Cheakamus River Ecosystem Recovery Technical Committee

Draft for Discussion Purposes and Public Comment

Date: February 8th, 2005

Re: Steelhead Trout Fish Culture Recovery Option

Introduction

This proposal is one recovery option for steelhead (*O.mykiss*), under consideration and evaluation by the Cheakamus Ecosystem Recovery Technical (CERTC) and Steering Committees. Implementation of this option, if chosen, is required prior to completion of the overall Cheakamus Recovery Plan, currently in preparation. Time sensitive recovery options can be implemented prior to Recovery Plan completion and consultation, pending separate consultation, approval of relevant agencies, and resource availability, as was the pink and Chinook salmon culture options previously undertaken by the recovery committees and CN Railway.

Comments: Provide comments in written form to comments@certc.ca prior to Feb 22, 2005. Comments on this topic previously sent to CERTC or relevant agencies are already on record and don't need to be resubmitted.

Background

Following the August 5th, 2005 CN Railway train derailment in the Cheakamus Canyon, initial fish impact assessments indicated an approximate 90% reduction in mainstem rearing steelhead/rainbow juveniles, composed of 3 year classes (McCubbing et. al. 2005, in prep). Two cohorts currently in the ocean, 2006 and 2007 brood years, were unaffected. Natural recovery time will depend on many factors including freshwater productivity, ocean survival, repeat spawners and occurrence of other stochastic events (e.g. major floods, anthropogenic interferences). Estimates range from 18-44 years (Korman et. al. 2005, in prep), with the first cycle of reduced escapement occurring in 2008-10.

One recovery strategy for steelhead trout is to increase freshwater productivity by increasing current survival and abundance of juveniles, with the goal of maximizing smolt production. Generally accepted options to increase freshwater productivity include, the following, but this proposal deals specifically with option iii) Fish Culture.

i) Fertilization with Limiting Nutrients

ii) Structural Habitat Improvement

iii) Fish Culture

The use of fish culture techniques have the advantage of increasing the smolts produced per adult return, but is controversial due to uncertainty in efficiency of producing offspring relative to wild fish and for other genetic (Ford 2002; Lynch and O'Healy 2001) and ecological impacts (Chilcote 2003; Levin et al 2001). There is little empirical evidence on the efficacy of using a supportive breeding culture program to aid in population recovery for salmonids (ISAB 2005). Most studies and models applied to study these questions consider long-term (>1 generation) impacts, therefore, the risks and benefits of a short term culture operation are difficult to quantify, and require further evaluation relative to recovery goals.

Assuming short-term impacts from fish culture are acceptable, two common and short-term fish culture techniques are applicable to the Cheakamus situation and worth consideration; fry plants and smolt releases.

Fry Plants

Fry plants using fed fry have been tried in different streams on the South Coast, including the Squamish watershed in the 1980s. Results have been variable, which should not preclude further testing of the technique or of other variations (e.g. unfed fry), if implications of failure are not severe.

Options for fry plants include using Cheakamus adults or nearby Mashiter or Squamish River runs as brood stock. The use of Cheakamus adult returns as a donor stock may not be advisable or feasible for several reasons. Adults needed to boost fry abundance would be dependant on adult spawners of the previous spring, which are forecast to be extremely low, and would have equally low adult capture rates. In addition, as smolts produced per spawner for steelhead naturally increase at low abundance due to low intraspecific competition, fry survival during periods of low adult returns should be above average. Returning spawners in spring 2008-10 will effectively produce high fry numbers compared to uncertain results from fry plants, and may be better off left in the river.

The use of other donor stocks such a Brohm, Mashiter or Squamish populations are not advisable. The relationship of these to Cheakamus stock are unknown, and while likely closely related, mixing of stocks should be avoided whenever possible. Additionally, and more importantly, returns to other systems in the watershed should not be reduced by mining brood stock considering the already low returns and conservation status of Mashiter and Squamish stocks (Lill 2002; Ahern 2004), and the importance of maintaining high productivity from Brohm Creek.

Fry plants alone are not recommended considering the paucity of adults for brood, and the uncertain effectiveness of the method. A combination of juvenile release strategies, involving multiple ages, could be explored.

Smolt Releases

Smolt releases have been the most efficient at producing adult returns and is now the dominant program for steelhead culture in BC. The management practices associated with this technique (Ludwig 1995), are intended to minimize the genetic and ecological impacts, briefly explained below.

Residualism

In the realm of fish culture, residualism refers to released smolts which fail to migrate to the ocean and remain in fresh water. This reduces the number of adult returns, results in competition with other stream rearing fish for food and territory, and can result in hybridization (or breeding) with other closely related species or sympatric resident rainbow trout (Costello and Rubidge 2004). The proportion of smolts residualizing from a release of cultured smolts are less for 1-year smolts compared to 2-year olds. Few residuals are found following their first winter, and are thought to expire as a result of physiological energy requirements in excess of in-stream food availability.

Genetic Impacts

The genetic integrity, or uniqueness, of a stock relates to behavioural (e.g. return timing) or phenotypic (e.g. size or shape) characteristics of a stock which match its unique environment. They are not conservative through time and change with changing environment – natural selection. Concerns with fish culture are that the genetic integrity can be altered by altering selection pressures (Ford 2004), resulting in lower fitness and reduced survival of the entire stock (ISAB 2005), results contrary to the intensions.

Recommendation:

The following parameters and conditions are recommendations for a fish culture operation for Cheakamus River steelhead stock(s) if the option is accepted for implementation. The objective of the program is to increase recovery rate by supplementation of fry, by increasing adult returns in 2008-11 to over 200, the estimated habitat seeding requirements (Table 1).

Program Parameters:

- Collection of surplus adult returns in 2006 & 2007
- Adult broodstock target: 22 pairs per brood year
- Release 1 year old smolts
- Annual smolt release target: 33,000

Table 1. Expected Adult Escapement by Year.

Return Year	Hatchery Returns	Wild Returns	Total Returns
2008	87	109	196
2009	408	22	430
2010	408	31	439
2011	87	118	205

Key Assumptions:

- adults required to seed habitat is 200
- ocean survival for Cheakamus steelhead is 4.5%, and 1.5% for hatchery fish
- 65% of adults return after 2 years in ocean, 17% as 1-year and 3-year
- 1,500 smolts produced per spawner in hatchery
- wild returns as predicted by Korman et. al. 2005, in prep.

Current low ocean survival rates for steelhead around Georgia Basin, 1-2% as measured at the Keogh River, are a major limitation to the efficiency of fish culture operations. Hatchery origin steelhead return at a rate usually 1/3 that of wild fish. To some extent this can be countered by increasing smolt releases, but some evidence suggests this can further reduce survival possibly due to productivity limitations or a finite carrying capacity in the ocean environment (Heard 1998; Nielsen 2004). Of note, ocean survival rates to not appear to be uniform for all steelhead stocks in Georgia Basin, but no direct evidence currently exists.

Unfortunate accidents can provide rare and unique opportunities to learn about fish stocks under conditions not normally available. The importance of such information, while difficult to explain to non-biologists, are extremely important for long-term stock management, and recovery strategy determination. One opportunity now possible on the Cheakamus is the development of a *stock recruitment curve* for steelhead. Instructive components such as a spawner-to-parr relationship, or the number of spawners actually required to seed the habitat, may not be possible if a fish culture operation is underway.

Conditions for Implementation

Broodstock collection will occur in 2006 and 2007 only. Pending evaluation of results, and rate of recovery, another cycle may be considered for 2011-14.

Co-occurrence of measures to increase river mainstem (steelhead/rainbow) habitat productivity. This will not only increase the effectiveness of the culture program, but will increase the natural (or overall) recovery rate for this species, and other mainstem dependant species. This is consistent with the recommendations of The Hatchery Scientific Review Group in Washington State recently which recently concluded that culture programs cannot meet their goals without healthy habitats (Mobrand et. al. 2005).

A smolt release strategy will be required to minimize residualism.

Escapement in 2006 and 2007 must exceed habitat seeding requirements of 200 adults, prior to wild broodstock spawning. Collection can start and continue concurrent with escapement estimation, with release of adults back to the river if habitat seeding threshold in not attained.

Best management practices for holding, feeding, etc will be determined following recommendations from the Freshwater Fisheries Society of BC, the provincial agent for fish culture.

The effectiveness of this option be monitored for adult returns, spawning location of hatchery returns, and stratified fry production in those areas. Details to be provided in Cheakamus Recovery Plan, or under separate cover.

Details are subject to change following refinement of proposal with an independent assessment to estimate risk and benefits using an accepted hatchery risk assessment tool (e.g. SHWIM; Korman et. al. 2005, in prep), or cost benefit analysis, to be completed prior to implementation.

Estimated Budget

The following cost estimate is preliminary and subject to change following complete workplan submission from FFSBC, TOR for monitoring work, refinement of habitat work option, and cost sharing opportunities.

Activity	Years	Annual Cost	Total Cost
Independent Assessment	2006	$ 6,000	$ 6,000
Fish Culture	2006-2007	$ 70,000	$ 140,000
Monitoring	2008-2011	$ 65,000	$ 260,000
Habitat Work	2006+	$ 162,000	$ 162,000
Total			$ 568,000

Time Line

- Feb 8 - Feb 22, public consultation
- Feb 8 – 24, independent assessment
- Feb 24, agency approval
- March 3, contract or MOU signed with CN Railway
- March 6, brood stock collection to begin

Prepared By: G. Wilson, BC MoE, CERTC
