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Scientific information in support of a Recovery Potential Assessment for the salish sucker (*Catostomus sp.*) in Canada

Information scientifique à l'appui de l'évaluation du potentiel de rétablissement du meunier de salish (*Catostomus sp.*) au Canada

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ABSTRACT

This Recovery Potential Assessment provides technical advice to the Minister of Fisheries and Oceans concerning the amount of allowable harm to Salish sucker *Catostomus* sp., which is listed as *Endangered* (Schedule 1) under the Species at Risk Act (*SARA*).

The suckers are a large freshwater family of fish that includes the widely distributed longnose sucker *Catostomus catostomus*. Salish sucker is a divergent form of longnose sucker found in western Washington and the lower Fraser Valley, B.C. It is genetically distinct but not yet recognized as a separate species. Salish sucker have been extirpated from at least one watershed in the Fraser Valley (Little Campbell River), and are presently confined to ten others. In these rivers, its distribution is concentrated within a few reaches. Most home ranges are small.

Small, short-lived and early-maturing, Salish sucker have an opportunistic life history that may facilitate population recovery if disturbances are short-term and confined to small areas. Salish sucker are most commonly found in marshes and beaver ponds where water is deeper than 70 cm. They require deep water with access to spawning riffles and shallower nursery habitat. Potential critical habitat is defined for all reaches currently containing populations of Salish sucker as *reaches with more than 50 m of continuous pool that is deeper than 70 cm at low flow*. Critical habitat includes riparian reserve strips on both river banks. Most of the potential critical habitat has been mapped and presently includes 141.5 km of surveyed channel (approximately 50% of the total surveyed).

Based on limited data to 2004, estimated mean abundances were well below the minimum viable population sizes commonly accepted as a ‘rule of thumb’ for vertebrates when abundance data are weak. If all potential critical habitat were occupied at a density of .05 fish/m^2, the estimated carrying capacity ranges between 800 and 7,000 fish per stream, also below the accepted vertebrate minimum. This is a strong argument for preserving as much critical habitat as possible.

The main cause of human-induced harm is agricultural and urban development in the Fraser Valley. Hypoxia, which can result mainly from pollution by agricultural fertilizers and manure, is the most serious threat. Habitat loss, fragmentation and degradation lead to sedimentation and isolation of sub-populations.

A Nutrient Management Planning Strategy developed by government agencies and agricultural producers identifies strategies whereby farms can achieve an acceptable nutrient balance and reduce the risk of hypoxia in Salish sucker habitat. Reducing habitat destruction and fragmentation can be achieved using existing regulatory mechanisms to develop reach-specific best management practices, as well as through restoration of damaged habitat. Public awareness materials and a participatory approach will be crucial. Minimum instream flow prescriptions should also be developed, and the licensing of groundwater withdrawal considered.

The opportunity exists to eliminate harmful activities in sections of the watersheds where critical habitat is damaged. Portions of actively farmed riparian land could be removed from production. A model is the Conservation Reserve Enhancement Program (CREP), a land retirement program administered by the United States Department of Agriculture. In Canada, similar objectives can be achieved through land trusts, some of which operate in a way analogous to CREP. The BC Environmental Farm Plan initiative also offers some immediate opportunities for protecting fish habitat.

RÉSUMÉ

La présente évaluation du potentiel de rétablissement fournit un avis technique au ministre des Pêches et des Océans concernant le niveau de dommages admissibles au meunier de Salish (*Catostomus* sp.), inscrit comme espèce en voie de disparition (annexe 1) en vertu de la *Loi sur les espèces en péril* (LEP).

Le meunier représente une grande famille de poissons qui comprend le meunier rouge (*Catostomus catostomus*), une espèce largement répandue. Le meunier de Salish est une forme divergente du meunier rouge, qui se trouve dans l'ouest de l'État de Washington et dans la vallée du bas Fraser, en Colombie-Britannique. Il se distingue du meunier rouge sur le plan génétique, mais il n'a pas encore été reconnu comme espèce distincte. Le meunier de Salish est disparu d'au moins un bassin hydrographique de la vallée du Fraser (la rivière Little Campbell), et il est présentement limité à dix autres bassins hydrographiques. Dans ces rivières, sa répartition est restreinte à quelques tronçons, et la plupart des domaines vitaux sont petits.

Comme le meunier de Salish est petit, a une maturité précoce et une courte vie, son cycle biologique opportuniste peut favoriser le rétablissement de sa population dans le cas où les perturbations sont à court terme et restreintes à une petite région. Le meunier de Salish est le plus couramment retrouvé dans des marais et des étangs de castor où la profondeur de l'eau est supérieure à 70 cm. L'espèce a besoin de zones d'eau profonde, d'un accès à des rapides pour le frai et à des habitats moins profonds, propices à l'alevinage. L'habitat essentiel potentiel a été défini, pour tous les tronçons dans lesquels vivent actuellement des populations de meuniers de Salish, comme correspondant aux *tronçons qui présentent une fosse continue sur plus de 50 m et excèdent 70 cm de profondeur à l'étiage*. L'habitat essentiel inclut les bandes de réserve riveraine le long des deux rives. La majeure partie de l'habitat essentiel potentiel a été cartographiée et inclut actuellement 141,5 km de chenal ayant fait l'objet de relevés (environ 50 % de l'aire totale visée par les relevés).

D'après les données limitées qui remontent à 2004, les abondances moyennes estimées étaient bien inférieures aux tailles de population viable généralement acceptées comme règle empirique pour les vertébrés dans le cas où les données sur l'abondance sont faibles. Si tous les habitats essentiels potentiels étaient occupés à une densité de 0,05 poisson/m^2, la capacité biotique estimée varierait alors de 800 à 7 000 poissons par cours d'eau, ce qui est également inférieur au minimum accepté pour les vertébrés. Il s'agit là d'un argument solide pour préserver le plus d'habitats essentiels que possible.

La principale cause des dommages anthropiques est l'agriculture et le développement urbain dans la vallée du Fraser. L'hypoxie, qui résulte principalement de la pollution par les engrais et le fumier agricoles, constitue la menace la plus grave. La perte, la fragmentation et la dégradation de l'habitat entraînent la sédimentation et l'isolement des sous-populations.

Des organismes gouvernementaux et des agriculteurs ont mis au point la Stratégie de planification de la gestion des éléments nutritifs afin de déterminer des stratégies permettant aux exploitations agricoles d'obtenir un équilibre acceptable en matière d'éléments nutritifs et de réduire le risque d'hypoxie dans l'habitat du meunier de Salish. Il est possible de réduire la destruction et la fragmentation de l'habitat par des mécanismes réglementaires en vigueur qui permettent d'élaborer des pratiques de gestion optimales propres à chaque tronçon ainsi que de restaurer les habitats endommagés. Des documents de sensibilisation du public et une approche participative seront essentiels. Des dispositions sur les débits réservés minimaux

doivent aussi être élaborées, et l'octroi de permis doit être considéré pour l'extraction d'eau souterraine.

Il est possible d'éliminer les activités nuisibles dans les parties des bassins hydrographiques où l'habitat essentiel est endommagé. Des parties des terres riveraines exploitées activement par l'agriculture pourraient être retirées de la production. L'un des modèles qui exposent cette mesure est le programme d'amélioration des réserves de conservation (CREP – Conservation Reserve Enhancement Program), un programme de retrait des terres administré par le Department of Agriculture des États-Unis. Au Canada, il est possible d'atteindre des objectifs similaires par l'intermédiaire de fiducies de terres, dont certaines fonctionnent d'une manière comparable au CREP. L'initiative des plans environnementaux en agriculture réalisée en Colombie-Britannique (BC Environmental Farm Plan) offre aussi certaines possibilités immédiates pour protéger l'habitat du poisson.

INTRODUCTION

A Recovery Potential Assessment (RPA) provides technical advice to the Minister of Fisheries and Oceans concerning the amount of allowable harm to an aquatic species. Ideally, an RPA precedes listing of a species or population under *SARA*, and is used to help make the decision whether or not to list. If the species is already listed, the RPA contains information and technical advice on status, threats, critical habitat and abundance that can be used to develop recovery plans. Salish sucker (*Catostomus sp.)* belongs to a third category: it is listed under *SARA*, and a draft Recovery Strategy has already been written.

The “allowable harm” described in an RPA anticipates Section 73 of *SARA*, under which the Minister may authorize activities that affect a listed aquatic species, any part of its critical habitat, or the residences of its individuals if all reasonable alternatives that would reduce the impact of the activity have been considered and the best solution adopted so that the activity will not jeopardize the survival or recovery of the species. The RPA attempts to answer the question: Can the species recover if human-induced mortality is greater than zero? Ideally, the RPA contains information the Minister must place on the *SARA* Public Registry to document the reasons for issuing a Section 73 permit.

This RPA for Salish sucker generally adheres to the three-phase format based on the Moncton Protocol and summarized in DFO (2004). It begins with a description of the species and its status; next, threats to the species (including human activities) and their effects are listed; finally, various scenarios that would reduce the threats and potentially allow harm under Section 73 of *SARA* are presented.

As a risk assessment, an RPA reflects the data available. In a case like that of the Salish sucker, where there are limited data on the species’ natural history, abundance and habitat use, an RPA can only provide the best advice with the information available, while noting specific information gaps that need to be filled. The knowledge base on Salish sucker is limited to a few peer-reviewed papers and unpublished reports, and first-hand experience remains confined to a small number of experts; without more field research, our understanding of the species is not likely to increase (G. Hartman 2007, pers. comm.). Uncertainties arising from this extremely limited knowledge base are noted throughout the RPA.

This Recovery Potential Assessment was written for DFO by Brian Harvey under contract to the Science Branch of Fisheries and Oceans Canada. The author is grateful for helpful comments and advice from Mike Pearson (Pearson Ecological Services, Vancouver). Formal reviews containing many useful suggestions were provided by Mike Bradford and Gordon Hartman; Jordan Rosenfeld also provided many helpful comments on the manuscript.

PART 1: CURRENT STATUS

BASIC BIOLOGY AND TAXONOMY

The suckers (Catostomidae) are a large, mainly North American freshwater family of fish that includes the widely distributed longnose sucker *Catostomus catostomus* (Scott and Crossman 1973). Salish sucker is a divergent form of longnose sucker found in western Washington and the lower Fraser Valley, B.C. It is genetically distinct but not yet recognized as a separate species. Salish sucker is well described in factsheets on the SARA website (Environment

Canada 2008) and that of the B.C. Ministry of Environment, Lands and Parks (B.C. Environment 2008).

Appearance

Scott and Crossman (1973) describe longnose sucker as torpedo-shaped, with small eyes and a long snout that overhangs a small, protrusible sucking mouth with no teeth. Adults are usually dark-coloured on the back, with a whitish ventral surface. Both sexes develop a coloured lateral stripe during breeding. The Salish form is generally smaller than the longnose (less than 25 cm long, as compared to up to 35 cm), with some slight morphological differences in lip dimensions and body shape (COSEWIC 2002).

Life history

Salish sucker mature earlier (at age two) than longnose sucker, and live for five years. A prolonged (April to July) spawning period completes the picture of an opportunistic life history that may facilitate rapid population recovery if disturbances are short-term and confined to small areas (Cooke et al. 2005). Pearson and Healey (2004) describe aspects of life history that have implications for conservation and management. The protracted spawning period may promote rapid population growth and colonization of habitat; many males even re-commence milt production in the fall, a possible adaptation to early spring spawning. They spawn over riffles (shallow, fast-water sections of the river), a habitat preference that implies migration from the deeper, pool-type habitat preferred for feeding. The adhesive eggs are broadcast over gravel and rocks, and those that do not settle beneath cover are consumed by predators (COSEWIC 2002). Completion of hatching and emergence are assumed to take around 30 days, based on data for longnose sucker.

Physiology and ecology

Like the longnose sucker, Salish sucker appears to tolerate a broad range of temperatures. Its habitat in the Fraser Valley would suggest an upper limit in the mid-twenties; Pearson (unpublished) has caught them at temperatures up to 23°C. There is no detailed report of their distribution in relation to temperature. A study of the Salish suckers in Pepin Creek, one of the populations in the Fraser Valley, found them to be active above 7°C, and more fish were trapped between May and September (Pearson and Healey 2003).

Based on radiotelemetry and visual observation, feeding on bottom-living invertebrates probably takes place at night, with daytime spent resting in heavy plant cover to avoid predators. Resting locations are frequently returned to. The home ranges of the suckers in Pepin Creek were from tens to hundreds of metres long, and seemed for the most part to be limited by shallow-water features such as riffles and beaver dams, a characteristic that needs to be taken into account in management. They are well adapted to low-oxygen environments and have been found at oxygen concentrations below 1 mg/l (Salish Sucker Recovery Team 2005); despite this tolerance, hypoxia is still the biggest threat to their survival.

Salish sucker live in ecological communities that include the native cutthroat trout (*Oncorhynchus clarkii clarkii*), rainbow trout (*O. mykiss*), coho salmon (*O. kisutch*), prickly sculpin (*Cottus asper*), three-spined stickleback (*Gasterosteus aculeatus)*, Nooksack dace (*Rhinichthys osculus*) and western brook lamprey (*Lampetra richardsoni*). Introduced species may include bullfrog (*Rana catesbeiana*), bullhead (*Ameiurus nebulosus*), pumpkinseed

(*Lepomis gibbosus*) and largemouth bass (*Micropterus salmoides*). All can be considered potential predators on adults, eggs or juveniles; some will also compete for food. Mink (*Mustela vison*) is common in Salish sucker habitat and known to prey on the species.

Taxonomy and evolutionary significance

Salish sucker is morphologically and genetically distinct from longnose sucker; however, it is not formally recognized as a different species. It is believed to have become isolated from the main body of longnose suckers during the most recent glaciation (ice age), surviving in the non-glaciated Chehalis refugium south of the Puget ice-lobe and west of the Coast Mountains. This origin explains its present distribution, which covers the eastern side of Puget Sound into the lower Fraser Valley. The ten Canadian populations are thought to have arrived by dispersal from the south.

McPhail and Taylor reviewed the taxonomic position of Salish sucker in 1999; the picture they present has not changed significantly. The fish is considered to be one of three divergent forms of longnose sucker in northwestern Canada (the other two are from more northern glacial refugia). The clear morphological differences do not necessarily imply genetic divergence (they may simply reflect different environments); results of mitochondrial DNA analysis, however, confirm that the Salish sucker is genetically distinct. There are no data describing genetic distinctness between the ten populations of Salish sucker in the rivers it inhabits in Canada; they are thus considered as a single conservation unit.

The key conclusion is that Salish sucker is reproductively isolated from longnose suckers, has had an independent evolutionary history and is thus is an evolutionarily significant unit. As a member of the "Chehalis fauna", the species has considerable scientific interest for evolutionary biologists. Interestingly, the geographic separation between Salish sucker and the typical western longnose sucker in the Fraser Valley is not great. McPhail and Taylor (1999) noted 60 km of unobstructed river between the Salish suckers in Semmihault Creek near Chilliwack, and the typical longnose suckers found further upstream, near Hope; with the discovery of Salish sucker in Miami Creek, a tributary of Harrison Lake, that distance was roughly halved (COSEWIC 2002).

Listings and protection

The ten populations of Salish sucker in Canadian waters are presently considered a single designated unit according to COSEWIC criteria (COSEWIC 2006a). The species was designated *Endangered* by COSEWIC in 1986, with an updated status report in 2002 (COSEWIC 2002). The B.C. Conservation Data Centre classifies Salish sucker as S1 (*Critically Imperiled because of extreme rarity*).

Salish sucker is listed as *Endangered* (Schedule 1) under the Species at Risk Act (*SARA*). *SARA* prohibits the alteration of habitat identified as critical in an approved recovery strategy. A draft recovery strategy pursuant to *SARA* was completed in 2005 (National Recovery Team for Salish Sucker 2005) and is currently under review. It provides detailed criteria for habitat critical to the subspecies, and specifically identifies that habitat. It also contains separate population targets for each watershed in which Salish sucker occur.

The streams currently occupied by Salish sucker run through lands that are privately, federally or municipally owned (COSEWIC 2002). They have the legislative protection afforded by the federal Fisheries Act, although there are also a number of provincial and municipal statutes intended to protect stream and riparian habitat (Pearson 2004). Regional and municipal parkland makes up a small percentage of the land. Parkland is no guarantee of protection when the damage originates upstream, as it does, for example, in Pepin Creek (Pearson 2008 pers. comm.).

RANGE AND RESIDENCE

Range

Salish sucker have been extirpated from at least one small watershed in the Fraser Valley (Little Campbell River), and are presently found in ten others:

Bertrand Creek
Pepin Creek
Fishtrap Creek
Salmon River
Salwein Creek/Hopedale Slough
Chilliwack Delta (Atchelitz, Chilliwack and Semmihault Creeks)
Miami Creek (Harrison Lake tributary)
Mountain Slough
Agassiz Slough
Elk Creek/Hope Slough

The first three watersheds also contain populations of endangered Nooksack dace; the two species, while they do not overlap greatly in their habitat preferences, are nevertheless subject to the many of the same threats (Harvey 2008). The population in Elk Creek is the most recently discovered; they appear to be thinly distributed and abundance is not known (Pearson 2008 pers. comm.). Populations grouped as occurring in the Chilliwack Delta occupy small creeks in the historic wetland area.

Within the above watersheds, distribution of Salish sucker is concentrated within a few reaches (Cooke et al. 2005). A reach is a section of river that contains smaller habitat features like riffles and pools and is more or less homogeneous in its habitat type (Annear et al. 2004; Frissell et al. 1986). For Salish sucker, the definition of “reach” is elastic and can include both pool and riffle habitat; a typical reach will be in the high hundreds to the low thousands of metres long. These “hotspots” are areas with deep (greater than 70 cm) pools, abundant in-stream vegetation and fewer riffles. Beaver dams are a typical feature.

Most home ranges are small (average 170 m). Population viability will depend on how close hotspots are to each other, and whether there are any barriers between them (e.g. beaver dams). This uneven distribution has important consequences for risk assessment and recovery planning. A “rescue effect” – re-colonization of a stretch of river – is limited by the low probability of natural exchange of individuals between watersheds or sections of watersheds (Pearson 2007); it is, however, still feasible given the demonstrated ability of some individuals to range beyond a few hundred metres (Pearson and Healey 2003); Recolonization could also be achieved by transplant from another location. The National Recovery Team for Salish Sucker (2005) points out that populations of Salish sucker in separate watersheds are essentially independent of each other, with a very low probability of natural exchange; this is the reason that each watershed has its own population target. Hotspots near beaver ponds can become anoxic during summer low-flow periods, which may account for reach-scale mortalities such as occurred in the marsh in Pepin Creek in 2003.

The Salish sucker in B.C. differ from longnose sucker in inhabiting small streams rather than lakes; within those streams, they do, however, prefer deeper pool habitat. The Salish sucker populations in Washington are somewhat different, in that they include several vigorous lake-dwelling populations that are less susceptible to habitat degradation (McPhail and Taylor 1999).

Residence

Animals that habitually return to dwelling places (dens, nests) during some part of their life cycles are described in *SARA* as having 'residence requirements.' Salish sucker do not build nests, nor do they defend breeding territories. Their unusually clumped distribution argues for considering residence as synonymous with their known distribution.

CRITICAL HABITAT

Small, short-lived and early-maturing, Salish sucker have an opportunistic life history that appears adapted to colonizing habitat over short spatial scales. These characteristics are less useful in responding to large- scale or chronic disturbances; the ability to colonize quickly can be negated by the tendency not to range very far. This limitation must be taken into account when identifying critical habitat. Small home ranges and clumped distribution are other characteristics that help in defining habitat.

Salish sucker are most commonly found in marshes and beaver ponds where water is deeper than 70 cm. They require extensive areas of deep water with access to spawning riffles and shallower nursery habitat. While tolerant to low oxygen, the fact that sublethal effects are likely between 2-4 mg/l suggests that a margin of safety can be achieved by setting the lower limit of dissolved oxygen at around 4 mg/l (Salish Sucker Recovery Team 2005).

The biological, physical and ecological principles used to identify aquatic and terrestrial critical habitat for Salish sucker are described by Pearson (2007). Potential critical habitat is defined therein for all reaches currently containing populations of Salish sucker as *those with more than 50 m of continuous pool that is deeper than 70 cm at low flow*. Like critical habitat for Nooksak dace, it includes all aquatic habitat plus riparian reserve strips on both banks. For the known populations of Salish sucker, most of the potential critical habitat has been mapped and presently includes 141.5 km of surveyed channel (approximately 50% of the total surveyed). Deep pool habitat, normally found in headwater ponds and marshes, is the primary habitat for most of the life cycle, and the 50 m threshold is the minimum length where CPUE is greater than 1.8 fish/trap (Pearson 2004). Riffles, which are used for spawning, are rare in such reaches; some fish may even leave their home reaches in search of them. Shallow pool and glide habitat, used by juvenile Salish suckers, is also included in critical reaches.

The riparian strip serves to protect the integrity of stream habitat. It helps prevent erosion and siltation, buffers water temperatures and limits nutrient input. The width of the buffer necessary to preserve stream integrity in different locations has not been quantified. Proposed riparian habitat was identified consistent with the B.C. Riparian Areas Regulation (RAR, Reg. 837 under the Fish Protection Act; B.C. Ministry of Environment 2007). In many areas, riparian habitat is restricted by existing permanent structures (roads, dykes, buildings). A detailed discussion of the rationale for including riparian zones in critical habitat for Salish sucker is found in Pearson

(2007); the rationale for applying the RAR rules, which were originally developed for salmonids, reflects the very low likelihood of the research necessary for sucker-specific rules ever being done (J. Rosenfeld 2008 pers. comm.).

The geographic location of proposed critical habitat for the known populations of Salish sucker, reflecting survey work up till 2005, is provided in the draft recovery strategy (Salish Sucker Recovery Team 2005).

Trends in critical habitat

Habitat loss, fragmentation and degradation are the primary threats to population viability of Salish sucker. Details of these threats, and their specific effects on habitat, are provided in Part 2 (*Threats*). Their overwhelming cause is urban and agricultural development in the Fraser Valley. Because this process started more than150 years ago and continues today, the clear trend in habitat is downward. It has not been quantified.

Abundance

Current estimates of abundance of Salish sucker reflect unpublished data from the Ph.D. thesis of Pearson (Pearson 2004), and do not cover all of the ten known populations. Density of Salish sucker is estimated based on CPUE and mark-recapture methods (Pearson 2004). After accounting for the anomalously high density of suckers in Pepin Creek (which crashed following a suspected episode of hypoxia in 2003), density ranged from 0 to 0.22 fish/m^2. Estimated mean abundances as of 2004, obtained through CPUE for six of the known populations and based on a density of 0.05 breeding adults/m^2, are provided below (CPUE was too low in the other four populations to allow estimation):

Watershed	*Estimated abundance*
Salmon River	1390
Bertrand Creek	240
Pepin Creek	2860
Fishtrap Creek	490
Salwein Creek	1290
Miami Creek	850

For purposes of comparison, the average minimum viable population (MVP) for vertebrate species, derived from a meta-analysis of over 100 species, is 7,300 breeding adults where there is less than 1% risk of extinction in 40 generations (Reed et al. 2003). The estimated abundances for Salish sucker are well below this number; raising the risk of extinction to 10% still produces a ‘rule of thumb’ MVP (4,700) significantly higher than what is believed to exist in the Salish sucker streams in Canada. These data are the best we currently have. There are insufficient data to describe any trends in abundance. Sampling designed specifically for determining the current abundance of Salish sucker, and that can stand up to rigorous scientific scrutiny, are a high research priority. The draft Recovery Strategy for Salish Sucker does not attempt to identify abundance (although it does provide population targets).

POPULATION AND DISTRIBUTION TARGETS FOR RECOVERY

If all good sucker habitat were occupied at a realistic density of .05 fish/m^2, and populations are not limited by other factors (such as invasive species or toxic chemicals), the estimated carrying capacity ranges between 800 and 7,000 fish per stream, with an average of 2,600 breeding adults (Pearson 2007). Carrying capacity is synonymous with population target in the draft Recovery Strategy for Salish Sucker. Excluding the little-known “new” population at Elk Creek, the targets for nine watersheds are:

Watershed	Carrying capacity
Bertrand Creek	800
Pepin Creek	1200
Fishtrap Creek	4700
Salmon River	1800
Salwein Creek/Hopedale Slough	2700
Chilliwack Delta	7000
Miami Creek	1500
Mountain Slough	2300
Agassiz Slough	2000

These targets are *not* minimum viable populations (MVPs), because there are insufficient demographic data to determine such a benchmark. All of them are, however, below the ‘rule of thumb’ mean minimum viable population size for vertebrate species (7,300 breeding adults; Reed et al. 2003), a strong argument for preserving as much critical habitat as possible. By definition, these target abundances assume that all habitat identified as critical will be occupied by Salish sucker. The target population in Bertrand Creek is significantly lower than all the others, suggesting that more habitat needs to be constructed (Salish Sucker Recovery Team 2005). The fact that the estimated abundance for Pepin Creek appears to exceed carrying capacity underscores the limitations of the data used to estimate abundance.

While the targets have been derived from incomplete data sets, they nevertheless have value for recovery so long as one accepts the limited data we have on Salish sucker density. Such targets are simply the best current response of science to the question of extinction risk. Whether they are actually achieved depends in part on social and economic considerations.

PART 2: THREATS

SOURCES OF HUMAN-CAUSED MORTALITY AND HARM

While most of the harm to Salish sucker is caused by people, there is one notable exception: beavers. Their dams create the kind of deep pool habitat that Salish suckers like, but can have two downside effects: they can obliterate the riffles that sucker need for spawning, and they can fragment habitat by putting up a barrier that sucker don't negotiate easily. The evidence for and against beavers appears to be equivocal, and to vary with the watershed (Salish Sucker Recovery Team 2005). In natural landscapes, the construction and degradation of beaver dams results in an equilibrium impact on stream habitats that has been generally though to achieve a net benefit to salmonids (Pollock et al. 2004). However, adult salmon have less of a problem getting over beaver dams to access spawning habitat; and while there may be a net beneficial impact of beaver in a really big watershed, their local impacts in a single stream can be extremely negative, particularly if flooding by dams eliminates limited spawning habitat.

Human-caused threats to Salish sucker are enumerated and discussed in the draft Recovery Strategy, the COSEWIC Assessment (2002), and in the published literature (Pearson and Healey 2003; Cooke et al. 2005). Their presentation in this RPA is designed to clearly separate causes from effects. There are three main causes, presented in order of the severity of their effects. Hypoxia, an effect resulting mainly from pollution by agricultural fertilizers and manure, is the most serious threat.

Pollution

Fraser Valley streams that support Salish sucker are vulnerable to many contaminants, which can reach them through direct runoff, spills or by way of groundwater. Contaminants include agricultural chemicals, manure and fertilizers, industrial chemicals, sewage and the effluent from its treatment. The likelihood of pollution is high, and its consequences are serious. Uncertainties generally reflect concomitant factors such as rainfall, water flow and temperature. The best-documented example for Salish sucker is hypoxia.

The most severe effect of pollution, to which Salish sucker are especially vulnerable, is hypoxia (low dissolved oxygen). Primarily a result of excess nutrients in the form of fertilizers, hypoxia happens when algae and plant growth explode, and subsequent decomposition of organic matter uses up oxygen. If riparian vegetation happens to be reduced, the effect is compounded by high daytime temperatures, because warmer water holds less oxygen. Reduced water movement from ponding, channelization or low flows can be an aggravating factor. The end result can be very rapid (a matter of days) collapse of a fish population, as is believed to have happened in Pepin Creek in 2003, when the single largest known population aggregation of Salish Sucker (~1500 fish) was locally extirpated from a single marsh above an old beaver dam—although the role of inorganic fertilizer has not been well documented in this instance. With luck, the imminence of hypoxia can be monitored, but its rapidity and our ignorance about the lower lethal level of oxygen for Salish sucker argue strongly for attacking the cause. This may require modifying or restricting landuse (e.g. types of agriculture that are particularly fertilizer intensive) or particular practices that have negative impacts on water quality.

Many of the pollutants that end up in Salish sucker aquatic habitat are also toxic; some may bind with sediments and be long-lived. While their effects are hard to predict because we don't know the toxic levels for Salish sucker, Pearson (2004) noted that the species is less likely to be found in reaches of streams where land use within 200 metres of the channel is mainly urban; he speculates that the reason may be toxins coming from sewage outfalls.

All rivers are vulnerable to toxins that may enter them through contaminated groundwater or direct discharge. In the Fraser Valley, which is already heavily developed for agriculture and industry and is now being rapidly urbanized, toxic chemicals include pesticides and herbicides that can also arrive from overspraying, sewage treatment effluent and storm runoff of urban and industrial wastes. Their actual role in affecting Salish sucker is not well documented.

Habitat destruction and fragmentation

The effects of human activities on instream habitat in the rivers that support Salish sucker in Canada generally extend beyond the high water mark into the riparian buffer zones described above; for this reason, the following discussion will consider the two types of habitat together. The likelihood of this threat is high, and its consequences severe. It has been well-demonstrated for Salish sucker (Salish Sucker Recovery Team 2005). Uncertainties flow from the location of the habitat change in relation to an unevenly distributed population.

The watersheds that support Salish sucker in Canada are all in the Fraser Valley, an area where there has been heavy historic pressure on natural ecosystems first for agriculture, and more recently for industry and urbanization. The course, structure and flow characteristics of many streams have been drastically altered by draining, dredging, building dikes, infilling and channelization for flood control, agricultural drainage, and construction projects. Marshes and beaver ponds, where Salish sucker density is highest, are often targeted for drainage in the “improvement” of agricultural land (Salish Sucker Recovery Team 2005), which makes them very vulnerable to this threat. Salish sucker habitat continues to be lost to flood control and agricultural drainage projects; not all of these are done under legal permits (Pearson et al. 2007).

Critical habitat need not be destroyed for there to be a detrimental effect on fish populations. Physical structures like culverts and weirs, if improperly designed, can become impassable barriers between sections of habitat (beaver dams, which are not discussed here because they are not man-made, have the same effect, although they can also create habitat for Salish sucker and other small fish species). Habitat destruction and fragmentation can have the following effects on Salish sucker:

Isolation: Because Salish sucker populations are spatially clumped, each watershed is probably inhabited by core subpopulations that are occasionally connected by migrations that would likely occur during transitory periods of high water. Habitat fragmentation would eliminate these migrations, thus reducing the ability to colonize new habitat, something the species will need to do to remain viable.

Sedimentation: Often caused by bank erosion from loss of riparian vegetation or direct discharge from runoff, excess sediment can smother riffles that Salish sucker need for spawning. An extreme case is Pepin Creek, where chronic sediment from gravel operations has filled in pools in some reaches and coated the stream bed with deposited fines (Salish Sucker Recovery Team 2005). Sediment erodes naturally from banks and stream beds that may be many kilometers upstream, and streams are the conduits for its redistribution. Their capacity to handle sediment can be overwhelmed either by the addition of sediment from outside sources by way of storm drain runoff, or by any action that increases bank scouring, such as removing riparian vegetation or increasing peak flow. Urban development, agriculture and mining can all trigger increased sedimentation.

Water withdrawal

Agricultural and domestic water demand tends to peak when supplies are the most scarce. Actions that exacerbate seasonal low flows include impermeable structures (buildings, parking lots) that reduce aquifer recharge, gravel mining that reduces the size of aquifers, and drainage of wetlands. Especially in summer, water demands for agriculture, domestic use and gravel mining can dewater streams whose only source of replenishment in a time of low rainfall is ground water. The effect of water withdrawal is mainly to exacerbate the problems caused by habitat loss, pollution and introduced species, because the deep pool habitats preferred by Salish sucker provide some buffer. However, it should also be recognized that water itself constitutes critical habitat for Salish sucker, and can be defined as such both in terms of water *quality* (range of temperature, D.O., etc. required for individual and species persistence) and water *quantity*, since the amount of water in the stream channel will determine habitat capacity for fish.

The likelihood of this threat is high, and its effects variable, ranging to severe if pools and riffles are strongly affected. Uncertainties derive from the amount of extraction, its location and timing.

Introduced species

There are introduced predators in all known Salish sucker streams: they include bullfrog (*Rana catesbeiana*), bullhead (*Ameiurus nebulosus*) and largemouth bass (*Micropterus salmoides*). These species appear to have coexisted with Salish sucker for a decade in some parts of their range (Pearson, unpublished); further introductions are possible. Their impacts on Salish sucker are not well known. Based on the existence of introduced species already in Salish sucker habitat and the easy accessibility of that habitat, the likelihood of further introductions is high.

MAXIMUM SUSTAINABLE MORTALITY

Mortality is here defined as adults effectively removed from the population; it can result from harm to any or all life stages. The maximum mortality sustainable by any population ideally provides decision makers with a practical benchmark that's useful for adjudicating proposed activities that can remove fish either directly (by killing them) or indirectly (by affecting habitat or water quality). Such figures are hard to arrive at for the Salish sucker populations in Canada, because estimated abundances rest on such limited data. Based on those data, the maximum population size that can be achieved in the habitat presently proposed as critical is below the minimum viable population sizes often accepted as generic for vertebrates when abundance data are weak (Pearson et al. 2007; Reed et al. 2003). This is the reason the Recovery Team designated all suitable habitat as critical; in the case of Bertrand Creek, it still appears to be inadequate (see Target abundances, above).

Any contemplated increase in mortality that reduces the current estimated abundance would need to be considered in the context of the individual river. For three of the watersheds (Bertrand, Fishtrap and Pepin Creeks), available habitat also limits the abundance of the endangered Nooksack dace (Harvey 2008), but the fact that the two species prefer different kinds of habitat (Nooksack dace are riffle specialists) could make risk aversion difficult. Bertrand Creek, for example, has the lowest abundance of Salish sucker of any of the ten known populations, but is in relatively good shape for Nooksack dace. Thus there may be room for some allowable harm to Nooksack dace in the Bertrand system, but not to Salish sucker. Those responsible for issuing permits for activities that could impact a stream like Bertrand Creek will have to carefully consider the kind of habitat that will be affected.

It is also important to note that Salish sucker occur in ten separate watersheds in Canada. While a rescue effect (re-colonization by a neighbouring population) may be tempered by the tendency of Salish sucker not to wander from their home range, extirpation from one watershed does not mean extirpation of the species, and it can probably be overcome by transplantation of fish from another watershed. This redundancy at least reduces the risk of species extirpation from random environmental or demographic effects, although population loss from habitat degradation clearly precludes the possibility of any rescue effect from adjacent populations as long as habitat remains degraded.

Based on the estimated abundances, removal of adults for scientific research may be considered allowable harm for some watersheds. The number of such watersheds appears limited, since abundance estimates are unavailable for four of the rivers where Salish sucker are found, and would not appear to support removal of fish even in the low hundreds for Bertrand, Fishtrap and Miami Creeks.

PART 3: SCENARIOS FOR MITIGATION AND ALTERNATIVES

The human activities that most threaten Salish sucker in Canada are those that alter, destroy, pollute or disrupt critical habitat. These threats are the result of more than a century of agricultural, industrial and urban development of the Fraser Valley. The historic context for the present condition of streams in the Fraser Valley is reviewed by Rosenau and Angelo (2005), and the Recovery Potential Analysis for Nooksack Dace contains a brief summary of historic development in the area (Harvey 2008).

While damage to habitat still occurs, our understanding of its effects on wildlife has grown; so too has the number of legislative and regulatory tools (including some that are rarely enforced). In the following section of this RPA, ways to minimize these effects are presented; after that, the report concludes with a consideration of ways in which some of these activities can actually be eliminated, and replaced by others that have no impact on critical habitat.

The existence of endangered Nooksack dace in Bertrand, Fishtrap and Pepin Creeks needs to be taken into account when developing best practices and restoration projects for these watersheds, because the two species prefer different habitats. In most cases Nooksack dace seem unlikely to be harmed by recovery activities for Salish sucker, many of which focus on creating new habitat, rather than converting existing habitat used by one species to a different type (Salish Sucker Recovery Team 2005; J. Rosenfeld 2007, pers. comm.). Recovery actions that benefit two endangered species will also have a positive awareness impact.

MINIMIZING HUMAN ACTIVITIES AND THREATS TO HABITAT

Pollution

Agricultural intensification, which means getting higher production out of the same amount of land, has been going on for 10,000 years, with enormous modification of global ecosystems

(FAO 2004). It continues in the Fraser Valley, which accounts for over half the gross farm receipts in B.C. on a small portion of the province's overall agricultural land (Fraser Basin Council 2001). Intensification can involve irrigation, increased mechanization, the use of higher-yielding plant varieties and increased use of fertilizers, including manure. Minimizing hypoxia, an indirect effect of pollution to which Salish sucker are especially vulnerable, starts with reducing fertilizer input.

In the Fraser Valley, using manure or fertilizer in excess of crop needs or at the wrong time increases non-point-source pollution from nutrients and other substances contained in manure. Minimizing the amount of nutrient loading in Fraser Valley streams is a challenge, and sustainable management of nutrients in the Fraser Valley is still a distant goal (Hall and Schreier 1996). The two most applicable Acts are the federal *Fisheries Act* and the provincial *Waste Management Act*. The Fisheries Act specifically prohibits entry of oxygen-depleting wastes into fish-frequented waters. The *Agricultural Waste Control Regulation* (AWCR), under the *Waste Management Act*, pertains specifically to nutrient management on farms. Both Acts contain provision for enforcement and fines up to $1 million. Further legislative options include developing and implementing provincial groundwater legislation.

A Nutrient Management Planning Strategy has been developed jointly by government agencies and agricultural producers (Fraser Basin Council 2001). For much of the Fraser Valley, farms can achieve an acceptable nutrient balance, and reduce the risk of hypoxia in Salish sucker habitat, by improving on-farm nutrient management practices, reducing the use of inorganic fertilizers, improving feeding strategies and setting up manure storage. There are substantial benefits beyond the environmental ones. These include improved consumer perception, reduced fertilizer costs and health risks to cattle, reduced greenhouse gases and improved human health through better water quality.

Monitoring and awareness are critical, and there is a major role for stewardship groups working in partnership with technical and regulatory advisors from the responsible federal, provincial and municipal agencies.

Habitat destruction and fragmentation

There are ways not only to reduce the instances of habitat destruction and fragmentation, but also to reduce their main effects on Salish sucker, namely isolation and sedimentation. The first approach is regulatory, educational and proactive. It relies on using our knowledge of the threats, their effects and the existing regulatory mechanisms to develop reach-specific best management practices. An example would be controlling sedimentation through better management of storm drain discharge and closer control of gravel mining operations. Such practices will only work if landowners, stewardship groups, regulatory agencies and the public buy into their development and enforcement. Awareness and engagement of landowners will be especially important in cases where *de facto* best management practices already exist.

The second approach accepts that habitat loss has already occurred, and concentrates on remediation. Restoration of damaged habitat, creation of new riffle habitat and riparian planting are all technically feasible and well within the interest and expertise of stewardship groups working in partnership with fisheries agencies. Restoration of habitat has the added virtue of being measurable. Public awareness materials and a participatory approach will again be crucial, especially for landowners expected to host the work of remediation. Based on excellent results from a long history of freshwater salmonid habitat restoration in B.C., such fieldwork, combined with participatory development of agricultural and industrial best practices, can significantly minimize harm to Salish sucker habitat. Isolation of subpopulations, for example, could be minimized by removing barriers; sedimentation could be reduced by planting riparian vegetation to limit bank scouring. Both the reduction of sedimentation and the restoration of sediment-damaged riffles depend on mapping, prioritizing and working with multi-stakeholder groups.

Water withdrawal

To preserve the buffering effect of the sloughs and pools that typify Salish sucker habitat, best management practices regarding seasonal flow will need to be developed from water balance models for all watersheds where the species is found. These models will quantify current flow regimes and the extent to which drainages have been altered by surface water abstraction and groundwater removal. Minimum instream flow prescriptions must then be developed for key reaches and harmonized with existing licenses for surface water extraction. The domino effect whereby groundwater extraction makes up for reduced availability of surface water needs also to be minimized, because the licensed withdrawal of surface water is not the only cause of decrease in flow. Withdrawal of ground water (which does not require a license in B.C.) may pose a risk in some of the watersheds occupied by Salish sucker. Current groundwater demands are likely lowering the groundwater table at critical summer low flows, and unrestricted groundwater extraction in the future will be a major cause of habitat loss and threat to population persistence (J. Rosenfeld 2007, pers.comm.). Two measures will help prevent water withdrawal exceeding any specified limits: licensing of groundwater extraction, and further research to determine the connection between surface and ground waters in the basin.

Introduced species

Introductions of non-native species are usually done by the general public; some are inadvertent. The only realistic way to minimize the likelihood of further introductions is awareness, including signage at easy access points.

ALTERNATIVES TO HUMAN ACTIVITIES AND THREATS TO HABITAT

While restoration of habitat that has already been damaged or fragmented is clearly called for in all the Salish sucker drainages in Canada, it is a strategy that treats the symptoms rather than the disease. The previous section discussed ways of minimizing human activities that degrade and pollute habitat; the opportunity also exists to actually eliminate those activities in sections of the watersheds where critical habitat is presently damaged. It is very important that areas of the Salish Sucker watersheds (particularly undeveloped areas) that contribute disproportionately to ecosystem functions (such as groundwater recharge that contribute to baseflows) are identified and given priority protection so that the function they confer is not lost.

Some of the riparian critical habitat is already occupied by permanent structures (buildings, roads, trails, railways, dikes). Portions of the remainder of actively farmed riparian land could, however, be removed from production. A model is the Conservation Reserve Enhancement Program (CREP), a land retirement program administered by the United States Department of Agriculture's Farm Service Agency (FSA). The CREP program, which is available in all states, helps producers protect and restore wildlife habitat while conserving ground and surface water (USDA 2007). Participation is voluntary; land enrolled in CREP is removed from production and grazing for a contracted period of 10-15 years. Landowners are paid an annual rent and reimbursed for buffer planting and maintenance.

In Canada, similar objectives can be achieved through land trusts. While most trusts work by acquiring land (hence removing the risk of development that could affect biodiversity and ecosystem processes), some operate in a way analogous to CREP. The Delta Farmland and Wildlife Trust, for example, achieves its land conservation objectives through assisted land management and stewardship on land that is owned by others (Delta Farmland and Wildlife Trust 2007). While many of its activities target farming practices in the Fraser Delta that will benefit wildfowl, the same methods (and probably even many of the same funders) will apply to Salish sucker riparian habitat. Any organization prepared to become involved in collaborative riparian restoration of Salish sucker habitat would need to be aware of potential habitat synergies and conflicts with other important species (both salmonids and the Nooksack dace, another SARA-listed species, have some habitat overlap with Salish sucker), and have demonstrated capacity for the long term building of landowner participation in restoration projects. Liaison with the Recovery Implementation Group for Salish sucker will also be important.

The kinds of land retirement and stewardship activities described above apply mainly to habitat degradation. Their impact on nutrient loading, which was identified by the Salish Sucker Recovery Team as the most severe threat to the species, would be limited by the amount of agricultural land included in any retirement or stewardship program.

Finally, the BC Environmental Farm Plan initiative offers some immediate opportunities for protecting fish habitat. This relatively recent voluntary program is available to agricultural producers and provides technical advice and funding for implementing approved farm plans (B.C. Agricultural Council 2007).

REFERENCES

Annear, T., Chisholm, I., Beecher, H., Locke, A., and 12 other authors. 2004. Instream flows for riverine resource stewardship, revised edition. Instream Flow Council, Cheyenne, WY. 267 pp.

B.C. Agricultural Council. 2007. The Canada - British Columbia Environmental Farm Plan Program. http://www.ardcorp.ca/index.php?page_id=14

B.C. Ministry of Environment. 2008. Wildlife in British Columbia At Risk. wlapwww.gov.bc.ca/wld/documents/salishsucker.pdf

B.C. Ministry of Environment. 2007. www.env.gov.bc.ca/habitat/fish_protection_act/riparian/riparian_areas.html

Cooke, S.J., Bunt, C.M., Hamilton, S.J., Jennings, C.A., Pearson, M.P., Cooperman, M.S., and Markle, D.F. 2005. Threats, conservation strategies, and prognosis for suckers (Catostomidae) in North America: insights from regional case studies of a diverse family of non-game fishes. Biological Conservation 121: 317-331.

COSEWIC. 2006. Operations and Procedures Manual, April 2006. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

COSEWIC. 2002. Assessment and update status report on the Salish sucker Catostomus sp. in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. Vii + 27 pp.

Delta Farmland and Wildlife Trust. 2007. www.deltafarmland.ca/dfwt2.html

Environment Canada. 2008. Salish Sucker. Species at Risk Summaries. www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=67

FAO. 2004. The ethics of sustainable agricultural intensification. Food and Agriculture Organization of the United Nations. 37pp. www.fao.org/docrep/007/j0902e/j0902e02.htm#TopOfPage

Fraser Basin Council. 2001. Nutrient management planning strategies for the Fraser Valley. Fraser Basin Council, Vancouver, B.C. 47 pp.

Fraser Basin Council. 2007. www.fraserbasin.bc.ca/regions/fvr.html

Frissell, C. A., Liss, W. J., Warren, C. E., and Hurley, M. D. 1986. A hierarchical framework for stream habitat classification: viewing streams in a watershed context. Environmental Management 10:199-214.

Hall, K.J., and Schreier, H. 1996. Urbanization and agricultural intensification in the Lower Fraser River valley: Impacts on water use and quality. Geo Journal 40: 135-146.

Harvey, B. 2008. Recovery Potential Assessment for the Nooksack dace Rhinichthys cataractae. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/075. 32 pp.

McPhail, J.D., and Taylor, E.B. 1999. Morphological and genetic variation in northwestern longnose suckers, Catostomus catostomus: the Salish sucker problem. Copeia 1999 (4): 884-893.

National Recovery Team for Salish Sucker. 2005. National Recovery Strategy for Salish Sucker (Catostomus sp.). Prepared for British Columbia Ministry of Water, Land and Air Protection, and Fisheries and Oceans Canada by Mike Pearson, Vancouver, B.C.

Pearson, M.P. 2007. An assessment of potential critical habitat for Nooksack dace (Rhinichthys cataractae ssp.) and Salish sucker (Catostomus sp.). DFO Can Sci. Advis. Sec. Res. Doc. 2007/058. 29 pp.

Pearson, M.P. 2004. The ecology, status and recovery potential of Nooksack dace and Salish sucker in Canada. Ph.D. thesis, University of British Columbia. Xv + 239 pp.

Pearson, M.P. and Healey, M.C. 2003. Life history characteristics of the endangered Salish sucker (Catostomus sp.) and their implications for management. Copeia 2003 (4): 759-768.

Pearson, M.P., Hatfield, T., McPhail, J.D., Richardson, J.S., Rosenfeld, J.S., Schreier, H., Schluter, D., Sneep, D.J., Stejpovic, M., Taylor, E.B., and Wood, P.M. 2007. Recovery Strategy for the Nooksack Dace (Rhinichthys cataractae) in Canada. Species at Risk Act Recovery Strategy Series, Fisheries and Oceans Canada, Vancouver. vi + 31 pp.

Pollock, M.M., Pess, G.R., Beechie, T.J., and Montgomery, D.R. 2004. The importance of beaver ponds to coho salmon production in the Stillaguamish River Basin, Washington, USA. North American Journal of Fisheries Management 24:749–760.

Reed, M.J., O'Grady, J.J., Brook, B.W., Ballou, J.D., and Frankham, R. 2003. Estimates of minimum viable population sizes for vertebrates, and factors influencing those estimates. Biol. Conserv. 113: 23-34.

Rosenau, M.L., and Angelo, M. 2005. Conflicts Between Agriculture and Salmon in the Eastern Fraser Valley. Pacific Fisheries Resource Conservation Council. Vancouver, BC.

USDA 2007. The conservation reserve enhancement program. http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep