5.5 Instream incubation

What

Instream incubation is the planting of fertilized eggs into a stream or stream bottom. Eggs may be deposited directly into holes dug into the stream bottom or more commonly, eggs are placed in incubators or groups of incubators that are deposited into, placed on, or suspended above the stream bottom. The most common type is the Jordan-Scottie system, which is based on plastic plates. Fertilized eggs are deposited in depressions on one plate, and a second plate is then bolted to it to form a "unit". The second plate is perforated to allow an emergent fry to leave the unit. Each unit has a capacity of 200 eggs and up to 5 cassettes can then be joined together to form a "set" with a capacity of 1000 eggs. Instream incubation requires egg acquisition from a hatchery or from spawning fish (which may be released back into the stream to complete their spawning). Fertilized eggs are loaded into the units and either placed or buried in the stream. Periodic monitoring of the incubator during the period that eggs or alevins are present is recommended. Fry can exit the egg pocket and enter the surface or subsurface environment. The incubators are retrieved and cleaned in the spring and used again the following summer. Alternative approaches to instream incubation, such as artificial redds, have been proposed but have yet to be evaluated in the Yukon.

Where

Instream incubators have been used in the Yukon for bio-assay purposes by DFO and others groups to assess possible hatchery sites, candidate streams for restoration, and for research. In areas with groundwater discharges that remain sufficiently warm throughout the winter, incubators can remain above stream bottoms. However, the design of the incubator makes them vulnerable to frazil/slush ice deposition, freezing, and destruction of any eggs they may contain in surface waters and so in locations where there is no groundwater the incubators must be buried in the stream bottom. Instream incubators are currently being considered for application within the Yukon River Panel R & E Fund to restore the upper Mayo River Chinook stock and to reintroduce Chinook to Deadman Creek in the Teslin River watershed.

When

- The time frame of an instream incubation project depends on the project's purpose. If the project is to re-introduce a stock, it is likely that a DFO License to Release Fish into Fish Habitat would be required, and an environmental assessment under the YESAB is triggered. The YESAB review process is at present open-ended and reviews may be lengthy. A minimum of one full year is likely, and two or more is possible.
- If the project is for stewardship/educational purposes, it is likely that the project could be conducted under a DFO License to Collect Fish for Scientific, Educational or Display and would not trigger a YESAB review. This would probably also be the case if the instream incubator is used for bio-assay purposes and is modified so that fish cannot escape. The DFO Collection License Process is efficient and a License could be in hand in as little as 3 weeks after application.

Why

- Instream incubation can increase egg to fry survival relative to naturally incubation and so in instances where egg-to-fry survival is limiting a population such an action can increase juvenile and adult abundance.

- A secondary use of the technique is in conducting bio-assays to pre-assess restoration or enhancement sites or water supply. Incubators deployed for bio-assay purposes are generally designed or modified so that the fry cannot leave. This allows investigators to remove incubators at predetermined times to assess the proportion of fry that have successfully emerged from the eggs and remain alive.

Pros and Cons

Pros

- Instream incubation can increase egg-to-fry survival relative to natural incubation.
- Instream incubation can be a useful means of engaging and maintaining public interest and participation in aquatic resources.
- Bio-assays using instream incubation is a valuable tool in the assessment of habitats and water supply for restoration or enhancement purposes.

Cons

- Egg incubation trays are not typically an efficient tool to increase the survival of large numbers of eggs because of the large number of incubation trays that would be required (i.e., typical female produces ~ 5000 eggs which would require 5 "sets" of 5 trays for each female).
- The success of this action in the Yukon is initially likely to be low, as sub-surface water flows are difficult to predict and the need to "prospect" for good sites may be required.
- It can be challenging to adequately assess adult returns from instream incubation because artificially propagated adults would be indistinguishable from wild fish unless, for example, a Parentage Based Tagging approach is used.
- Risk of frazil ice formation is sufficiently high in all but a limited number of locations in the Yukon and so incubators would typically have to be buried. Burying incubators at an acceptable depth in the streambed may require significant excavation in the loose gravels or cobbles most likely to provide adequate flow through the boxes. A group of incubators would require a correspondingly greater disturbance.
- Instream incubation devices left on the streambed are vulnerable to disturbance by people or wildlife.
- In most Chinook salmon spawning rivers and some streams water depths at deployment during natural spawning periods will be too high to wade the stream, and divers will be required.
- If fertilized eggs are acquired from broodstock that are not from the river in which the incubation trays are used then there is the potential for adverse genetic effects on the local population as a result of genetic introgression.

- Most Yukon Chinook spawning rivers and streams are unregulated. Flows will vary seasonally and annually, reducing the potential to be able to plan the deployment of incubators. In addition, water velocities at deployment will be too high to consistently deploy the incubators.
- If natural spawning stocks will be used as brood stock, trained and experienced staff will have to be available during the critical period that salmon are spawning and at the location that spawning occurs. Local hydrologic conditions during this time can make the capture of brood stock very challenging.
- If hatchery stocks are to be used, the hatchery will have to be designed or modified to accommodate the stock in isolation from other stocks.

Critical Uncertainties

- The two primary uncertainties are (1) the extent to which instream incubation increases egg-to-fry survival relative to naturally incubating eggs in a given system and (2) the sensitivity of the incubation trays to interannual variability in ice formation.
- Uncertainty in those factors outside of freshwater habitats in the Yukon River that may be limiting Chinook survival means that the success of this action is also uncertain.

Supporting Actions

- In order to deploy incubators with fertilized eggs one needs to acquire from wild brood stock or from an existing hatchery.
- If instream incubators are deployed as an educational/stewardship opportunity then agency or stewardship program support should be given to incorporate the action into existing programs where local streams may be safely accessed and are suitable for deployment.