



## 5.7 Removal of larger natural barriers to upstream migration

### What

The removal of existing natural barriers to upstream migration by adult salmon (e.g., landslides, waterfalls) through fishways or excavated channels, and modification of partial barriers to decrease delays and increase access past barriers. Increasing access could include trapping adult salmon downstream and release upstream of a barrier or out-planting of artificially propagated juveniles upstream of a barrier.

### Where

There are few natural barriers to upstream migration on known spawning streams in the upper Yukon River basin. In addition to Fraser Falls, which is a partial barrier to migration, waterfalls on the following stream are known barriers to upstream migration:

- Watson Creek, tributary to the Stewart;
- Lapie River, tributary to the Pelly River;
- Squanga Creek, tributary to the Teslin River; and
- the McClinton River, tributary to the Yukon River near Marsh Lake.

### When

At least one full year of assessment of upstream habitats at flows low enough to characterize river bed materials is required to support a decision regarding provision of adult Chinook passage past natural obstructions. Each of the natural obstructions identified above has salmon spawning immediately below it, largely removing requirements for detailed and lengthy water quality/quantity studies.

Detailed geotechnical investigations of all sites where channels could be modified and/or fishways or related structures erected would be required at a range of flows. These geotechnical investigations may take one or more years to be satisfactorily completed.

Site investigations would need to be carried out to estimate the capital cost of the asset (and associated infrastructure) and the operating and maintenance requirements. If a decision is made to proceed, hatchery produced fry, native fry captured in the river downstream, or adult salmon could be released above the obstruction prior to or during construction to start the process of attempting to build the stock in the previously in-accessible habitat.

Monitoring of upstream migrants would be required during at least the first few years that the structure was completed to evaluate the degree to which the structure is successful in meeting its objective. Modifications would be required if it did not. Annual inspections would then be necessary to ensure that the channel or fishway remained open and did not impede passage during upstream migrations.

Capture and release of adults or juveniles could be conducted as soon as a decision to proceed was made and regulatory issues resolved. These regulatory issues would include licenses and authorizations from regulatory agencies, and assessment by the Yukon Environmental and Socio-economic Assessment Board (YESAB).



## Why

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- This action would be taken to increase accessible spawning and rearing habitat to increase spawning success and egg-to-fry survival (via increased access to high quality spawning habitat) and juvenile growth and survival (via reduced influence of density dependent effects on growth and survival). This assumes that spawning and rearing habitat are limiting the population under consideration. The extent to which this assumption is true is poorly understood, but there is some evidence of density-dependent growth in rearing habitat downstream of natural obstructions in the Squanga Creek (i.e., high abundances of smaller than average fry at the end of the growing season). Spawning and rearing habitat above these natural barriers appear to be of high quality, but further study is required to confirm this.
- Justification for modification of Fraser Falls is based on the observation that Chinook salmon experience difficulty swimming over the falls at low water levels and so if the falls were modified the condition of spawners may be improved and pre-spawn mortality may be reduced.

## Pros & Cons

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### Pros

- Construction of fishways (including blasting graded channels through bedrock) is an accepted method of increasing salmon production and is, in general, within the scientific/technical community's comfort zone.
- Capture below and release of adults and/or juvenile Chinook upstream of obstructions could be a relatively inexpensive means of increasing available rearing and overwintering habitat and reducing competition among juvenile Chinook in habitat downstream of natural obstructions.
- Enabling natural access to habitat for spawning and rearing would ensure spawning and fry development occurs naturally and therefore that there will be limited to no unintended effects on the time of return to spawn or the size of returning adults.

### Cons

- The design and construction of fishways is expensive, particularly if infrastructure such as roads is required. As a result it is likely that the cost of any fish-way would exceed the total value of the Yukon River Panel R & E Fund (~ \$1 million USD per year), perhaps by many times.
- Fishways require monitoring, maintenance and periodic renewal.
- Fishways may negatively affect the bio-diversity and local adaptation of organisms residing in upstream waters isolated for thousands of years by allowing individuals of non-salmon species upstream access to areas where they could reproduce with locally adapted individuals from above the obstruction.
- Allowing access through fishways or release of adult or juvenile salmon above obstructions risks introducing of pathogens to upstream waters and to non-Chinook stocks that evolved in their absence.
- The Squanga Creek stock is very small and could not support a capture and release program. Adult Chinook could be captured in the Teslin River, but these adults would spawn with Chinook native to



the creek, potentially leading to a loss or erosion of unique local adaptation by the Squanga Creek stock.

- Evaluation of projects that enable migration and rearing upstream of barriers (e.g., fry enumeration and adult returns) is very challenging because some fry will leave the system to rear elsewhere and the origin of returning adults is logistically difficult to determine (e.g., due to stream flows during spawning).
- The community of Mayo and the First Nation of the Na-Cho Nyak Dun have rejected any modification to Fraser Falls due to its importance (e.g. cultural/spiritual value).

### **Critical Uncertainties**

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- The primary uncertainty regarding the effectiveness of this action is the degree to which the fresh water life stages of Yukon River Chinook salmon are currently limited and so the degree to which increased habitat for juveniles would lead to eventual increased return of adults. If this is believed to be true, or evidence is provided to support it, then the apparent quantity and quality of spawning and rearing habitat above the obstructions requires assessment.
- The quality and quantity of habitat in currently inaccessible habitat.
- It is uncertain whether adults returned to the river upstream of obstructions would remain there or would move back downstream to spawn.
- The YESAB application and review process is at present open-ended and may result in considerable expense and uncertain outcomes.
- 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**

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- Limiting conditions for both eggs and fry are likely to occur under ice in the winter and the quality and quantity of habitat in areas upstream of the barrier should be confirmed through field investigations in February or March.
- The extent to which adults spawn in areas upstream of the barrier after passage has been granted could be monitored by passive integrated transponder (PIT) tagging all relocated adults and placing a tag reader at the obstruction.