

# **FROM EGG TO STREAM**

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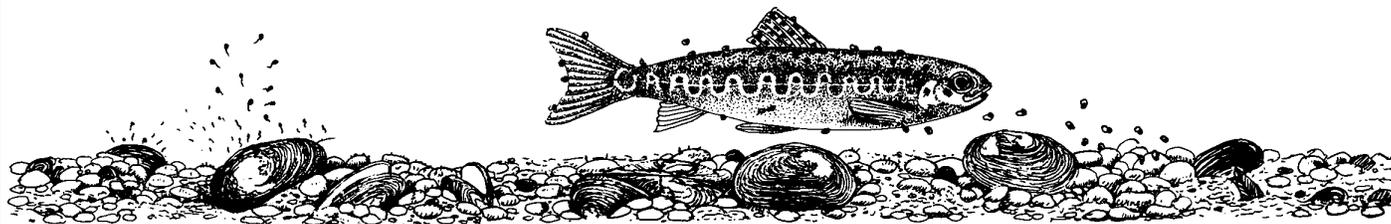
## **A Guide to Building and Maintaining Classroom Incubators for Atlantic Salmon**



A Companion Document to the  
**Adopt-A-Salmon Family Teacher's Guide**

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U.S. Fish and Wildlife Service  
Central New England Anadromous Fish Program  
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Nashua, New Hampshire 03063



## A New and Improved Guide

All across New England, schools in the Adopt-A-Salmon Family program have been raising Atlantic salmon in the classroom for five years. In that balance of time, the collective experience of teachers and students with their "salmon families" has inevitably lead to the need to update this guide. As a new program in the fall of 1993, not much was known about how to raise healthy salmon in small aquariums with recirculated water. Most of the guidance provided then has held up. Some of it hasn't. This revised guide provides the "latest and greatest" recommendations for raising healthy Atlantic salmon in classroom incubators.

The biggest challenge to raising healthy salmon is controlling ammonia levels in the classroom incubator. Salmon contribute ammonia to the water column through respiration, urination, and defecation. Ammonia can be easily controlled through frequent water changes. In the past, water and filter changes were conducted blindly, at somewhat arbitrary intervals. It has become clear over time that the water chemistry of individual incubators can vary greatly. Thus, some incubators need more frequent water changes than others. But how do you know this?

The new approach to incubator housekeeping includes both scheduled water changes and simple water chemistry tests. Specifically, teachers (and perhaps students), will be encouraged to test for pH and ammonia levels in their incubators on a frequent basis. The test results should help determine the necessary frequency of water and filter changes. The new approach to "incubator housekeeping" is detailed in this revised guide.

Please take the time to review this revised guide in its entirety. If you look at the table of contents, you will notice that there are several new sections and an expanded list of "frequently asked questions." Should you come across any errors, or have any suggestions for improving the guide, please let me know.

Good luck with your salmon and watershed adventures!



Matt Poole,  
Program Coordinator

August, 1998

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## **INTRODUCTION**

Given the proper training and support, raising Atlantic salmon in the classroom can be a simple, fun, and educational activity for both teachers and students. This guide details, step by step, what's involved with constructing and operating an incubator, caring for salmon eggs and fry in the classroom, and releasing a "salmon family" into a local stream. Almost literally, the reader is guided "From Egg to Stream."

## **THE NATURE OF AN INCUBATOR**

In the Adopt-A-Salmon Family program every effort is made to raise fish in conditions that are as close to natural as possible. In the wild, female salmon deposit their eggs in gravel depressions on the bottom of cold water streams. All of the elements of a natural nest (or redd) are incorporated into the classroom incubator: cold, clean, moving water; a gravel bottom; and darkness (foam-wrapped aquarium). This approach leads to healthy fish and gives students an accurate, up-close understanding of salmon reproduction.

Schools may opt for one of two incubation methods. The preferred method requires the purchase of a chilling unit. Together the unit, aquarium, filter, and related supplies cost approximately \$700. Recognizing that school budgets are tighter than ever before, a second, low cost approach to incubation is offered as an alternative. In this case salmon eggs are placed in a small glass vessel inside of a standard refrigerator. This approach works, though it does require considerably more maintenance on the part of the teacher or facilitator. In the best of all worlds, the "Rolls Royce" approach is the method recommended by the program developers. Construction and operation of both incubation approaches will be discussed, step by step, in the following sections.

## **WATER - AN INCUBATOR'S LIFE BLOOD**

Water quality is the most important factor influencing the health of eggs and fry. Before the eggs are placed in the incubator, chlorine (if present) must be removed from the water. This can be accomplished in one of two ways: 1. Let the water sit in the tank or bucket (with the lid off) for 72 hours while the chlorine naturally dissipates, or 2. Add a chlorine-removing agent to the water. This chemical can be obtained at most aquarium supply stores. The bottom line - chlorine will kill salmon eggs.

Atlantic salmon are a cold water fish. Water temperature is especially crucial during the incubation process. For the eggs, the water temperature should be 38 to 40 degrees Fahrenheit. Later, as the young fish mature, the temperature may be elevated - but usually not much above 55 degrees (discussed in greater detail later).

## **GRAVEL - AQUATIC "HIDE N' SEEK"**

One common mistake made by novice classroom salmon aquaculturists is using gravel that is too small. **Individual cobbles should be a minimum of one inch in diameter.** Smaller cobbles don't provide the "hiding places" where newly hatched salmon alevin like to congregate. More importantly, decomposing organic debris (dead eggs/fish, fish waste, and fish food), can accumulate under the smaller sized gravel - usually undetected - giving rise to dangerous fungal and bacterial growth. Gravel of appropriate size cannot generally be found in a fish or aquarium supply store. Rather, it is more likely to be found at gravel pits, landscape supply stores, or home centers. A creative approach employed by some teachers is to assign students to bring in several rocks from home. This type of approach generally yields all the gravel that is needed because **the gravel layer in the incubator should only be one rock deep.**

**OPTION A - THE "ROLLS ROYCE" INCUBATOR**

***Parts List***

**chiller; 20 or 30 gallon glass aquarium; AquaClear 300 aquarium filter (or other filter of similar design); filter cartridges (1) foam, (3) activated carbon, (2) ammonia); (3) 4' X 8' X 1" sheets of rigid foam insulation; aquarium thermometer; 2" clear plastic packing tape; (20) 3" common nails or sheetrock screws; dip net; (2) 5 gallon plastic bucket with lids; aquarium siphon or 3 feet of .5" clear, flexible, plastic tubing; (1) 2 gallon pail of washed cobbles (approximately 1" diameter); turkey baster; sturdy table**

The Rolls Royce incubator consists of a thermostatically controlled chiller, 20 or 30 gallon aquarium, standard aquarium filter, and other supplies. With the exception of the chiller, all parts and supplies can be purchased locally from pet and/or hardware stores. Here is how to assemble the Rolls Royce incubator (also detailed in the photographs on page 5):

**Step 1:** Place a table or other firm support where the incubator will be located. The table should be large enough to fully encompass the incubator base (chiller and aquarium) and sturdy enough to support approximately 250 pounds. Table height should be such that students are able to view the fish from the front and top of the aquarium. The incubator should be located near an electrical outlet (obviating the need for extension cords) and out of direct sunlight. Once the incubator is filled with water, it cannot be moved.

Two saw horses with several 2" by 6" X 6' planks laid across the top provide a sturdy, low-cost alternative to a table. For safety reasons, it is important that the planks are screwed down to the saw horses.

**Step 2:** Cut the one inch styrofoam into pieces to form a box around the aquarium. Accommodation should be made for the electrical filter that will overhang the aquarium at one end. The back panel should be notched where the chiller element overhangs the aquarium rim. A rectangular viewing window should be cut into the front panel. The viewing window can be any size desired. Pieces can be cut to size with a utility knife and straight edge or on a tablesaw.

**Step 3:** Place the aquarium on the bottom styrofoam panel. Position the electrical filter on one end of the aquarium.

**Step 4:** Assemble the box around the aquarium, fastening pieces together with small nails or sheetrock screws. Joints should then be reinforced with clear plastic tape. The top styrofoam panel rests unattached on top of the foam box.

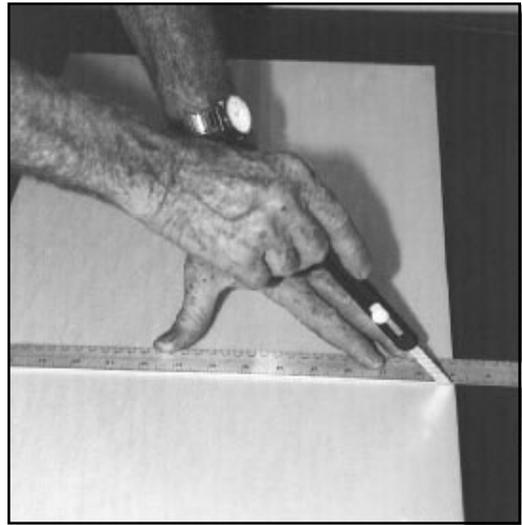
**Step 5:** Position the chiller unit behind the aquarium and foam box, placing the chilling coil within the aquarium.

**Step 6:** Place gravel at bottom of aquarium - one stone deep. Fill the aquarium with water to within 1.5 inches of the rim. Set thermostat on aquarium for approximately 38 degrees Fahrenheit. Plug chiller in and turn on. If the water temperature is above the thermostatic setting the chiller should engage immediately.

**Step 7:** Place the sponge and charcoal filter elements within the filter reservoir following the manufacturer's instructions. Using a utility knife, **cut a slit into the end of a small foam block and place it over the opening of the intake tube. This will prevent eggs and fry from getting drawn into the filter.**



**Figure 1.** The "Rolls Royce Incubator," Option A, shown with front, side and top panels removed. The chiller sits behind the aquarium in this photo.



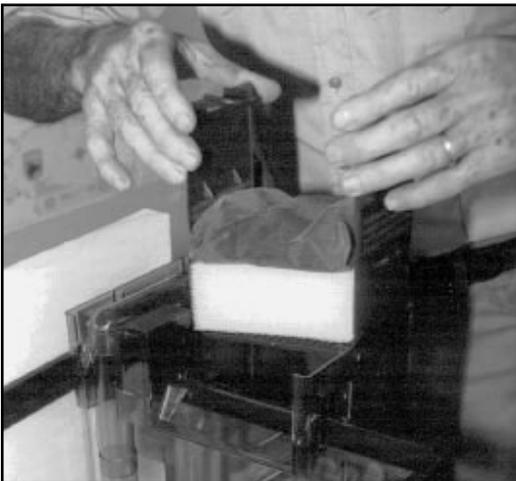
**Figure 2.** The foam panels are easily cut with a utility knife and straight edge. A bandsaw or tablesaw may also be used.



**Figure 3.** Styrofoam panels are held together with small nails or sheetrock screws. The joints are then reinforced with plastic tape.



**Figure 4.** The chiller coil is lowered into the aquarium over the back styrofoam panel.



**Figure 5.** When placing filter elements into the filter basket, the foam element must be at the bottom.



**Figure 6.** A small foam block is placed over the filter intake tube to prevent fry from being drawn into the filter.

**Step 8:** Position the thermometer so it can be viewed through the window in the front panel. After allowing the chlorine in the water to dissipate for 72 hours, the incubator is ready to receive the salmon eggs. Periodically check the thermometer to make sure the chiller is functioning properly.

**OPTION B - THE BUDGET APPROACH INCUBATOR**

**Parts List**

refrigerator (small dormitory type or larger), 2.5 gallon (or larger) glass aquarium; 20 gallon glass aquarium (if fish will eventually be placed in room temperature water); aquarium filter (similar in design to the Aquaclear 300); filter cartridges (1) foam, (3) activated carbon, (2) ammonia; aquarium thermometer with suction cup; dip net; (2) 5 gallon plastic bucket with lids; aquarium siphon or 3' of .5" clear, flexible, plastic tubing; turkey baster; (1) .5 gallon pail of washed cobbles (approximately 1" diameter).

The Option B - Budget Approach provides a low cost alternative to the "Rolls Royce" incubator. A small glass or plastic aquarium, outfitted with an electrical filter and containing approximately 50 salmon eggs, is placed inside a refrigerator. Later, after the fish "swim up" (explained in a later section), the salmon may be transferred to a larger aquarium with room temperature water.

While the Budget Approach incubator has been used successfully in many classrooms, it does have a few drawbacks: 1. because the eggs are in a refrigerator, students don't have as much direct access to their salmon family, and 2. tank care is somewhat more intensive. Nevertheless, this approach does work and has a much more attractive price tag than the Rolls Royce! (Note: While the following directions address assembling a budget incubator using a two gallon aquarium, a larger aquarium may be used provided the refrigerator has the space). Here is how to assemble the budget incubator:

**Step 1:** Place a layer of gravel at the bottom of the 2.5 gallon (or other size) aquarium - one stone deep.

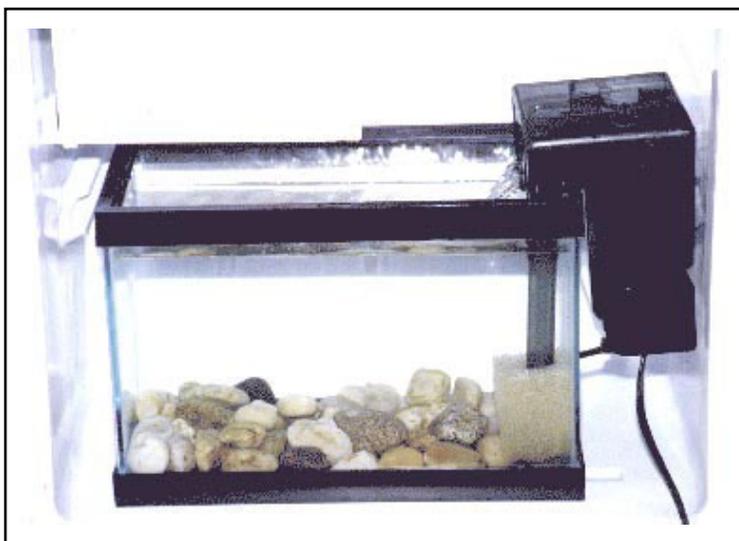
**Step 2:** Place the filter in the aquarium. Install the foam and charcoal filter elements according to the manufacturer's instructions. Using a utility knife, **cut a slit into the end of a small foam block and place it over the opening of the intake tube. This will prevent eggs and fish from being drawn into the filter.**

**Step 3.** Fill the aquarium with water to within 1.5 inches of the top of the aquarium.

**Step 4.** Place the thermometer in the tank.

**Step 5.** Place the aquarium and filter in the refrigerator, making sure the shelf will support the weight.

**Step 6:** Plug the filter in, making sure the reservoir is filled with water first. The electrical power cord will protrude from the refrigerator. This should not adversely affect the seal on most refrigerator doors.



**Figure 7.** The budget approach incubator consists of a small glass aquarium (or similar vessel) with a small electrical filter which is placed inside of a refrigerator.

The water temperature in the refrigerator should be kept as close to 38 to 40 degrees Fahrenheit as possible. This may require some trial and error adjustment of the refrigerator's temperature setting.

After allowing the chlorine in the water to dissipate for 72 hours, the incubator is ready to receive the salmon eggs. Periodically check the thermometer to make sure the temperature is appropriate.

At the discretion of the teacher or facilitator, the salmon family may be transferred to a 20 gallon aquarium containing room temperature water several weeks prior to the release date, but only after "swim-up" (the fish have emerged from the gravel). This affords students a better opportunity to see their fish "up close and personal." The larger tank should not contain any gravel, as this will make tank maintenance much easier. Alternatively, the fish may be kept in the refrigerator until the stocking date. A tank with water at room temperature will require more frequent maintenance - primarily in the form of water and filter changes - because the fish are producing waste at a faster rate. Decomposition of fish food and waste will also occur at a faster rate at warmer temperatures.

### ***SALMON EGG PLACEMENT***

Salmon eggs are generally delivered to the school in January. The number of eggs delivered depends upon the size of the aquarium. The rule of thumb is ten eggs per gallon of water. The eggs are called "eyed" because of the two dark spots evident within the developing embryo. These are the actual eyes of the fish. The eggs have been incubating at the hatchery for approximately three months and have reached a stage in their development where they can tolerate handling relatively well. Use of eyed eggs improves salmon family survivability in the classroom.

Placing the eggs into the incubator is a relatively simple endeavor. Water temperatures in tank and delivery container should be about equal - within 5 degrees Fahrenheit. Using a small dip net or slotted spoon, carefully scatter the eggs over the surface of the gravel. The eggs should be placed where students can see them through the viewing window. Eggs resting on top of one another are not a problem. This is what occurs in a natural redd.

### ***EGG HATCH***

Students always look forward to the hatching of their salmon eggs. By tracking daily water temperatures, they will be able to mathematically predict the approximate hatch date. A guide detailing this activity can be found in chapter 4 of the teacher's guide.

Eggs normally hatch over a period of days. As they do, a white foam will collect at the top of the tank. This substance results from the enzymatic breakdown of the egg shells and will dissipate after several days.

Egg care consists of removing dead eggs in a timely manner, daily if possible. If this is not done, fungus may colonize the dead eggs and jeopardize neighboring healthy eggs. Dead eggs turn white. They are removed with an "egg picker," a contraption that resembles a turkey baster. A turkey baster can be modified to act as an egg picker by cutting off its narrow tip (to accommodate the diameter of the eggs). Because eyed eggs are placed in the salmon incubators, pre-hatch mortality should be relatively low. Below five percent can be expected.

### ***INCUBATOR HOUSEKEEPING***

Caring for a salmon family is very similar to maintaining a tropical fish tank at home. Provided certain routine tasks are performed, the incubation experience should be relatively trouble-free. However, neglecting to perform these tasks can lead to the sudden and total loss of the salmon.

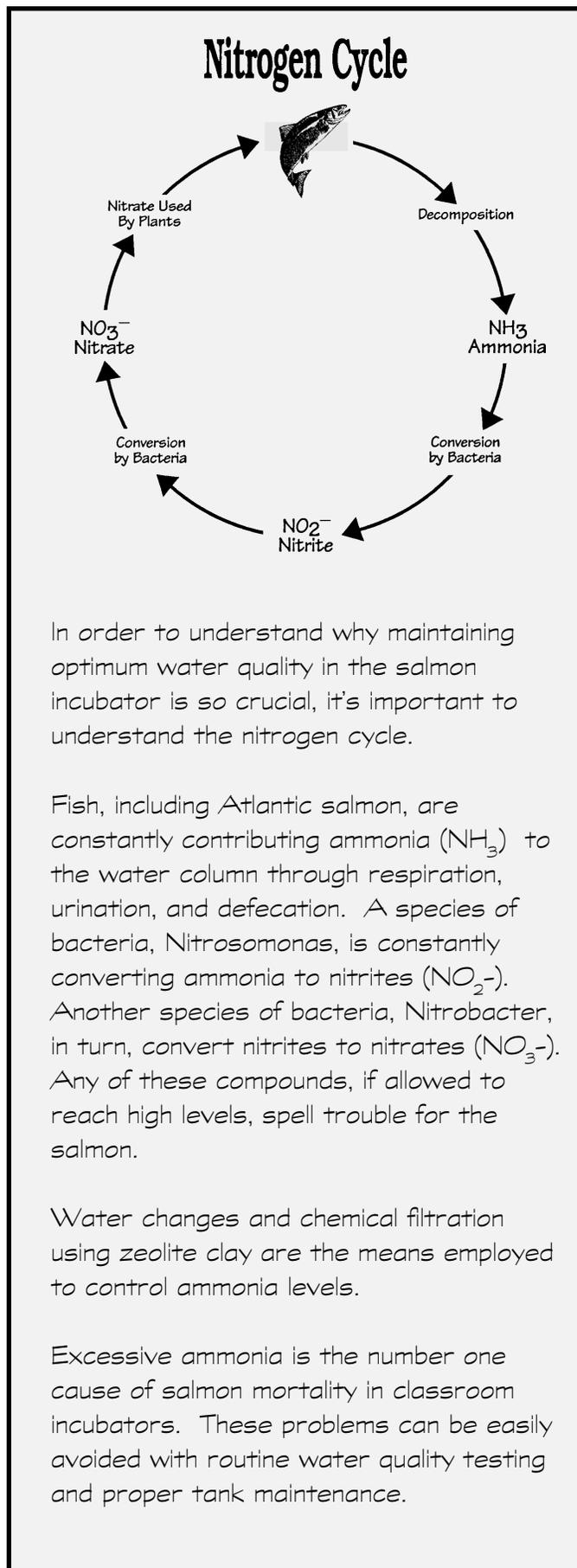
Fish produce waste, primarily in the form of ammonia. Ammonia is produced through respiration, urination, and defecation. Decomposing dead fish, eggs, and food can contribute to the ammonia load in a tank. Simply stated, ammonia above a certain level is extremely toxic to fish. **The principal goal of incubator housekeeping is to keep ammonia at manageable levels.** This is done by changing and filtering the water.

**Water Changes:** The old adage, “the only solution to pollution is dilution,” applies to ammonia in a salmon incubator. The most direct way of dealing with ammonia is to frequently change a portion of the water in the tank. **After the eggs have hatched, twenty five (25%) to fifty percent (50%) of the water volume should be replaced on a weekly basis. Also, pH and ammonia tests should be performed every week in order to determine if more frequent water and filter changes are necessary. A pH range of 6.5 to 7.5 is acceptable. Ammonia should not exceed 1 part per million (ppm).**

When replacing, water should be removed from the bottom of the tank using a gravity fed siphon or length of vinyl tubing. The siphon acts like a vacuum cleaner, sucking up debris from among and under the gravel. Gravel vacuuming is an important tool in the war against ammonia. **It is imperative that fresh water be dechlorinated and at the appropriate temperature before being added to the tank.** Fresh water should be poured very slowly, taking great care NOT to produce too much turbulence on the tank bottom.

Inexpensive test kits for pH and ammonia can be purchased at aquarium supply stores. pH testing generally involves one of the following: 1) colorimetric test papers (change color to indicate pH level), 2) colorimetric tests using a chemical reagent, or 3) pH meter (the easiest, but most expensive method). Ammonia test kits generally consist of a chemical reagent and colorimetric comparison chart.

Great care should be taken when handling any of the chemical reagents in the test kits. Never pour chemical reagents into the incubator. When purchasing test kits, ask the retailer to provide a MSDS (Material Safety Data Sheet), for each of the chemical reagents in the test kit. These fact sheets provide important information about a chemical.



## FIRST AID FOR AN AILING SALMON TANK

- ✓ Carefully remove all of the gravel (to see what is lying underneath)
- ✓ Remove any "crud" from the bottom of the tank with a fine mesh dip net
- ✓ Remove 50% to 100% of the water and replace with fresh, chilled, dechlorinated water
- ✓ Clean the sponge filter element
- ✓ Replace or add a zeolite clay filter element (to remove ammonia)

**Filtration:** The incubator filter cleans and aerates (adds oxygen to), the water. With so many different brands and types of aquarium filters on the market, it is important to purchase the right one. The filter should have an intake tube, which withdraws water from the tank and circulates it through a reservoir filled with filter media (typically includes sponge, activated carbon, and zeolite clay filter elements). The water is then discharged back into the tank. The turbulence from the discharge serves to add oxygen to the water. AquaClear is one brand of filter that operates in this manner. There are many other brands with filters that function similarly. The AquaClear 300 is appropriate for a twenty to thirty gallon tank. **Under-gravel filters should not be used in a salmon incubator.**

The filter removes waste materials in three ways:

- ◆ **Mechanical Filtration:** The sponge filter element traps free-floating particulate matter;
- ◆ **Chemical Filtration:** Activated carbon reacts with heavy metals and organic molecules, removing unwanted colors and odors. The zeolite clay filter element removes ammonia from the water; and
- ◆ **Biological Filtration:** The sponge and activated carbon filter elements play host to colonies of beneficial bacteria that, as part of the nitrogen cycle, convert ammonia to less toxic forms (nitrite and nitrate - see the diagram on page 8).

Here are some important tips regarding filter element changes that apply to AquaClear filters and others of similar design:

- ◆ After the eggs have hatched, the activated carbon filter element should be replaced every month;
- ◆ After the eggs have hatched, the zeolite clay (ammonia-removing) filter element should be replaced every month (or more frequently if test results indicate an elevated ammonia level);
- ◆ The sponge filter is washed, not replaced. The activated carbon and ammonia filters are replaced;
- ◆ The activated carbon and zeolite clay filter elements should be rinsed in dechlorinated water before being placed into the filter. This will decrease clouding of the aquarium water;
- ◆ Never replace the activated carbon element and clean the sponge element at the same time. The goal is to establish beneficial, waste-removing bacteria within the filtration system. Alternating sponge cleaning with activated carbon element replacement ensures that the bacteria will not be wiped out; and
- ◆ The sponge element should always be washed in clean, dechlorinated water.

**Egg Care:** Salmon eggs turn white when dead. They should be removed with the egg picker or turkey baster immediately. The turkey baster tip may have to be cut off to accommodate the diameter of the salmon eggs.

**Equipment Disinfection:** Using clean equipment is the key to success when working with Atlantic salmon. All equipment, including the aquarium and filter prior to incubator assembly, should be cleaned and sterilized with a solution consisting of .5 cup of Chlorox per one gallon of water. All equipment should be rinsed thoroughly.

### ***HUNGRY MOUTHS TO FEED***

Whether or not salmon fry are fed in the classroom prior to release into the stream depends upon how developed they are. The transition from yolk sac dependence to active feeding is directly related to photoperiod (length of day), and water temperature. The salmon fry are ready to feed at “swim-up,” when they leave the gravel and enter the water column. At this stage of development the yolk sacs are approximately 75% absorbed. **There is a brief period of time, beginning with swim-up, during which the salmon will learn to feed. If food is not offered to the fish until after this window has closed, they will not learn to feed and will eventually die.**

It is perfectly acceptable to release non-feeding (or unfed), fry. Indeed, some fishery biologists prefer to. In terms of post-release survival, there appears to be no difference whether fed or unfed fry are released.

**Keeping incubator water temperatures in the forty degree range right up until several days before the fry release will almost certainly result in the stocking of unfed fry.** This, therefore, is certainly an option if a school so chooses.

In order to ensure the best possible chance for success during the feeding phase of the salmon-in-the-classroom experience, the following guidelines are provided for each of the two incubator types:

**Using the Option A - Rolls Royce Incubator:** When the yolk sacs are approximately 75% absorbed OR three or four weeks prior to the scheduled release date (whichever comes first), remove the foam panels and place the incubator in an area of indirect light. Gradually raise the water temperature to 55 degrees Fahrenheit (approximately five degrees per day). The warmer water temperatures will move up the date of “swim-up,” (or when the fry first enter the water column). When they do, they are ready to begin feeding. They generally will not feed at temperatures below 50 degrees. The temperature should be kept at 55 until the stocking date. (Note: If stream temperature is being tracked, the incubator thermostat should be adjusted to match the stream a day or two before the release date).

**Using the Option B - Budget Approach Incubator:** If a teacher wants students to be able to feed salmon that are being raised in a budget approach incubator, those fish will likely have to be transferred to a larger aquarium with room temperature water, unless the refrigerator temperature can be increased to 55 degrees Fahrenheit, in which case the same guidelines apply that are outlined for the Rolls Royce incubator (see above). When a refrigerator’s temperature cannot be raised to 55 degrees, the salmon should be transferred to a twenty gallon aquarium, with room temperature water, no sooner than three weeks prior to the scheduled release date. The water temperature should not rise above 70 degrees. The aquarium should be placed in an area with indirect lighting. When “swim-up” occurs (see above), feeding begins.

It should be mentioned that, at room temperature, the salmon will grow quite quickly. Fungus and bacteria will also do very well at warmer temperatures. So, needless to say, water quality testing (pH and ammonia), and tank housekeeping become that much more important.

**What's for Dinner?:** Salmon fry are fed either live, frozen or dehydrated brine shrimp - in very small amounts. Live brine shrimp can be cultured in the classroom (see Appendix B of the AASF teacher’s guide). Frozen or freeze-dried brine shrimp are inexpensive and can be purchased at most aquarium shops. **Live brine shrimp should not be purchased at an aquarium shop because of the potential for introducing pathogenic organisms into the incubator.** There is no magic amount of food to feed the salmon. It simply requires a careful trial and error approach. **The primary rule of thumb is to place no**

**more food in the tank than the fish can consume before the food settles to the bottom. Salmon fry will not eat food that has reached the bottom.** That which settles to the bottom, along with accumulating feces, provides fertile ground for fungus - “public enemy number one” in a salmon incubator.

**There’s a fungus among us!:** Fungus has a filamentous, cotton-like appearance and generally first appears at the bottom of the tank, below the gravel. This can make it difficult to detect. Routine gravel vacuuming (described earlier) is the best way to detect and control fungus. Any unusual problems with water quality should be reported to the facilitator immediately.

### **STUDENT BEHAVIOR AROUND THE INCUBATOR**

Students quickly develop a keen interest and attachment for their salmon family. They need to learn, early on, that their behavior around the incubator has a definite influence on the health of their salmon family. The teacher or facilitator should make a few simple points:

- ◆ Hands should be kept out of the water. That is what the dip net and egg picker are for. Again, clean water is of paramount importance.
- ◆ Salmon are very sensitive to noise and vibrations. Students should keep voices low when around the tank and avoid any unnecessary disturbance - including hanging or leaning on the incubator or table.
- ◆ The incubator is an electrical appliance. Students should be directed not to touch the plugs and thermostat control. If possible the unit should be plugged into a ground fault circuit interrupter (GFCI) outlet.
- ◆ Salmon can be viewed through the front panel. Removal of the top panel will allow for better illumination. All panels should be replaced when students are done viewing the fish.

### **SALMON FAMILY RELEASE**

The salmon are released as inch-long fry, usually in mid to late May. This date can be moved up or back depending on the particular needs of the school or facilitator. Before release can occur, an appropriate site must be selected. A riffle in a cold water stream provides the best habitat. Riffles have a moderate current and gravel bottom. Gravel is extremely important for providing the salmon with safe refuge from predators. Other factors to think about when selecting a release site:

- ◆ Preferably, the fish should be stocked in a LOCAL stream to make the environmental ownership message more personally relevant for the students;
- ◆ For student safety, the stream bank should be relatively flat and otherwise accessible;
- ◆ Site ownership should be determined and permission for access obtained from the landowner;
- ◆ The facilitator should obtain permission from the state fisheries agency before stocking the salmon family into the chosen stream. (Note: For schools in New Hampshire and Massachusetts, the AASF coordinator in Nashua will assign salmon release sites. Those schools will not directly interface with the state wildlife agencies);
- ◆ Is the river presently the target of a salmon recovery effort? If not, is there a reasonable (biologically based) expectation that salmon can survive in the river system? Consider known water quality problems and barriers to migration.

**Matching Incubator and Stream Water Temperatures:** It is important that the stream and incubator water temperatures be close in order to avoid shocking the fish. A severe and sudden temperature change can kill the fish. As a general rule, it is better to transfer fish from warmer to colder water, NOT the other way around. The salmon fry can tolerate a maximum sudden decrease in temperature of about 8 degrees Fahrenheit. They can tolerate a sudden increase in temperature of about 2-3 degrees. Needless to say, it is best to track stream temperature before releasing the fish. Because of a school's location, this may not be possible in some cases. That is why an incubator temperature of about 55 degrees is recommended at

## Appendix A: From Egg to Stream

this time of year. That temperature will be “in the ballpark” of the stream's actual temperature in May - or within an acceptable margin that will allow for equilibrating the water temperatures at stream's edge (this is done by slowly adding small amounts of stream water to the fry bucket).

**Moving Salmon to the River:** Stocking day is the culminating program activity for the Adopt-A-Salmon Family program. The day begins with students transferring their salmon family from the incubator to a five gallon plastic bucket using a dip net. It is much easier to net all the fish if the gravel has been removed (carefully!) ahead of time. A bait bucket aerator (a \$6 item available at most angling supply centers) will keep the water aerated. If the trip to the stream is particularly lengthy (more than an hour) use of an insulated container is recommended. Ice (made from dechlorinated water) can be added to the transport container to maintain temperature if the trip is extremely long.

Having arrived at the stream, the facilitator or teacher generally leads a brief discussion about salmon habitat requirements and why the particular stocking site was chosen. Next each student is given a cup of fish and directed to approach the stream bank. If a school has a particularly large number of students, the hatchery may have to supplement the number of salmon brought from the school. It is very important that each student be given some fish. Upon the direction of the teacher or facilitator, the students gently pour their fish into the stream.

Students should watch the behavior of the fish. Do the fry stay up high in the current or immediately hide behind some gravel? Do the fish turn color? Why? What other interesting things do the students notice? What other creatures are apparent in the stream? Other fish? Crayfish? Aquatic Insects? Where do they fit in the food web with respect to Atlantic salmon? A simple survey of the stream's forage base using the “kick seining” method can be an interesting extended activity while at the stream.

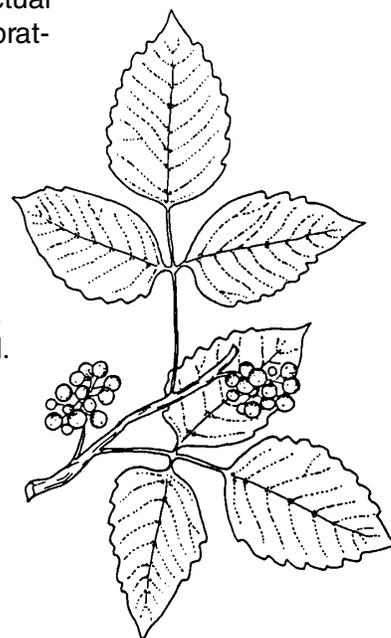
### **TECHNICAL SUPPORT**

Teachers and facilitators receive basic training in incubator care and maintenance at the beginning of the Adopt-A-Salmon Family program. When problems that are beyond their ability to cope with occur, a call to the partner hatchery and/or Adopt-A-Salmon Family New England Coordinator can usually resolve the situation.

### **KEEPING STUDENT INTEREST**

A common complaint expressed by teachers is that student interest in the incubator wains as winter moves into spring. Indeed, there isn't much to look at in the incubator much of the time. The alevin, just like their cousins in the wild, are huddling among the rocks - out of sight, out of (students) mind. So how to keep students interested? There are two ways of addressing this problem. First, explain to the students on day one that the incubator is not an exhibit; it's not there for entertainment value. It is instead an artificial habitat. Second, view the incubator itself as an opportunity for further educational exploration. Here are a few simple ideas to help keep students interested in the salmon:

- ◆ After all of the eggs have hatched, some of the rocks can be removed, one at a time, using a pair of kitchen or barbecue tongs. This may make some of the alevin more visible. Approximately one third of the rocks should be left in place. Rock removal should be done very carefully, lifting straight upward, so as not to injure any of the fish.



***Poison Ivy - A Common Companion on Spring Fry Stocking Trips***

- ◆ Have students conduct the water chemistry tests (pH and ammonia), necessary for proper tank maintenance; perform other water chemistry tests (e.g., dissolved oxygen)
- ◆ Have students conduct a comparative chemical analysis using water from the incubator and nearby water body - perhaps the stream where the salmon will be released. Would the water chemistry of the stream or pond be appropriate for Atlantic salmon? Why or why not?
- ◆ Have students track incubator water temperature to mathematically predict hatch and first feeding dates (refer to activity in January chapter of the AASF teacher's guide);
- ◆ Give students responsibility for certain tank maintenance chores; this may encourage ownership in the incubator;
- ◆ Periodically remove eggs, alevin, or fry from the incubator and view with magnifying lenses or microscopes; study the embryological development of Atlantic salmon;
- ◆ Raise live brine shrimp in the classroom, a form of zooplankton typically fed to salmon at hatcheries. An outline for raising brine shrimp can be found in Appendix B of the AASF teacher's guide. An inexpensive way to raise one "family" of brine shrimp is to purchase a "Sea Monkey" kit, available at many toy stores. The creatures in the Sea Monkey kit are really brine shrimp. Studying another life form will spark student interest and draw their attention to the larger biological community that the salmon belongs to (e.g., food web);
- ◆ Conduct Atlantic salmon research on the internet;
- ◆ Communicate or pen-pal, via the internet, with other schools that are raising salmon in the classroom. The AASF coordinator in Nashua can provide a list of potential schools for this activity;
- ◆ Study salmon behavior in the incubator (after the fish swim-up).

### **AQUARIUM CHILLER SOURCES**

Glacier Corporation  
2800 South Main Street, Unit K  
Santa Ana, California 92707  
Phone/Fax: (714) 557-2826

Refrigeration Specialists, Inc.  
Vernon River Post Office  
Prince Edward Island, Canada COA 2E0  
Phone: (902) 651-2722

### **FREQUENTLY ASKED QUESTIONS**

#### **Why do the alevin stay under the rocks?**

This is a natural behavior. The gravel provides cover from predators and the river current. In the wild, salmon emerge from the gravel in search of food after the yolk sac has been absorbed.

#### **What do I do if I notice fungus on the bottom of the tank?**

Carefully remove the rocks from the incubator, one at a time (only if all the eggs have hatched), using a pair of tongs. Vacuum the fungus off the bottom of the tank using the gravity-fed siphon and replace the volume withdrawn with clean water. Clean the filter sponge element and replace the activated carbon and/or ammonia filter elements as necessary. Clean the sponge on the intake tube.

#### **What happens if I notice changes in water color and odor?**

If the water begins to smell and/or changes color, there are definite water quality problems - probably due to high ammonia levels. Make water changes (as outlined in the housekeeping section of this guide) until the water remains clear and the odor disappears. Replace the zeolite clay (ammonia-removing), filter element.

**What happens if my tank leaks?**

Some tanks seem to develop small leaks after a period of time. Unless the leak is unmanageable (beyond the drip stage), it is better to live with it until the salmon are released. If the leak is severe then the fish will have to be transferred to another tank. A leaking tank can be resealed using silicone made specifically for aquariums. Standard, off-the-shelf silicone sealant contains chemicals that will harm the fish.

**Why are some of the eggs turning white?**

Eggs that turn white are dead. A certain number of dead eggs should be expected in every salmon family. That's normal. Dead eggs should be removed promptly using an egg picker or turkey baster. Fungus may soon appear if the dead eggs are not removed and will endanger the remaining live eggs.

**The chiller is not maintaining the proper temperature. What should I do?**

Some of the refrigerant in the chiller may have leaked out or the thermostat may not be working properly. The chiller needs to be repaired.

**What do I do if the chiller breaks down?**

If the chiller breaks down after the eggs have hatched all is not necessarily lost. Alevin and fry have proven to be viable in room temperature water - the cooler, the better. If the chiller breaks down with eggs in the incubator, move the eggs to a glass container placed in a refrigerator. If possible, this water should be aerated and/or filtered (refer to Option B incubator instructions).

**How can I tell when the salmon are ready to feed?**

When the salmon are ready to feed, they will emerge from the gravel and swim up into the water column. This is the cue to start them on feed. There is a limited window of opportunity, beyond which the salmon will no longer be able to "learn" how to feed. Fish that don't learn to feed eventually become "pin heads" due to a large head and undernourished body. These fish will die.

**Can I look at eggs and alevin under a microscope?**

Yes. Students will enjoy looking at the various developmental stages under a microscope. A video microscope is even better. The "critter" should be placed in a water-filled petri dish and not be kept out of the incubator for more than a couple of minutes. A cool light source is best for use with the microscope.

**What happens if the salesperson at the aquarium store recommends that I purchase equipment that is different from what is called for in this guide?**

Aquarium store employees can be very knowledgeable and usually mean well. However, their knowledge is usually limited to tropical fish. Disregard their recommendations and follow this guide.

**If I am having water quality problems in my incubator, will any of the fish medications or chemicals available at aquarium stores solve my problems?**

No, do not add any chemicals to the salmon incubator. The only thing that will successfully address water quality problems is water replacement and filtration.

**Do I always have to dechlorinate water before adding it to the incubator, even if I know it comes from a well?**

Unless you are absolutely certain that there is no chlorine in the water, it should be treated as if it did. The water can be left standing in the open air for 72 hours and/or treated with a chlorine neutralizing chemical (available at most aquarium stores).

**My fish were doing fine and then, all of a sudden, they all died within a few days. What happened?**

Ammonia levels in the tank were probably too high. The die-off could also have been the result of fungus or bacterial gill disease. All three are the result of poor water quality.

**The chiller coil in my incubator is icing up. How do I fix this?**

The chiller thermostat is set too low (shouldn't be set below 36 degrees Fahrenheit), and/or there is insufficient water movement within the tank. The filter size (too small), and/or location (e.g., on short side of tank vs. long side) within the tank may be causing the inadequate flow. Place air stones below the chiller coil to increase water movement. Move the filter to a new location within the tank and/or consider replacing the filter with a larger model. Raise the chiller temperature setting.

**When can I remove the foam panels from around the aquarium?**

The foam panels can be removed about one month before the scheduled salmon family release date. The tank should be placed in an area with indirect lighting.

**Do I have to feed the salmon while they are in the classroom?**

The answer is a qualified "no." If the water temperature in the incubator is kept in the forty degree Fahrenheit range until just before the scheduled release date (in May or early June), chances are that the salmon will still have yolk sacs; they'll still be alevin. Releasing alevin (which are technically unfed fry), is perfectly acceptable. Keep in mind that the incubator water will have to be at about the same temperature as the stream by the release day. Adjusting the water temperature from forty to fifty-five degrees will take awhile (about five degrees per day).