trailer/tank was driven right into the mall where over a four day period, approximately 30,000 people were able to see a live sturgeon for the first time. Young and old alike were amazed at the sight of the prehistoric fish and much positive public outreach resulted. Film clips of the event were aired on "Pennsylvania Outdoor Life" in March, 1995.

SPAWNING OF HUDSON RIVER ATLANTIC STURGEON:

Three female Atlantic sturgeon from the Hudson River near Norrie Point State Park, New York were captured and transported to NEFC. Hormone injections of Common Carp Pituitary (CCP) were used to induce the females to spawn. The first female gave only a partial spawn which yielded approximately 2,000 fry while the second female (total length 93 inches) yielded a hatch of 170,000 fry. The third female was not spawned but is being held at NEFC for future

use. Milt for fertilizing the eggs was obtained from Hudson River male sturgeon which were released unharmed.

An important discovery was made with the three adult male sturgeon captured from the Hudson River and held since 1991 at NEFC. These three fish have learned to feed on trout pellets and appeared to be in excellent condition so the decision was made to administer hormone injections near the date when they would normally spawn. Twenty-four hours after injection, all three males yielded copious amounts of milt, some of which was used to successfully fertilize eggs obtained later. To the best of NEFC knowledge, this is the first time a male Atlantic sturgeon was ever induced to give milt in captivity.

This year's hatch of sturgeon fry far surpassed previous attempts. It was estimated that the percent hatch was 65%, far better than the previous year of around 13%. Fry and fingerlings were shipped to the following:

NBS-Conte lab,
the Corps of Engineers Waterways Experimental Station, Mississippi,
State of Maryland
The Chesapeake Bay Biology Lab at Univ. of Maryland
Hofstra University

The shipped sturgeon will be involved in diet, behavior, culture, and disease experiments. Approximately 5,000 of the FY95 hatch remain at NEFC for use in additional experiments or as needed.

WETLAND CONSTRUCTION: A wetland was constructed by modifying an abandoned pond that had reverted to shrub-scrub and forestland. With a minimum of excavation and some "replumbing", the ¼-acre area was flooded with hatchery effluent water to create wildlife habitat and effect some water quality improvement. Within a few days, mallard ducks began to visit the area regularly.

FISH FEED INSPECTIONS: As in previous years, the Center has taken responsibility for quality control of production fish diets for Region 5. Quarterly feed inspections were performed by biologist Jerre Mohler and biotechnician Pat Farrell. Only minor quality control problems were encountered during the year.

INFORMATION DISSEMINATION AND PUBLIC RELATIONS: The Center received and responded to the following requests for information and other technical assistance during FY93:

1. Maynard Rasch, private author from Delaware requested a copy of NEFC 1994 Biological Activities Report.
2. Columbia River Inter-tribal Fish Commission, WA requested information on Atlantic sturgeon pelvic fin amputation experiment to apply results to white sturgeon recovery efforts in the Columbia River.
3. Mark Vincent, private individual from Webster, MA requested information on setting up a hatchery.
4. The State of New York Dept. of Environmental Conservation requested an update on the status of NEFC's FY95 Atlantic sturgeon work for inclusion in their Hudson River Estuary Quarterly publication.
5. Region 1 of the U.S.F.W.S. requested information on the Region 5 fish food contract to use as guidance in constructing their own.
6. NBS-Wellsboro requested information on NEFC's captive Atlantic sturgeon for use in constructing a National Fish Broodstock Registry - Paddlefish and Sturgeon.

N.P.D.E.S PERMIT COMPLIANCE: The Center is responsible for monthly reporting of flows and various effluent parameters to state and federal agencies for purposes of compliance with the National Pollution Discharge Elimination System permit (N.P.D.E.S.). Water samples from designated discharge points on

the facility are taken to a nearby laboratory each month to undergo analysis for: B.O.D., Suspended Solids, Phosphorus, and Ammonium. Monthly reporting forms were completed and sent to the appropriate agencies.

BLUE HERON CAPTURE AND RELOCATION: At the request of private hatchery owner, Charlie Conklin of Effort, PA, an alternative to issuing a kill permit for nuisance blue heron was explored by NEFC. Mr. Conklin was suffering fish loss due to predation by the birds so it was decided to capture a number of the problem birds. Captured birds were to be tagged then relocated to the John Heinz Refuge in Philadelphia, PA to see if they would remain there or return to the point of capture. The large net-covered trap was equipped with a pool containing live goldfish and small trout to attract the heron. Remote control trap doors were triggered and the heron could then be tagged and transported. The birds were a challenge to capture as "key triggerman" Mike Hendrix was the only one to successfully trap a heron. NEFC has not been informed that this bird returned to the problem hatchery, but will try the technique again next year as a potential alternative to killing problem birds.

ADVOCACY TRAINING: Mike Hendrix, Bill Fletcher, and Jerre Mohler attended advocacy training at Region 5 office in Hadley, MA. This training resulted in production and implementation of a display panel which was used in conjunction with the exhibition of a mature Atlantic sturgeon and Atlantic salmon at the Lycoming Mall "Pennsylvania Outdoor Life Exposition" in Muncy, PA. While people waited to view the sturgeon, they viewed the display panel which was attractive, provocative, and informative.

IMPERILED MUSSELS MEETING: Jerre Mohler attended a meeting in Roanoke, VA concerning coordination of efforts on future work with restoration and protection of fresh water mussels. The meeting was attended by federal, state, and commercial interests and dealt with current status of mussel populations as well as research and technology needs necessary to restore and protect these organisms. The meeting resulted in formation of a steering committee which will oversee production of a framework document for conservation of freshwater mussels.

STUDIES PERFORMED: Fiscal year 1995 met NEFC staff head-on with challenging and interesting biological work. The majority of studies performed by Center biologists and our partners were related to Atlantic sturgeon and Atlantic salmon restoration and are identified as follows:

Study Number and title:

- L-95-01 Experimental stocking of hatchery-produced Atlantic sturgeon (*Acipenser oxyrinchus*) into the Hudson River.
- L-95-02 Comparison of eye-up between green Atlantic salmon (*Salmo salar*) eggs transported to incubation facilities unfertilized with those fertilized prior to transport
- L-95-03 Comparison of use of LHRHa and CCP for synchronization of gonadal development in Atlantic Salmon (*Salmo salar*).
- L-95-04 Mass marking trials with non-feeding Atlantic salmon fry.
- L-95-05 Observation of oocyte development in captive female Atlantic sturgeon acquired when oocytes are in an early vitellogenic stage.
- L-95-06 Location of mature Atlantic sturgeon as indication of potential spawning areas in the Delaware River.

STUDIES IN WHICH THE CENTER COOPERATED:

Immunomodulators as a fish health management tool (*Abernathy Salmon Culture Technology Center*)

Monitoring stress responses on the reproductive physiology of Atlantic sturgeon (*William F. Krise, NBS-Wellsboro*)

Northeast Fishery Center
- Biological Studies Performed -

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- L-95-03 Comparison of use of LHRHa and CCP for synchronization of gonadal development in Atlantic Salmon (*Salmo salar*).
- L-95-04 Mass marking trials with non-feeding Atlantic salmon fry.
- L-95-05 Observation of oocyte development in captive female Atlantic sturgeon acquired when oocytes are in an early vitellogenic stage.
- L-95-06 Location of mature Atlantic sturgeon as indication of potential spawning areas in the Delaware River.

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Immunomodulators as a fish health management tool (*Abernathy Salmon Culture Technology Center*)

Monitoring stress responses on the reproductive physiology of Atlantic sturgeon (*William F. Krise, NBS-Wellsboro*)

Reproduction and alevin marking techniques for Atlantic salmon (*William F. Krise, NBS-Wellsboro, PA and J. Sternick, Mansfield Univ., PA*)

Study Number and Title:

**L-95-01 Experimental stocking of hatchery-produced Atlantic sturgeon
(*Acipenser oxyrinchus*) into the Hudson River.**

Principal Investigator: NEFC Biologists
Co-Invest/Cooperators: Kathy Hatalla, New York DEC/Jorgen Skeveland, USFWS, MD
Fish. Resource Office Mark Bain, NBS-Cornell University

Background and Justification

Commercial records of Atlantic sturgeon (ASN) landings from the late 1800's to the present indicate a severe decline in the fishery (Taub, 1990). This problem has been addressed in the form of management plans for restoration of this species throughout its range by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC recommended formation of a culture and stocking group to develop guidelines for culture and restoration activities to ensure consistency with the goals and objectives of the ASMFC's Fishery Management Plan for Atlantic Sturgeon, November, 1990. The culture and stocking group, which is comprised of all ASMFC states, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, has made various recommendations including monitoring effectiveness of restoration programs through tagging of all stocked fish. No records have been found indicating hatchery-reared ASN have previously been stocked as part of a restoration effort for this species.

Study Objectives

The survival and growth of 5,000 fingerling size sturgeon released into the Hudson River in the fall of 1994 will be evaluated by study cooperators during the summer and fall of 1995 by sampling with gill nets and trawl gear.

Materials and Methods

Approximately 5,000 Atlantic sturgeon hatched and raised at NEFC for 14 weeks will be released into the Hudson River under the direction of New York DEC. Prior to stocking, all fish will receive a pelvic fin amputation and a coded-wire tag under the first dorsal scute. Evaluation of the experimental stocking will be performed through river survey efforts of a power consortium and a Cornell University river survey crew. All captured sturgeon will be measured for total length and checked for pelvic fin amputation/coded wire tags.

Results

The Cornell sampling team captured 22 ASN that were potentially age 1+ fish. Of these 22, thirteen (13) had coded wire tags and were of hatchery origin. Three of the wild fish were questionable as to age status and may have been 2+ fish. Captured hatchery fish were smaller than their wild counterparts (Av. length = 396 millimeters vs 473 millimeters, respectively). These results suggest that wild age 1+ ASN are not abundant in the Hudson River. Results of power consortium sampling have not been analyzed as yet.

Study Number and Title:

L-95-02 Comparison of eye-up between green Atlantic salmon (*Salmo salar*) eggs transported to incubation facilities unfertilized with those fertilized prior to transport

Principal Investigators: Bill Fletcher, Mike Hendrix and Jerre Mohler - Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Bill Krise, Dale Holyfield - National Biological Survey (NBS) Wellsboro; Cathy Johnson - NEFC; Paul Gaston, Fred Trasko - Green Lake NFH; Larry Lofton - North Attleboro NFH; Tom Nelson, Bruce Jenson - White River NFH; Mickey Novack - Richard Cronin NSS; Vic Segarich, Bob Groton - Nashua NFH

Background and Justification

The Atlantic Salmon (ATS) Program has placed increased emphasis on fry stocking as a restoration tool; this has increased demand for quality eggs. Currently, many of the production eggs are spawned at one station and transported for incubation to another hatchery. Eye-ups for fertilized ATS eggs transported in gallon jugs, have reached levels exceeding 90 percent; however, in recent years eye-ups have been as low as 60 percent. Since 1989, the NEFC and other U.S. Fish and Wildlife facilities have conducted studies with the aim of improving egg quality. For example, NEFC biologists found significantly greater ($P=0.05$) egg eye-up by delaying fertilization until the eggs had arrived at the incubating facility rather than shipping fertilized eggs (87 vs. 41% respectively)

Study Objectives

The objective of the present study is to compare percent eye-up on a production scale between Atlantic salmon eggs fertilized prior to transport with those fertilized after transport to incubating facilities in the fall of 1994.

Methods

The NEFC spawning team will coordinate spawning activities at the following facilities with the indicated number and type of eggs: Richard S. Cronin NSS (50,000 sea-run and 100,000 domestic broodstock eggs); Green Lake NFH (200,000 captive broodstock eggs); Nashua NFH (200,000 domestic broodstock eggs); North Attleboro (1.5 million kelt eggs and incubation site); and White River NFH (incubation site). Collected milt will be pooled and placed in test tubes on ice; motility will be checked. One-half of the eggs from each female spawned will be fertilized with two ml of milt per take and transported in insulated gallon jugs containing water and 200 grams of ice. The second half of the eggs will be placed into plastic bags with ovarian fluid, oxygenated and placed into coolers on a tray that rests on ice. Milt for this group will be transported in test tubes sealed in an oxygenated plastic bag in a cooler. Egg disinfection methods will follow recommendations of the Lamar Fish Health Unit. For Connecticut River kelts held at North Attleboro NFH, spawning and transport of both fertilized (50%) and unfertilized eggs (50%) to White River NFH (via R.S. Cronin NSS) for incubation will occur on multiple dates and will be conducted by hatchery personnel from these three stations. For Richard S. Cronin NSS sea-run broodstock, eggs collected from approximately 10 females will be pooled. Eggs will be split into six groups; three for fertilization at R.S. Cronin NSS and three for fertilization at the incubating facility - White River NFH. Methods for handling of gametes will proceed as described above. Mean percent eye-up of egg treatments will be compared with 2 sample t-tests.

Results

Eggs with fertilization delayed until arrival at the incubating station had a total of 61.2% eye-up vs 49.2% eye-up with eggs fertilized before transport. In each egg type transported to White River NFH in 1994, eye-up was greater when fertilization was delayed until eggs reached the receiving station but results were not significantly different ($P>0.05$). However, eggs taken from Nashua to North Attleboro NFH had significantly better eye-up ($P\#0.05$) when fertilized after transport rather than before (56.6% vs 41.6% respectively).

Study Number and Title:

L-95-03 Comparison of use of LHRHa and CCP for synchronization of gonadal development in Atlantic Salmon (SALMO SALAR).

Principle Investigator: Catharine Johnson, Northeast Fishery Center (NEFC)

Co-Invest/Cooperators: Victor Segarich, Bob Groton - Nashua National Fish Hatchery (NFH); Bill Krise, Dale Holyfield; National Biological Survey (NBS) - Wellsboro; Mike Hendrix, Bill Fletcher, Jerre Mohler - NEFC

Background and Justification

Atlantic salmon restoration is the highest priority program in Region 5 with a major requirement of the program being successful spawning of adult fish. In 1993, Nashua NFH male domestic salmon did not provide viable gametes in synchronization with female fish thus affecting 1:1 sex ratio required to enhance genetic diversity. In addition, the quality of milt produced was questioned by culturists at the Nashua facility. A management tool was necessary to synchronize the gonadal development ensuring that sufficient male gametes were available at the appropriate time to permit paired matings. Luteinizing Hormone Releasing Hormone analogue (LHRHa) and Common Carp Pituitary Hormone (CCP) have both been used to induce maturation in Atlantic salmon.

Study Objectives

Time of spermiation, milt volume, and sperm counts will be determined in three groups of fish receiving either LHRHa, CCP, or injection of saline solution in 1994 (controls). Performance will be compared between the groups and recommendations made to Nashua personnel.

Materials and Methods

Sixty three (63) 2+ year male domestic Atlantic salmon from Nashua NFH with little or no milt will be selected for this experiment. Fish will be injected with 1 ml stock solution of either CCP, LHRHa, or sterile saline using a tuberculin syringe and 20-gauge needle. All injections will be administered intramuscularly in the dorsal sinus area adjacent to the dorsal fin. Seven days after the first injection, all males will be checked for milt volume. The quality of milt will be determined with a sperm count and motility score in pools of seven fish. For each group, milt from 7 fish pools will be used to fertilize pooled eggs from 3 females. Eggs will be divided into aliquots of approximately 500 eggs each. One ml. of milt from each of the pooled males will then be used to fertilize each 500 egg aliquot. There will be 3 egg replicates for each of the 7-pool males in each of the 3 treatment groups for a total of 27. Eggs will be incubated in randomly selected compartments of Heath incubator trays. Egg mortality records will be maintained by Nashua personnel. At egg eye-up, eggs will be shocked and mortality recorded. Remaining live eggs will be determined by direct count. Total live eggs plus mortality will provide exact egg counts for each replicate.

Results

At 7 days post-injection, percentages of fish which produced milt were: 95% of LHRHa, 91% of CCP, and 43% of controls. Statistically, LHRH and CCP-injected fish gave significantly greater average milt volumes than controls. The average number of cells per unit of milt was significantly greater between all three treatments with LHRH having the greatest number followed by CCP, then controls ($P < 0.05$). Motility appeared to be comparable between the three treatments. At 14 days post-injection, there was no significant difference between milt volumes for the treatments. However, controls increased average milt production as compared to the 7 day examination while both LHRH and CCP gave significantly less milt. There was no significant difference ($P > 0.05$) in mean percent hatch between eggs fertilized with milt from any treatment group at 7 or 14 days post-injection. Average hatch rates ranged from 53 to 60% in the study.

Study Number and Title:

L-95-04 Mass marking trials with non-feeding Atlantic salmon fry

Principal Investigator: Northeast Fishery Center Biologists

Background and Justification

Fry stocking by the U.S. Fish and Wildlife Service has become an increasingly important part of the Atlantic salmon (ATS) restoration program in the Northeastern U.S.. Paramount to the success of fry stocking in achieving management goals is the ability to assess the effectiveness of the strategy. Therefore, a need exists within region 5 of the U.S. Fish and Wildlife Service for a technique of marking non-feeding Atlantic salmon fry (sac-fry) with a readily recognizable tag or mark capable of being detected in returning adult fish. Chemical markers such as oxytetracycline, produce a mark on calcified fish tissues made visible under UV light but no information was given concerning longevity of detectable fluorescence. In larval teleosts, very fine horny filaments, the actinotrichia, can occur in the fin fold and may persist in the outer edge of the adult fin membrane. These filaments may bind fluorescent compounds if sufficient calcium content is present. An additional fluorescent compound, calcein, can produce a detectable mark on fish otoliths similar to tetracycline but may be less toxic than tetracycline.

Study Objectives

The efficacy of marking calcified tissues of Atlantic salmon sac-fry will be tested using two treatments: (1) tetracycline immersion bath (2) calcein immersion bath. In addition, fluorescent pigment and micro-taggant will be mechanically pressure sprayed into the epidermis of a number of sac-fry for additional treatments. Short and long term mark retention and effects on health and growth will be tracked on study fish at the Northeast Fishery Center (NEFC), Lamar, PA. over a five year period.

Materials and Methods

Experimental design will consist of two major components: (1) immersion treatments and (2) mechanical pressure spray treatments. Immersion trials will consist of tetracycline and calcein static baths. Each chemical immersion trial will have three replicates in the form of 6½-liter acrylic hatching jars each containing 200 non-feeding ATS fry of Connecticut River sea-run parental origin. Tetracycline immersion baths will be prepared at a concentration of 250 mg/l tetracycline hydrochloride in the form of oxytetracycline - 343, an approved INAD chemical for immersion marking of salmonids. Calcein immersion will be prepared at a concentration of 125 and 250 mg/L. All immersion trials will be for a duration of 48 hours. Pressure spray treatments will consist of an inert pigmented compound and a microtaggant described above both of which fluoresce under longwave UV radiation. Numbers of fish and replicates will be the same as immersion bath treatments along with three control replicates handled similarly except for withstanding pressurized spray.

Results

Immersion treatments - Neither oxytetracycline-treated or control fish received a detectable mark when examined under 100X using long wave UV light (490 nm). Fish from both calcein treatments received a mark detectable as brilliant green fluorescence in all fin ray structures when viewed as above. The mark was non-lethally detected in 35 out of 40 parr (88%) sampled at 5 months post-immersion and 58 out of 61 (95%) sampled at 8 months post-immersion. Fry immersed in 125 mg/L calcein had lowest 10-day mortality but no significant difference was found between treatments ($P > 0.05$). Control fish exhibited greater growth than any other treatment at 30 days and 150 days. This was most likely due to an experimental error which resulted in culturing control fry at a lower density than other treatments. Calcein-marked tissue samples were clearly readable after storage for 5 months in 70% ethyl alcohol.

Mechanical pressure spray treatments - Neither spray treatment resulted in producing a mark which would be retained in a majority of treated fry for extended periods of time.

Study Number and Title:

L-95-05 Observation of oocyte development in captive female Atlantic sturgeon (*Acipenser oxyrinchus*) acquired when oocytes are in an early vitellogenic stage.

Principal Investigator: Jerre W. Mohler; Northeast Fishery Center

Co-Invest/Cooperators: NEFC biologists

Background and Justification

Commercial records of Atlantic sturgeon (ASN) landings from the late 1800's to the present indicate a severe decline in the fishery (Taub, 1990). This problem has been addressed in the form of management plans for restoration of this species throughout its range by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC recommended formation of a culture and stocking group to develop guidelines for culture and restoration activities to ensure consistency with the goals and objectives of the ASMFC's Fishery Management Plan for Atlantic Sturgeon, November, 1990. The culture and stocking group, which is comprised of all ASMFC states, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service, has made recommendations including: "Basic cultural experiments should be undertaken at appropriate federal and state facilities to provide information on: "efficacy of alternative spawning techniques....." (Smith, 1992). Current techniques used for capture and spawning of ASN can lead to poor fry production. Capture (of female ASN) and undoubtedly the transport stress are major contributing factors to the arrest of final maturation and ovulation. Alternative techniques for obtaining viable gametes from female ASN are desirable. According to other sturgeon researchers, three modal groups are usually present in a chondrostean population with longer than annual vitellogenic cycle: early, mid, and late vitellogenic stages. During two years of sampling both off-coast and Hudson River ASN, no mid or late vitellogenic stages were found. However, additional sampling subsequent to 1994 revealed a small number of females which had oocytes past the early vitellogenic stage.

Study Objectives

NEFC, in cooperation with fishermen participating in the New Jersey off-coast 1995 ASN fishing season, will capture one to three female ASN with oocytes in an early or later vitellogenic stage. The fish will be transported and held at NEFC where efforts for conversion to formulated feed and observations of oocyte maturation will be performed with the ultimate objective of hormone induced spawning of the female should oocyte maturity occur.

Materials and Methods

NEFC will contact known ASN fishermen and to provide ASN capture. Biopsies will be performed to sample gonadal condition of all suspected female ASN. Females with ovaries in the desired stage of oocyte development will be transported to NEFC and held in a fresh water, flow-through, 20-foot diameter tank at ambient water temperature. Pelletized feed will be introduced daily. Monthly samples of the ovary will be taken to determine changes in oocyte development. If oocytes develop to the completed stage IV of maturity (germinal vesicle index = 0.07 or less) (Detlaf, et al., 1993), injection of spawning hormones LHRHa and/or CCP will be initiated and the fish will be spawned.

Results

Out of A total of 19 ASN captured, 12 were examined by NEFC for gender and sexual maturity. Of the 12 examined, 10 were judged to be male and 2 were female with immature ovaries. Five fish (1&, 4%) were transported to NEFC, acclimated to fresh water, and placed into a 20-foot diameter tank with flow-through fresh water. These fish have shown interest in pelletized fee, but no confirmed feeding has been observed by NEFC staff. No mortality was seen in biopsied fish including those transported to Lamar. No further biopsies have been performed on the fish since there has been no evidence of feeding activity.

Study title:

Reproduction and alevin marking techniques for Atlantic salmon.

Principal Investigators: NBS-Wellsboro study plan #08012-9

Co-Invest/Cooperators: Northeast Fishery Center Biologists - Lamar, Pa

Theory: Marks applied to bone, skin, or similar tissue become hidden in tissue, or lost as tissue regenerates over time. These marks could require lethal sampling. The objective of this study is to establish an alevin blood marker which can be identified in returning adult ATS. Immune markers would be regenerated from immune system memory of exposure to an antigen not normally encountered in natural systems. Fish will be exposed to several antigens (bovine serum albumin, avidin, neutravidin, and hapten/carrier combinations) via a water bath antigen delivery. Fish will be sampled at 20, 30, and 40 days post-treatment to determine optimum sample dates after treatment and will show that antigen uptake is achieved. Unexposed fish will be examined as a negative control. We will develop ELISA (enzyme linked immunosorbent assay) procedures to detect marked fish. Different dosages will be tested to find the best one for sac-fry. Sea-run ATS will be sampled to ascertain that wild fish do not encounter the antigen naturally. In spring of 1996, groups of fry will be exposed to antigens and mark retention will be monitored for several months.

Results

Study is in progress as four hundred (1+) Penobscot smolts have been transferred from NEFC to Wellsboro where they were used as controls or exposed to one of four antigens -bovine serum albumin, avidin, trinitro phenol and dinitro phenol. Appropriate immunological detection chemicals and expendibles have been acquired. Efforts are underway to determine optimum dose and time exposure rates, blood sampling frequency, and purification of antibodies. Blood serum from 1995 searun ATS will be collected in December for screening against cross reactive antibodies to the above antigens.

Study Title:

Immunomodulators as a fish health management tool

Principal Investigators: Abernathy Salmon Culture Technology Center

Co-Invest/Cooperators: Northeast Fishery Center Biologists - Lamar, Pa

Background and Justification

Furunculosis, a pathogenic disease in salmonids is caused by the bacterium *Aeromonas salmonicida* has been considered a scourge of salmonid culture. The disease has a negative impact on the Atlantic salmon program from holding returning sea-run fish for spawning to maintaining and producing domestic broodstock and smolts. Oxytetracycline has been injected to prevent outbreaks of the disease but is often an impractical means of control.

Study Objectives

This study will test the efficacy of three different diets containing additives for immune system enhancement in prevention of furunculosis in domestic Atlantic salmon parr.

Methods and Materials

Domestic Atlantic salmon parr raised at the Northeast Fishery Center will be used in the study. The diets to be tested are: (1) VST (2) Tetraselmis (3) Levucell, a glucans enriched feed. Fish will be randomly assigned to four holding tanks. All fish will be fed the control diet for 14 days. During the second 14 days, groups will be offered one of the test diets or the control. On day 29, fish will be challenged with a furunculosis bath and placed into replicate experimental holding tanks. During the final three weeks of the study, all groups will receive the control diet. Mortality will be recorded daily for all study tanks.

Results

- 1st attempt 1994 - Immersion bath did not elicit a furunculosis response in challenge fish
- 2nd attempt 1994 - Fish broke with furunculosis prior to challenges
- 1st attempt 1995 - Ninety-eight percent mortality occurred in ATS smolts which were bath challenged with 10^7 cells/ml of *A. salmonicida*. Mortality occurred both in control and test diet groups. Of interest, mortality was delayed for 24-hours in the Tetraselmis treatment.

Study Title:

Monitoring stress responses on the reproductive physiology of Atlantic sturgeon

Principal Investigator: William F. Krise, Ph.D.- National Biological Survey - Wellsboro

Co-Invest/Cooperators: Northeast Fishery Center (NEFC) - Lamar; Joel Van Eenennaam - University of California, Davis

Background and Justification

Remnant populations of Atlantic sturgeon (ASN) exist in large eastern U.S. rivers such as the Hudson and Delaware. As part of the restoration efforts on this species, more data is needed on induced spawning and effect of stress related to capture of individuals in the wild. This will allow production of viable spawn for use in management of ASN in the Hudson and other rivers.

Nothing is known about the endocrinological patterns of ASN after induced ovulation, and there has been no monitoring of responses to capture stress to determine the impacts of handling, netting, temperature, and surgical stress on the reproductive physiology of ASN captured when near gonad maturation.

Objectives

Objectives are (1) to monitor the response to capture and handling stress in adult Atlantic sturgeon (2) to monitor levels of sex hormones in wild and captive Hudson river fish once induced to spawn. Egg viability will also be monitored.

Results

Blood analysis showed that there is a slow increase in response to stress (compared to salmonids) where effects require more than 15 minutes after capture to show physiological adaptations in response to stress. These descriptions should be used only for general planning since small sample sizes were used in this study. In general, fish which were allowed to recover from capture in a holding tank for 24 hours or more had differential white blood cell counts which indicated some recovery from stress when compared to those sampled within three hours of capture. Stress was manifested in blood analyses by low lymphocyte and high neutrophil percentages. In addition, fish sampled with less than 24 hours recovery time after capture showed somewhat higher glucose and low cholesterol levels, indicating that energy was mobilized from fat and was temporarily used up (Personal communication 8/30/95, William Krise, NBS-Wellsboro).

Studies Planned for FY96

Atlantic salmon:

- Determine effect of low oxygen levels on survival of Atlantic salmon eggs during transport.
- Expose control and Tetraselmis (immunomodulator) diet groups to natural challenge (Fishing Creek water) to determine efficacy of Tetraselmis diet for controlling low level exposure to *A. salmonicida*.
- Continued study of fry marking techniques.
- Experimental stocking of non-feeding Atlantic salmon fry mass-marked by immersion in a calcein solution with subsequent non-lethal evaluation.

Atlantic sturgeon:

- Capture and induced spawning of mature Delaware River and/or Hudson River Atlantic sturgeon
- Continue search for mature broodstock in the Delaware River and Chesapeake Bay.
- Influence of feeding regimes on growth of juvenile Atlantic sturgeon
- Initiation of feeding in captive Atlantic sturgeon using formulated diets
- Cooperation with National Biological Survey - Leetown in challenging Atlantic sturgeon to known salmonid pathogens
- Cooperation with National Biological Survey - Conte Lab on studies of behavior and fish passage for Atlantic sturgeon
- Evaluation of pond culture of juvenile sturgeon over winter.

Miscellaneous:

- Cooperation with Aquatic Systems Engineering and Electric Power Research Institute (EPRI) on Effects of daily fluctuating dissolved Oxygen levels on growth of various fish species.