5.6 Hatchery program including egg take, incubation and outplanting

What

A hatchery is any facility where water is taken from the ground - or surface-waters, directed through incubation and rearing facilities, and released back to the environment. Hatcheries vary in size and complexity from large, sophisticated facilities producing millions of fry to small, simple stream-side incubation boxes. Hatchery operations include egg takes, which is the artificial spawning of adult broodstock; incubation of eggs; early life rearing and out-planting of juveniles.

Hatcheries can be used for a number of purposes. Compensatory hatcheries can help replace lost productivity as a result of industrial activities such as hydroelectric dams. Conservation hatcheries can be used in an attempt to restore depleted stocks or save endangered stocks. Production hatcheries can be used to produce fish for capture in fisheries. Stewardship hatcheries provide local employment or tourism opportunities, educational services and augment local stocks, but may not be integral to the overall management regime of the stock or the fishery.

Facilities for hatcheries including water supply and treatment works require maintenance, upgrading and eventual renewal. Larger facilities require permanent and seasonal staff and substantial administrative support. Land tenure must be acquired. Licenses for the water use, collection of broodstock and movement and release of juveniles into the environment, and environmental assessment under the YESAB must be applied for and reports submitted to the regulatory authorities.

Where

Operational Chinook hatcheries within the Canadian portion of the Yukon River include the McIntyre Creek fish incubation facility and the Whitehorse Rapids fish hatchery. Both facilities are located in Whitehorse. In the past hatcheries were also located at a groundwater-fed facility on the North Klondike River upstream of the Klondike Ditch; a surface water fed facility on the Mayo River below the Wareham Dam; and a surface water fed facility on Wolf Creek downstream of the Alaska Highway. Additionally, one or more surface water fed hatcheries were located on the Klukshu River and its tributaries. In recent years there has been interest in a hatchery in the Mayo area to restore Chinook on the Mayo River and another in the Dawson area to restore Chinook in the Klondike River and to serve as an educational facility. Other communities and First Nation Governments have also considered small-scale hatcheries as a way to restore specific stocks.

When

- The length of the pre-assessment phase for a hatchery depends on the amount of existing stock and habitat information. As a general rule, at least 2 years of pre-assessment work is advisable. Facility design, consultation with First Nation, Renewable Resource Councils and communities, environmental assessment and licensing could be completed in the second year, but are more likely to take an additional year.

- Assuming a 6-year Chinook generation time, a hatchery would have to operate for a minimum of 12 years (2 generations) to allow for an evaluation of its ability to achieve its objectives (e.g., increase adult abundance). The adult enumeration phase would have to be in place and functional for 8 years of this period in order to enumerate all age classes that may return (i.e., 4 - 6 year olds).

Why

- In instances where freshwater habitat currently limits egg and fry survival or spawning success, hatcheries can be used to increase the survival of eggs and early life fry or spawning success relative to survival rates that would occur under natural conditions. Hatcheries can also produce juvenile fish that can then be used to re-establish extirpated populations.
- Areas where there is some evidence of freshwater conditions currently limiting freshwater survival of eggs and fry and/or spawning success include: the upper Mayo and the Klondike Rivers.

Pros and Cons

Pros

- Hatcheries provide a controlled environment for the incubation and early life stages of salmon, and can result in greatly increased egg-to-fry survival.
- If lack of fry is a substantive reason for the decline in productivity of a Chinook stock, hatchery production can increase the number of fry migrating to the ocean and the number of adults returning.
- A hatchery can serve as a central incubation facility, incubating eggs for a number of different stocks at one time or over a period of time.
- Data on marked fish from hatchery programs (e.g., with Coded Wire Tagging CWT) can help to inform fisheries management (e.g., run timing, exploitation rates and marine survival).
- Hatcheries can provide a focus for leveraging funding and donations from industries (as offsets for harm to fish habitat or green funding), foundations, or government agencies and can also play an important role in stewardship (i.e., outreach, education and local employment) and, when partnered with local or extra-territorial research institutions can conduct or support scientific research on Yukon River Salmon issues.

Cons

- Hatcheries can be expensive to plan, build, operate, maintain and renew.
- Hatchery-based stock augmentation programs require long term funding commitments – as a working number, a minimum of 12 years is required for the implementation of a stock restoration plan for approximately two complete Chinook cycles.
- Incubating and rearing at a central facility with water from outside the watershed where the eggs are taken from can reduce the likelihood of imprinting to target the stream/watershed and hence increase straying rates of returning adults.

- All hatcheries pose some risk to the eggs and fry incubating within them due to unanticipated operational issues. Generally:
  - new hatcheries pose a greater risk to incubating eggs and fry than similar established hatcheries;
  - larger, better staffed, secured, and funded hatcheries with backup water and electrical systems pose less risk than smaller, unstaffed hatcheries with no backup systems and no site security;
  - hatcheries using surface water pose a higher risk of fish infection from pathogens than ground water fed hatcheries, and therefore often require the use of chemical agents to control disease or parasite outbreaks;
  - hatcheries requiring surface water during winter pose a risk of mass mortality due to frazil ice blockage of pipes.

- As a result of genetic introgression, hatcheries can contribute to changes to the genetic makeup of locally adapted populations that hatchery fish are introduced to. Integrated hatchery programs which keep hatchery contributions to less than 30% (for example) of spawning populations can minimize this risk.
- Hatchery operations may result in juvenile growth rates exceeding natural rates (e.g., Whitehorse Rapids fish hatchery), leading to earlier migration to sea and age of maturity.
- Significant, and successful, enhancement of a single population can result in overharvesting of non-enhanced populations in mixed population fisheries.
- Hatchery operations require skilled and experienced staff, and certain activities may require staff certification/recertification to meet Occupational Health and Safety standards.
- Unless there is a structure where brood stock can be collected and held, such as a fish counting weir or fish ladder (e.g., at the Whitehorse Rapids dam), acquisition of brood stock may require capture of adult salmon and holding them in non-secured areas until they are ready to spawn.
- The number of adults removed for brood stock is usually limited to some percentage of the total return of adult salmon in the target stream (e.g., less than 30%). Therefore an assessment of stock size is generally required to ensure that sufficient adults are present to support the hatchery brood stock collection program.
- Flows in spawning rivers vary seasonally and annually, and brood stock may be difficult to safely and efficiently capture during high water years. Contingencies must be considered to address non-typical volumes of flow during times when brood stock need to be collected.
- When produced in sufficient numbers, hatchery reared fry that are introduced into the natural environment can compete with wild produced juveniles for food and habitat leading to unintended density-dependent reductions in growth and survival of both wild and hatchery Chinook.

Critical Uncertainties

- Both the Whitehorse Rapids and McIntyre hatcheries have successfully produced adult Chinook salmon. However, a critical uncertainty regarding the potential effectiveness of existing or new hatchery facilities is understanding what the most appropriate rearing and release strategy is to follow. For example, there have been concerns with the Whitehorse Rapids strategy of releasing juvenile Chinook salmon at the start of the open water period that approach the average size of wild Chinook at the end of the open water period, the resulting conversion of the artificially propagated fish from "stream" to "ocean" type life histories, and the return of many of the males as jacks. The McIntyre Hatchery release strategy includes releasing juveniles at sizes that approximate wild juveniles.
- Uncertainty in those factors outside of freshwater habitats in the Yukon River that may be limiting Chinook survival means that the success is also uncertain.

Supporting Actions

- A plan for monitoring the growth of the released fry and measuring critical habitat parameters to determine the degree of rearing success and whether the release strategy should be modified must also be developed. The plan should include a means of enumerating the returning adults to evaluate the success of the hatchery in producing adults.
- A third-party evaluation of hatchery practices at existing and potential hatchery facilities (e.g., brood stock collection, current and potential future rearing and release strategies like rearing temperature and size of fry at release). The results of such evaluations could inform the (re)design of facilities under consideration and the development of Hatchery Operation Plans. If more than one stock will be restored with fry produced in the hatchery, each should have its own stock restoration plan.
- Continuation of nose tagging/adipose clipping or use of Parentage Based Tagging would allow for some degree of assessment/evaluation of the return of adult Chinook.