Species at Risk Act
Recovery Strategy Series

Recovery Strategy for the Speckled Dace (*Rhinichthys osculus*) in Canada

Speckled Dace

2018

Canada

Recommended citation:

Fisheries and Oceans Canada. 2018. Recovery Strategy for the Speckled Dace (*Rhinichthys osculus*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. v + 31 pp.

For copies of the recovery strategy, or for additional information on species at risk, including COSEWIC Status Reports, residence descriptions, action plans, and other related recovery documents, please visit the Species at Risk Public Registry.

Cover illustration: Copyright (c) [2007] Regents of the University of California. Credit: Dave Giordano

Également disponible en français sous le titre
«Programme de rétablissement du naseux moucheté (Rhinichthys osculus) au Canada»

ISBN 978-0-660-06858-9
Catalogue no. En3-4/245-2016E-PDF

Preface

The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada. Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of recovery strategies for listed Extirpated, Endangered, and Threatened species and are required to report on progress five years after the publication of the final document on the Species at Risk Public Registry.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Speckled Dace and has prepared this strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the British Columbia Ministry of Environment.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this strategy and will not be achieved by Fisheries and Oceans Canada (DFO), or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this strategy for the benefit of the Speckled Dace and Canadian society as a whole.

This recovery strategy will be followed by one or more action plans that will provide information on recovery measures to be taken by DFO and other jurisdictions and/or organizations involved in the conservation of the species. Implementation of this strategy is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

Acknowledgments

This recovery strategy was authored by Heather Stalberg (Fisheries and Oceans Canada; DFO). DFO extends its appreciation to the many individuals and organizations that supported the development of this recovery strategy. DFO acknowledges the efforts of the members of the former Non-Game Freshwater Fish Recovery Team (NGFWRT) (listed below) for preparing an early draft of this recovery strategy that was later substantially revised. DFO also acknowledges Brian Harvey who provided species expertise and assistance in updating the draft strategy. The valuable information, expertise and perspectives shared by stakeholders at a December 2013 recovery planning technical workshop for the Speckled Dace are also acknowledged and greatly appreciated.

Members of the NGFWRT assembled to provide science-based recommendations to the government with respect to the recovery of the Speckled Dace at the time of preparing the 2008 draft recovery strategy were:

Jordan Rosenfeld, British Columbia Ministry of Environment (Co-Chair)
Dan Sneep, DFO (Co-Chair)
Todd Hatfield, Solander Ecological Research (coordinator)
Don McPhail, formerly of University of British Columbia
John Richardson, University of British Columbia
Dolph Schluter, University of British Columbia
Eric Taylor, University of British Columbia
Paul Wood, University of British Columbia

The recovery strategy does not necessarily represent the views of all of the individuals who provided advice or contributed to its preparation, or the official positions of the organizations with which the individuals are associated.

Executive Summary

The Speckled Dace (*Rhinichthys osculus)* is a small freshwater minnow. Within its Canadian range, Speckled Dace is a riverine fish that makes use of riffles, runs and pools, feeding off the bottom on algae and aquatic insects. While widely distributed in western North American rivers, the species is confined in Canada to a short section of the Columbia River drainage that includes the West Kettle, Kettle, and Granby Rivers. Recent field studies have confirmed a large and apparently robust population of Speckled Dace throughout its Canadian range, far in excess of previous estimates made prior to being listed as Endangered in Schedule 1 of the *Species at Risk Act* (SARA).

Threats to the Speckled Dace include: water use from reduced flows in the summer and autumn due to irrigation and other consumptive uses, and inundation and loss of habitat through potential hydro development; industrial land use such as agricultural and forestry activities that increase siltation leading to substrate embeddedness, plus mining activities that can also release harmful substances; invasive piscivorous fish that can increase predation on Speckled Dace, and; possibly climate change where the impacts on habitat quality and future availability are uncertain.

This recovery strategy identifies the population and distribution objective for Speckled Dace as: maintain current[1] distribution and abundance within natural fluctuations. As well, broad strategies and approaches necessary for the recovery of Speckled Dace are provided.

Critical habitat for the Speckled Dace is identified to the extent possible using the best available information. The critical habitat has been identified using a parcel approach, where the exact area identified by the boundaries supports the functions and features necessary for the survival or recovery of the species; the features are margins, pools, runs, riffles and food availability with the associated attributes described to the extent possible. The geographic extent of the critical habitat is a 2.4 kilometre-long section in each of the West Kettle, Kettle, and Granby Rivers, sited in the uppermost areas where Speckled Dace have recently been captured. Each section has been identified to maintain a minimum adult population of 7,000 individuals, which is a conservative, generic target for maintenance of a vertebrate population; providing three such populations is an additionally precautionary approach and supports the population and distribution objective. It is anticipated that the critical habitat will be protected from destruction by a SARA Critical Habitat Order.

An action plan for the recovery of Speckled Dace will be completed within five years of posting the final recovery strategy on the Species at Risk Public Registry.

[1] "Current" refers to the best available knowledge on Speckled Dace as stated in section 3.2.

Recovery Feasibility Summary

Recovery of Speckled Dace is technically and biologically feasible. The draft *Species at Risk Act* Policies, Overarching Policy Framework (Government of Canada 2009) establishes four criteria on which to base the assessment of feasibility. These criteria are posed as questions and answered below:

1. Are individuals of the wildlife species capable of reproduction available now, or in the foreseeable future, to sustain the population or improve its abundance?

Yes. Recent field survey data confirm a robust population.

2. Is sufficient suitable habitat available to support the species or could it be made available through habitat management or restoration?

Yes. Availability of suitable habitat is not a limiting factor for Speckled Dace.

3. Can the primary threats to the species or its habitat (including threats outside Canada) be avoided or mitigated?

Yes, with the possible exception of unpredictable changes in stream temperature and flow as a result of long term climate change.

4. Do recovery techniques exist to achieve the population and distribution objectives or can they be expected to be developed within a reasonable timeframe?

Yes. The identification of critical habitat is conservative and precautionary, and techniques exist to minimize the threats.

Table of Contents

1. COSEWIC Species Assessment Information

Date of Assessment: April 2006

Common Name (population): Speckled Dace

Scientific Name: *Rhinichthys osculus*

COSEWIC Status: Endangered

Reason for Designation: The species is restricted to the Kettle River mainstem and two main tributaries in southcentral British Columbia where it appears to be limited by the availability of suitable habitat. As this population is isolated above Cascade Falls, it cannot be rescued from downstream United States populations. The Kettle River is a flow-sensitive system that appears to be experiencing increasing frequency of drought conditions. The species is threatened by these reduced water flows and projected increasing water demands.

Canadian Occurrence: British Columbia

COSEWIC Status History: Designated Special Concern in April 1980. Status re-examined and designated Endangered in November 2002 and in April 2006.

2. Species Status Information

Several of the many populations of Speckled Dace (*Rhinichthys osculus*) within the western United States are listed under that country's *Endangered Species Act*. The species is not found on the International Union for Conservation of Nature's red list; its global rank is G5 (demonstrably widespread, abundant, and secure). The Canadian population of Speckled Dace was designated Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1980, and reassessed as Endangered in 2002 based on that year's status report (COSEWIC 2002). Its endangered status was confirmed by COSEWIC in 2006 (COSEWIC 2006). In 2009, Speckled Dace was listed as Endangered under the *Species at Risk Act* (SARA). The species is red-listed by the British Columbia Conservation Data Centre and categorized level S2 (imperiled).

3. Species Information

3.1 Species Description

Speckled Dace, while widely distributed in western North American rivers, is confined in Canada to a short section of the Columbia River drainage (Scott and Crossman 1973; Wooding 1994). Genetic data indicate Speckled Dace above Cascade Falls have diverged from Snake River and lower Columbia dace populations (McPhail 2007); the

Speckled Dace in Canada appear to be unique. Population structure within Canada is not known; in this Recovery Strategy, “the Canadian population” refers to all the Speckled Dace in Canada.

The Speckled Dace is a small freshwater minnow (51-94 millimetres (mm) in length), with a prominent snout and a sucker-like mouth (Brown et al. 2012). Within its Canadian range, Speckled Dace is a riverine fish that makes use of river margins, riffles, runs and pools (Brown et al. 2012; COSEWIC 2006) (Section 3.3 below provides further detail on the current understanding of habitat preferences of different life stages). Speckled Dace are bottom feeders that eat filamentous algae and aquatic insects (Peden and Hughes 1981; Batty 2010). Dace likely provide a link in aquatic and terrestrial food chains as food for larger fish and birds (Brown et al. 2012).

Spawning of Speckled Dace has never been documented in the wild, although it is believed to begin in mid-July (COSEWIC 2006) and is assumed to occur over unembedded substrate, at the edge of the channel or under protection of debris (Andrusak pers. comm. 2013). Laboratory observations suggest that the eggs are adhesive (Kaya 1991). Spawning is likely triggered by some combination of increased photoperiod and rising water temperature (Kaya 1991). Survival at the various life stages is not known. McPhail (2003) combines his own personal field observations and observations from populations in Arizona to suggest that development from fertilization is around one week at 18 degrees Celsius (°C), and that larvae become free-swimming about a week after that. Hence, fry appear in the Kettle River in early August. There are no data on possible nest construction, egg guarding or survival at different life stages. The life span of Speckled Dace is believed to be around four years (COSEWIC 2006; McPhail 2003).

3.2 Population and Distribution

Recent field research by Batty (2010) provided strong evidence for a Canadian population approximately 40 times the estimate contained in COSEWIC (2006) and accepted in the Recovery Potential Assessment (RPA) for the species (Harvey 2007; DFO 2008). Batty’s abundance estimate (which was derived from electrofishing), when adjusted for capture efficiency, was close to one million mature[2] adult Speckled Dace (939,610 with a 90% confidence interval of 412,000 – 1,955,000). Given that electrofishing cannot access all depths, and there remain some unsampled areas, this estimate could be low. Any trends in abundance are unknown. Subsequent field studies by Andrusak and Andrusak (2011) and Andrusak et al. (2012) filled in many gaps concerning habitat use by mature and immature Speckled Dace and added more information on abundance and density. Based on these recent reports, abundance of Speckled Dace appears to be robust, and the large population suggests that suitable habitat is abundant.

[2] Batty (2010) adopted a size related criterion to partition immature (juvenile) and mature (adult) Speckled Dace, which Andrusak and Andrusak (2011) similarly adopted with immature 18-54 mm and mature >54 mm. Andrusak et al. (2012) then utilized <55 mm for immature and >55 mm for mature Speckled Dace.

Speckled Dace appear to be distributed widely and somewhat evenly throughout their approximately 300 kilometre (km) range in Canada. Within the Kettle-Granby system (Figure 1), Speckled Dace have been collected or observed at a number of sites over 275-300 km of river. On a linear basis (expressed as adult Speckled Dace/metre (m)), abundance was found to be highest in the West Kettle and lowest in the Granby (Batty 2010). COSEWIC (2006) notes evidence for small numbers of Speckled Dace below the “natural barrier” of Cascade Falls but upstream of the international border between Canada and the United States; this short stretch of the Kettle River (around 5 km) therefore comprises part of the species’ distribution in Canada. Batty (2010) was able to catch Speckled Dace further upstream than previously recorded in the Kettle and Granby Rivers and he felt they may extend even further north in the Kettle system. Batty (2010) concluded there was no evidence of range contraction since the 2006 COSEWIC assessment.

At the time of writing the 2006 COSEWIC assessment, the approximately 11 km section of river just upstream of Cascade Falls was thought to possibly represent a significant proportion of the Canadian Speckled Dace population, and that a major catastrophic event, capable of causing downstream impacts, could threaten a significant portion of the population in that area (COSEWIC 2006). However, the COSEWIC assessment noted it was unlikely that such an event could affect all of the Speckled Dace in Canada as they occur in more than one river and that re-colonization would most likely be possible from portions of the distribution that were not impacted (COSEWIC 2006). Significant numbers of adult fish found by Batty (2010) in each of the three headwater segments of the Kettle River support this suggested capacity for recolonization, or “rescue,” between the rivers.

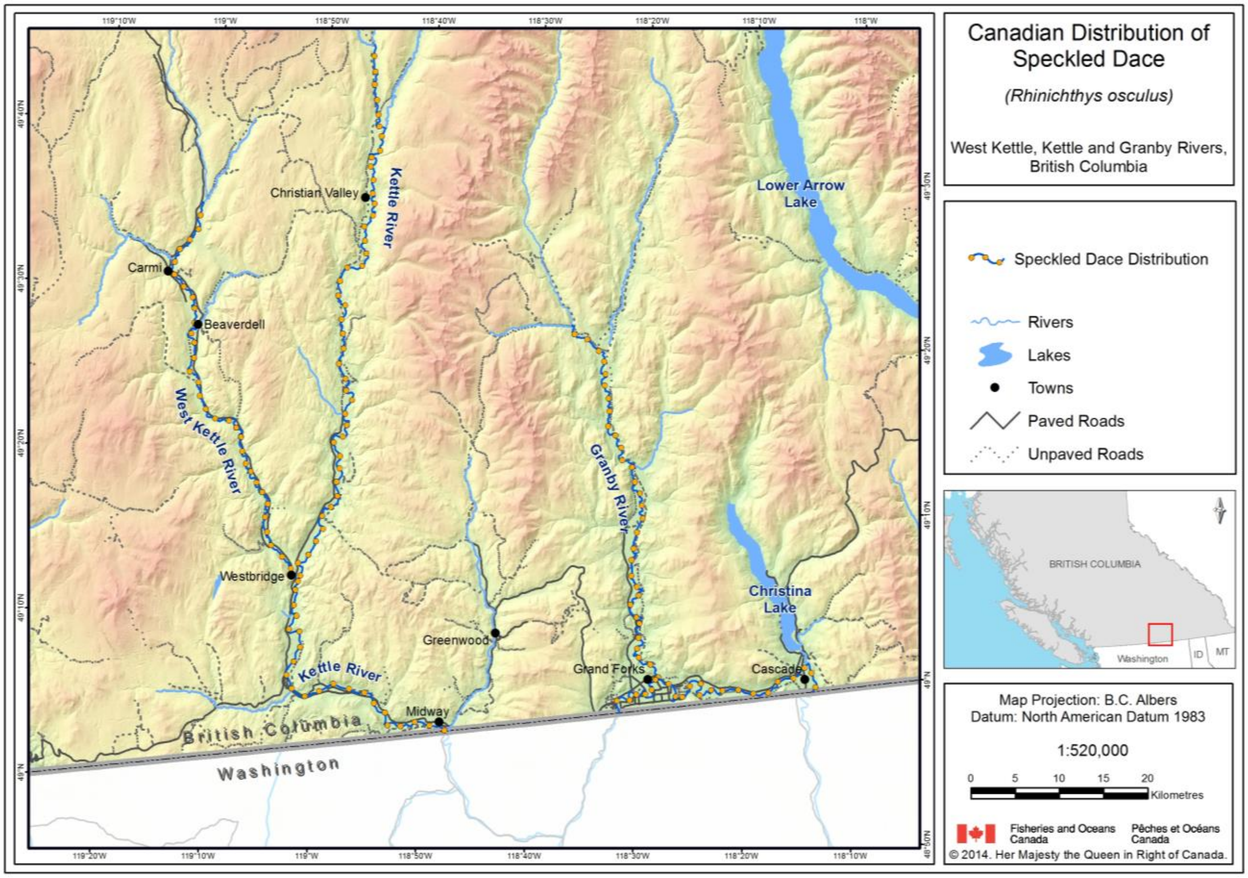

Figure 1. Canadian distribution of Speckled Dace

3.3 Needs of the Speckled Dace

Since the 2006 COSEWIC assessment and the 2008 RPA, research to fill gaps identified in both documents has yielded a more complete understanding, not only of abundance and distribution, but also of the species' habitat preferences and requirements.

There remains concern that the understanding of Speckled Dace habitat utilization, which is based on daytime backpack electrofishing alone, is incomplete. Andrusak and Andrusak (2011) note that snorkel sightings of mature dace in deep water, beyond electrofishing depth range, highlight the limitations of backpack electrofishing with increasing depth and velocity. Nevertheless, the data base for crafting recovery actions is much more robust than at the time of its SARA listing.

Batty (2010) found that the probability of finding Speckled Dace decreased with increasing depth and water velocity, suggesting a preference for slow, shallow habitats. Recent research by Andrusak and Andrusak (2011) suggests that habitat utilization is life stage-specific. These researchers found immature dace associated with river margins, with no preference for woody debris. They found adults less associated with river margins, instead their habitat extends into deeper water, and they use runs and riffles. The adults exhibited neither a preference for woody debris nor overhanging vegetation. Little is known, however, about adult use of deep pool habitats, and the fact that some pools in the Kettle River are up to 20 feet deep injects additional uncertainty into population estimates (Andrusak pers. comm. 2013). Andrusak and Andrusak (2011) did not capture adults at West Kettle sites in autumn, and immature dace shifted from riffle to deeper habitats in autumn suggesting a possible adult migration in autumn.

Batty (2010) also provides much information on dietary needs and preferences, which appears to include bottom feeding of adults on filamentous algae and the larvae of aquatic insects, most commonly from the Orders Ephemeroptera (mayflies and dragonflies), Plecoptera (stoneflies) and Tricoptera (caddisflies), as well as the Family Chironomidae (midges). Diet preferences of juveniles less than 18 mm (i.e., young of the year and larvae) remain a knowledge gap. Regarding substrate, Andrusak and Andrusak (2011) found that immature dace used small gravel or cobble, with low to moderate embeddedness.[3] Mature dace used boulder or cobble with low embeddedness. This implies that coarse substrate provides in-stream cover and that excessive sedimentation would be detrimental, a conclusion reinforced by Batty (2010), who describe the species as bottom-dwelling and likely relying on substrate for cover.

In terms of flow, Batty (2010) noted that his abundance sampling, which estimated around a million mature fish in the system, was conducted five years after the 2003 extreme drought, which produced the lowest flows on record. In his view, Speckled Dace are either tolerant of drought or resilient to it. Dace have been observed over a wide range of velocities (0-1.08 m/second (s)), indicating that they are an adaptable species (Batty 2010). Andrusak and Andrusak (2011) found that immature dace preferred lower velocity sites (below 0.24 m/s) along the river margins and in association with runs, riffles and pools, while mature fish preferred higher velocities (0.18-0.45 m/s) and deeper water. Again, lack of knowledge of the species' use of deeper pools, both during the day and at night, puts some limits on the ability to neatly describe habitat preferences.

Andrusak et al.'s (2012) study concentrated on the relationship between discharge and the amount of habitat used; useable width of river (and hence available habitat) was found to decrease as discharge declined, especially in the West Kettle. Depth and velocity habitat suitability curves were derived for immature and mature Speckled Dace. Flow for immature dace for the West Kettle, Kettle and Granby Rivers appeared to be optimal below 10 m^3/s. For mature dace, the range of useable area in relation to discharge is wider and varies with the system; in general, useable width was optimal near a discharge of 5-10 m^3/s. Overall, though, the preference for both life stages is for slow, shallow systems, which are in good supply (Andrusak et al. 2012). The main area

[3] Andrusak and Andrusak (2011) visually determined embeddedness based upon categories in Platts et al. (1983) i.e. low: 0-5 percent of surface covered by fine sediment; moderate: 5-25 percent of surface covered by fine sediment; high: 25-50 percent of surface covered by fine sediment; very high: 50-75 percent of surface covered by fine sediment; and complete: >75 percent of surface covered by fine sediment.

of concern about flow, according to these authors, is for the effects of discharges below 5 m^3/s in the West Kettle River, which will provide a substantial decline in useable width and available habitat.

The range of temperatures in which Speckled Dace have been found within the Kettle area is quite broad, with daily maximum water temperatures in the lower river sections now routinely reaching 24°C by the middle of July; in the winter, temperatures fall below 0°C and anchor ice can form (Brown et al. 2012). The species also appears able to cope with changes in water temperature as studies on the species from other parts of its range where maximum temperatures are higher than in British Columbia found the species could acclimate in the laboratory to a temperature of 31°C (Harvey 2007). Water temperature in the Kettle drainage is discharge related (Brown et al. 2012).

4. Threats

4.1 Threat Assessment

Table 1. Threat assessment table

Threat	Level of Concern[a]	Extent	Occurrence	Frequency	Severity[b]	Causal Certainty[c]
HABITAT LOSS AND/OR DEGRADATION (GENERAL THREAT: WATER USE)						
Specific Threat: Reduced flows in summer and autumn due to irrigation and other consumptive uses	Medium	Widespread, especially lower sections of all three watersheds	Current/ anticipated	Seasonal (irrigation); continuous for other consumptive uses	Unknown; highest in West Kettle River	Low; lowest in West Kettle River
Specific Threat: Inundation and loss of habitat through proposed Cascade Falls hydro development	Low	Localized	Anticipated	Continuous	Low	High
WATER POLLUTION (GENERAL THREAT: INDUSTRIAL LAND USE)						
Specific Threat: Increased siltation and substrate embeddedness from agricultural land clearing	Medium	Widespread in lower sections of all three watersheds	Historical/ current/ anticipated	Continuous	Unknown	Medium

Threat	Level of Concern[a]	Extent	Occurrence	Frequency	Severity[b]	Causal Certainty[c]
Specific Threat: Increased siltation and substrate embeddedness from forestry activities	Low	Localized (upper watershed)	Historical/ anticipated	Recurrent	Unknown	Medium
Specific Threat: Harmful substance and sediment releases and substrate embeddedness from mining activities	Low	Localized	Historical/ unknown	Unknown	Unknown	Low
AQUATIC INVASIVE SPECIES (GENERAL THREAT: INVASIVE PLANTS, ANIMALS AND MICROORGANISMS)						
Specific Threat: Increased predation by piscivorous fish	Medium	Localized	Current/ anticipated	Continuous	Unknown	High
CLIMATE CHANGE (GENERAL THREAT: CHANGES IN PRECIPITATION AND TEMPERATURE)						
Specific Threat: Changes in hydrograph, temperature, cover and stream morphology	Low	Widespread	Anticipated	Continuous/ seasonal	Unknown	Low

[a] *Level of Concern: signifies that managing the threat is of (high, medium or low) concern for the recovery of the species, consistent with the population and distribution objectives. This criterion considers the assessment of all the information in the table.*

[b] *Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).*

[c] *Causal certainty: reflects the degree of evidence that is known for the threat (High: available evidence strongly links the threat to stresses on population viability; Medium: there is a correlation between the threat and population viability e.g. expert opinion; Low: the threat is assumed or plausible).*

4.2 Description of Threats

Water Use

Reduced flows in summer and autumn due to irrigation and other consumptive uses

Agriculture accounts for approximately 80% of the total annual water use in the Kettle watershed, and continues through a time of low seasonal flow (late summer/early fall) (COSEWIC 2006). In the interior of British Columbia, the highest water demand in relation to flow occurs from May to October. Approximately 75% of the water used for irrigation is withdrawn in June, July, and August (Rood and Hamilton 1995 cited in Epp 2012). Both surface and groundwater flows are used for irrigation, with 38% of agricultural water use coming from groundwater (White pers. comm. 2013). Water withdrawal contributes to low summer and autumn discharge (COSEWIC 2006), which is also affected by the nature of the watershed, possibly climate change, and lack of storage (storage for irrigation represents only 4% of the water used for irrigation; Brown et al. 2012). Climate change can also be expected to affect discharge (COSEWIC 2006). The system is currently overlicensed which could pose a problem during August and September in low flow years (White pers. comm. 2013).

A recent metadata analysis of existing records for water flow and use in the Kettle basin, prepared for the Kettle River Watershed Management Plan process, provides important insights into historical and current water use, as well as analysis of temporal changes in flow at a variety of measurement stations (S.E.C. Inc. 2012). In terms of annual average flow, declines from historical levels appear insignificant. Even in August, when flows are expected to drop, average flow remains at 74-96% of “pre-development” historical flow (S.E.C. Inc. 2012). However, a consideration of average annual flows alone may not sufficiently capture the implications of water extraction (White pers. comm. 2013). A greater focus on limiting scenarios, including the effect of drought years, increasing withdrawal, climate change and the critical late summer and early fall period (July-September) would provide a better picture of the degree of threat to fish species (White pers. comm. 2013). In the West Kettle, for example, discharge drops below 5 m^3/s by August 5, and reaches that level roughly two weeks later in the Kettle and Granby Rivers. Discharges continue to fall, and the gradual recharge by autumn rains is not complete until October (White pers. comm. 2013). As noted previously, a substantial decline in useable width and available habitat for flows below 5 m^3/s is most prominent in the West Kettle River (Andrusak et al. 2012; Epp and Andrusak 2012).

There are three main uncertainties regarding the threat of low summer flows. First, are the varying interpretations of the existing data. Relating a measured discharge such as 5 m^3/s to long term mean annual discharge (LTMAD) is problematic in the Kettle watershed: for the West Kettle, for example, Andrusak et al. (2012) propose 5 m^3/s as 10% LTMAD, while S.E.C. Inc. (2012) arrives at a value of 1.41 m^3/s. Actual water use is similarly problematic. If the Agricultural Water Demand Model (Van der Gulik et al. 2013) had been used to estimate water use for 2003 (when there was an extreme drought), results may have increased the estimates for water use beyond the model results that are currently provided in S.E.C. Inc. (2012). The Agricultural Water Demand Model results do demonstrate that actual use of surface and groundwater for irrigation approximates the full licensed volume in average years, and exceeds it in dry years. Accordingly, current water use may be underestimated (White pers. comm. 2013).

A second major source of uncertainty is the degree to which unregulated groundwater withdrawal affects summer flow. Much of the water withdrawn from the basin, for both domestic and irrigation needs, comes from aquifers (Aqua Factor Consulting Inc. 2004). Over the entire watershed, around 40% of water demand is met using groundwater (White pers. comm. 2013). Although the largest cities, Midway and Grand Forks, do hold licenses for diversion of surface water from the Kettle River, current water withdrawals are from the local aquifers. The City of Greenwood also obtains its water from an aquifer and abandoned its surface water license in 1997. Aqua Factor Consulting Inc. (2004) indicated that some ranches in other parts of the basin have also shifted from authorized surface water intake to drawing from unregulated groundwater sources.

The shift to groundwater from surface water withdrawal in the Speckled Dace catchment makes it difficult to link water withdrawal to the severity of its threat to Speckled Dace, because there is no reliable measure of how much water is being withdrawn. The linkage between aquifers and river discharge is still inadequately known although, in the Kettle River, groundwater and surface water appear tightly connected (S.E.C. Inc. 2012; White pers. comm. 2013).

The third source of uncertainty pertaining to the threat of reduced flow from water withdrawal may be that it is somewhat mitigated by the species’ ability to survive and adapt to low flows and warm summer waters, as noted in the more southerly portion of its global range. In the event that there are increased water withdrawals and drought in the future, Batty (2010) suggested that Speckled Dace may not be as negatively affected by the changes given his work suggested they had a preference for slow shallow habitats. In addition, Batty’s 2010 abundance sampling estimated about a million mature fish in the system five years after the 2003 extreme drought produced the lowest flows on record. Andrusak and Andrusak (2012) suggest that, except for the West Kettle population, susceptibility to reduced flow may be less than previously believed. A partial explanation for increased susceptibility of Speckled Dace in the West Kettle River may be due to the river’s significantly smaller useable width (i.e. the proportional decline in useable width caused by reduced flow may be greater for the West Kettle than for the Kettle and Granby Rivers). However, Batty (2010) found the highest linear densities of Speckled Dace in the West Kettle as compared to the Kettle and Granby Rivers, a finding that challenges this concern. Causal certainty associated with this threat and population level effects is therefore low.

Inundation and loss of habitat through Cascade Falls hydro development

The Cascade Heritage Project, a proposed 25-megawatt (MW) run-of-river hydroelectric generation project at Cascade Falls on the Kettle River (about 2.5 km south of the community of Christina Lake), was approved in August 2006 by the British Columbia Environmental Assessment Office, with the application later amended to 28 MW. Shawn Hamilton and Associates Ltd. (2005) determined that if a 25 MW power project was built, it would result in a 750 m head-pond in the Kettle River immediately upstream of the newly constructed dam. Bradford (2006) concluded that the 25 MW project posed negligible risk to Speckled Dace as he estimated less than 2% of Speckled Dace habitat would be affected by the dam head-pond via inundation of riffle areas and reduced productive capacity. With Speckled Dace flow requirements appearing less rigorous than those for salmonids, Bradford (2006) also noted that any base flows deemed suitable for salmonids provided by the project should benefit protection of Speckled Dace as well. Batty's (2010) work greatly increased the knowledge on the Speckled Dace population and distribution and supports Bradford's earlier conclusions. A conditional water license has been issued for the Cascade Heritage project (Ministry of Forests, Lands and Natural Resource Operations 2014).

Industrial Land Use

There are a number of industrial land use activities which are considered threats due to their potential to increase sedimentation into the rivers which can result in increased embeddedness of the substrate. As described in section 3.3 (Needs of the Speckled Dace), the level of embeddedness is a characteristic of Speckled Dace habitat with special importance. An increase in embeddedness means that spaces between the substrate elements (gravel, cobbles, boulders) are in-filled with sediment. This can: reduce cover habitat; decrease food availability for Speckled Dace through decreased benthic invertebrate production; make the substrate inappropriate for egg deposition; and reduce the flushing of metabolic waste from eggs through a decreased rate of flow through the substrate, thereby decreasing their potential to survive. The following narrative describes these land use activities in greater detail and their linkages to increasing embeddedness of the substrate.

Increased siltation and substrate embeddedness from agricultural land clearing

The vast majority of agricultural land within the watershed is used for livestock (range) and forage crops (Brown et al. 2012). Proceeding downstream, the valleys are used more for agriculture (Brown et al. 2012). Brown et al. (2012) reported that, along with forestry, historical clearing of riparian land for agriculture and ranching contributed to altering the physical structure and function of the Kettle system. These activities can affect Speckled Dace habitat by increasing the rate of bank erosion, sediment deposition, embeddedness and cover loss, and eliminate sources of large woody debris. However, there was substantial uncertainty as to the impacts of these effects on the Speckled Dace population which Brown et al. (2012) explores further.

Presently, Andrusak (pers. comm. 2013) has found siltation from range use to be a chronic problem, especially in the lower part of the watershed. Where cattle have access to the rivers, impacts can include bank erosion, compaction of stream substrate directly in areas where the animals access the streams and indirectly from sediment from the destabilized banks entering the streams, and nutrient loading from waste. A variety of improperly designed bank stabilization and channelization works have also compounded these problems, e.g. stabilization materials unravelling and deflecting flow forces into other areas creating further erosion (Andrusak pers. comm. 2013). The extent of the cattle intrusions into the rivers is unknown, however Brown et al. (2012) also flagged the concern for the need for adequate protection of riparian areas from cattle and private land clearing at specific sites and that bank stability issues could be addressed through livestock exclusion.

The British Columbia Forest and Range Evaluation Program (FREP) evaluates stream ecosystem function through assessing forestry and range impacts on stream channel and riparian impact factors. FREP generally corroborates the concerns noted above, as in 2010, livestock trampling in riparian areas was a top-ranked impact factor in the Southern Interior Forest Region (FREP 2011). The report found effects of livestock incursion into the riparian areas were generally higher for larger streams and their fish-bearing tributaries. The Selkirk Forest District, which captures most of the Kettle watershed, is within the Southern Interior Forest Region however the FREP report did not specifically identify any riparian incursion cases within the Selkirk Forest District. S.E.C. Inc. (2012) did look more specifically at the Kettle River watershed and captured the concern among watershed residents that range use is impacting riparian function in some areas. S.E.C. Inc. (2012) referred to a 2003 report which documented complaints to the Forest Practices Board leading to investigations in the Ingram-Boundary Range Unit where a number of stream reaches were found to be “non-functional” or “highly at risk”. A 2009 assessment of the Overton-Moody Range Unit by the Forest Practices Board also found damage from range cattle on Gilpin Creek, a tributary to the Kettle River (S.E.C. Inc. 2012).

Effects of all of these impacts on Speckled Dace are poorly known, which creates significant uncertainty about the severity of the threat.

Increased siltation and substrate embeddedness from forestry activities

Timber harvest in the Kettle River basin is concentrated in the more northern interior zones associated with the upper part of the watershed, including tributary valleys and slopes of the Kettle, West Kettle, and Granby Rivers. Sediment from new roads may be the single greatest remaining forestry-related threat to Speckled Dace in the Kettle basin. McPhail (pers. comm. 2007 in Brown et al. 2012) noted sediment from road building in the Granby basin had smothered cobble and boulder substrate, and that some parts of the watershed where Speckled Dace had previously been easily sampled are now almost devoid of them.

FREP recently recommended enhancing riparian retention on small streams beyond that specified in the *Forest and Range Protection Act* (B.C. Stat. 69/2002) and following best management practices for stream crossings and roads throughout British Columbia, in order to decrease the input of fine sediments into watercourses and thus improve fish/riparian outcomes (FREP 2011, 2012). Sedimentation is also audited and reported through Periodic Audits of Forest Planning and Practices by the British Columbia Forest Practices Board. In 2011, audits in the Kettle watershed, with one exception, related to a poorly constructed bridge, found planning and field activities complied in all significant respects with relevant requirements and codes (Forest Practices Board 2011).

Infestation of lodgepole pine by mountain pine beetle (*Dendroctonus ponderosae)* has the potential to impact the forests of the Kettle-Granby watershed and may ultimately influence hydrology and water quality. Salvage logging is now largely pre-emptive, and further from streams than in the past (Brown et al. 2012). Death or managed removal of lodgepole pine in the watershed will result in deeper snow pack (because of less interception of snow) and faster snowmelt (because of less shading) with the eventual overall result being earlier, bigger and more frequent floods (Brown et al. 2012). There is uncertainty regarding the potential impact of such high water events on Speckled Dace.

Harmful substances and sediment releases, and substrate embeddedness from mining activities

The Kettle Valley was first developed for mining in the late 1890s, and some of the mobile sands and gravels in the lower Kettle River may be attributed to early mining activities (Brown et al. 2012). Although mining is now much reduced from its 1900 levels, mining activity reflects the price of metals. Old mines may be reactivated and new ones developed. Most of the current mining applications are for mineral exploration. Mining could alter water quality and increase sedimentation and embeddedness (Brown et al. 2012).

Invasive Plants, Animals and Microorganisms

Increased predation by piscivorous fish

There are a number of piscivorous species currently established in the Columbia basin below Cascade Falls and in Christina Lake that are considered aquatic invasive species (Brown et al. 2012). If any of these species were to become established above the falls within the current Canadian distribution of Speckled Dace, predation on Speckled Dace could have severe consequences. These aquatic invasive species include Smallmouth Bass (*Micropterus dolomieu*), Largemouth Bass (*Micropterus salmoides*), Walleye (*Sander vitreus*) and Pumpkinseed (*Lepomis gibbosus*); of these species, habitat and diet preferences suggest that Pumpkinseed represent the least serious threat (Brown et al. 2012).

Two additional invasive species merit mention even though their high level of uncertainty did not warrant their inclusion in the assessment of threats table (Table 1). *Didymosphenia germinata* (“didymo”), a proliferating carpeting alga native to cool temperate regions of the Northern Hemisphere and which thrives in flowing water, could affect food availability for Speckled Dace. Didymo first appeared in British Columbia in 1989 on Vancouver Island and has since spread to mainland rivers (Bothwell et al. 2009). The New Zealand mudsnail (*Potamopyrgus antipodarum*), an invasive invertebrate, also has the capability of smothering substrate and altering ecosystem services (Therriault et al. 2011). This too could affect food availability for Speckled Dace. The mud snail has not been recorded in the Columbia drainage in British Columbia, but can be expected to arrive (Gillespie pers. comm. 2014). A small population of the snails recently found near Port Alberni, British Columbia, is hypothesized to have arrived from the Columbia River estuary by way of sport fishing gear (Davidson et al. 2008).

Changes in Precipitation and Temperature

Changes in hydrograph, temperature, cover and stream morphology

Climate change can be expected to alter the timing, magnitude, and duration of hydrograph characteristics, as well as affect stream temperature, available in-stream cover and possibly stream morphology. S.E.C. Inc. (2012) reviews anticipated effects for the Regional District of Kootenay-Boundary. These include warmer annual average temperatures, less rainfall in summer and a shift in winter/spring precipitation from snow to rain. Stream flows from late fall to early spring are thus expected to be greater, while flows in late spring, summer and early fall are expected to decrease. Spring runoff will likely occur sooner and annual total water yield will likely increase. The anticipated reduction in summer flow may exacerbate any negative effects associated with the current periodic summer low flows.

There is considerable uncertainty in relating these projected changes to persistence of Speckled Dace. Understanding of the variation of habitat preference with life-stage is limited, and the species is known to thrive, in more southerly portions of its range, at elevated temperatures and in periodic drought conditions. Recent research on documented poleward or upslope shifts in ranges of a variety of terrestrial and aquatic species (Anderson et al. 2009) could be used to argue that the Speckled Dace in Canada, currently at the northern extreme of its continental distribution, could benefit under such conditions.

5. Population and Distribution Objectives

No recovery target population was set in the RPA for Speckled Dace (Harvey 2007; DFO 2008), where the goal was stated as “preservation of the species’ current distribution”. Population and distribution objectives are ideally stated as quantitative targets. For Speckled Dace, the current population estimate of approximately 940,000 adult fish may be low (due to sampling methodology) and its entire distribution may not have been sampled; as well, the estimate is a single one, so a population trend cannot be discerned. Defining a defensible quantitative target is thus impossible at this time. The population and distribution objective for Speckled Dace is therefore a qualitative one:

> Maintain current[4] distribution and abundance within natural fluctuations.

As the Speckled Dace was assessed by COSEWIC as Endangered in part because of their restricted distribution, meeting the population and distribution objective may not result in the species being re-assessed as Threatened or Special Concern.

6. Broad Strategies and General Approaches to Meet Objectives

In addition to the specific threats already tabulated and described, a number of key knowledge gaps contribute to uncertainty. Both kinds of challenges (threats and knowledge gaps) need to be reflected in strategies and general approaches to meet the population and distribution objective.

The population and distribution objective for the species is to maintain current distribution and abundance within natural fluctuations. The main knowledge limitation associated with this objective is that “current distribution and abundance” are based on a limited number of targeted studies; abundance, for example, is based on a single estimate. Inadequate knowledge of certain key life history elements (for example, no knowledge of night-time distribution) compounds these uncertainties.

6.1 Actions Already Completed or Under Way

Since the 2006 COSEWIC assessment document was published, a number of significant actions specific to recovery of Speckled Dace have taken place. They are:

- 2008: Canadian Science Advisory Secretariat (CSAS) RPA (DFO 2008). The document summarized the state of information on population and distribution, critical habitat considerations and threats to the species;
- 2010: Simon Fraser University Master of Science thesis on population, distribution and diet of Speckled Dace (Batty 2010). Abundance estimates arrived at in this study have been very important in challenging the understanding of threats and developing the population and distribution objective;
- 2011, 2012: Investigations of Speckled Dace habitat use, preferences and availability (Andrusak and Andrusak 2011; Andrusak et al. 2012). Results of both studies informed recommendations for critical habitat identification; and

[4] “Current” refers to the best available knowledge on Speckled Dace as stated in section 3.2

- 2012/13: CSAS recommendations for identifying Speckled Dace critical habitat (Brown et al. 2012). These recommendations are adopted in this Recovery Strategy.

The Kettle River Watershed Management Plan, currently in development by the Province of British Columbia, has multiple objectives including preserving appropriate flows for Rainbow Trout (*Oncorhynchus mykiss*) production. Through this initiative, resources such as the metadata analysis of water use in the Kettle Valley (S.E.C. Inc. 2012), and the British Columbia Agriculture Water Demand Model (Van der Gulik et al. 2013) have been used. While not always in agreement, the information these two resources have generated will inform the Province's decisions around flow management, particularly the periodic low summer flows, and is expected to benefit Speckled Dace. Another initiative of the Kettle River Watershed Management Plan is the examination of locations, threats to, and condition of, riparian vegetation in the basin to develop a case for riparian management (Tedesco 2014 pers comm.). Riparian management actions that result in stabilizing the riverbanks and reducing sediment inputs to the rivers would also likely benefit Speckled Dace.

6.2 Strategic Direction for Recovery

Table 2. Recovery planning table

Threat or Limitation	Priority[d]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Information gap: population and trends	H	1. Increase understanding of population and distribution trends, natural variability, and any linkages to threats	• Develop and implement a standardized long term monitoring program, with index sites, to assess population and distribution trends, variability, and any responses to management activities and/or threats • Develop guidelines on monitoring protocols
Threats: reduced flows in summer and autumn due to irrigation and other consumptive uses; changes in hydrograph, temperature, cover and stream morphology from climate change	H	2. Clarify threats associated with water use in the West Kettle, Kettle and Granby watersheds 3. Study the relationship between discharge and Speckled Dace productivity to help replace assumptions with direct observations	• Link studies to life history and behaviour studies to determine any age-specific susceptibility to reduced flow • Analyse surface-groundwater coupling • Link efforts to the Kettle River Watershed Management Plan

Threat or Limitation	Priority[d]	Broad Strategy to Recovery	General Description of Research and Management Approaches
Information gap: lack of public awareness on Speckled Dace and their threats	H	4. Support local stewardship groups to advance Speckled Dace recovery	• Support stewardship groups, where possible, for outreach, public awareness and data collection for studies
Threat: aquatic invasive species	H	5. Work towards preventing entry of aquatic invasive species into Speckled Dace range above Cascade Falls	• Undertake and support initiatives to prevent the spread of aquatic invasive species
Information gap: life history	M	6. Research diet of juveniles less than 18 mm 7. Research importance of embeddedness and relate to threats that create embeddedness 8. Research spawning, night-time, overwintering and migratory behaviour	• Develop and implement studies
Information gap: extent of cattle access to streams	M	9. Clarify impacts of rangeland operations, including nutrient loading	• Develop and implement studies

[d] *Priority reflects the degree to which the approach contributes directly to the recovery of the species or is an essential precursor to an approach that contributes to the recovery of the species (H=High, M=Medium, L=Low).*

6.3 Narrative to Support the Recovery Planning Table

Specific recovery actions that target the threats described in Section 4.2 will be developed in the action plan for the species. Where studies are developed to increase understanding, there is an opportunity for efficient implementation by carefully choosing index sampling sites that are relevant to a number of research objectives.

The threat of low summer flows would benefit from a multi-faceted approach that includes gathering and interpretation of data on periodic low flows, research on Speckled Dace life history and behavior that helps estimate the threat caused to different life stages, site-specific investigation of the coupling between ground and surface waters, and differentiation of any effects on growth and survival of individuals from overall population effects.

Strategies for reducing the threat of sedimentation and embeddedness will need to reflect whether the impact results from forestry activities, agricultural land clearing or rangeland operations. Effective community awareness and outreach, particularly in the case of non-engineered attempts at bank stabilization, and uncontrolled cattle access to the rivers, would be beneficial. An alignment of stewardship groups' interests and capacity with these strategies would advance recovery substantially.

The threat from aquatic invasive species is challenging, even with the existence of regulations on introductions and transfers of fish. The index site approach noted above could also serve as early warning observation posts for the invasive species identified in Section 4.2. As with sedimentation and embeddedness, increasing awareness through the action of local stewardship groups is identified as a means for recovery. The Christina Lake Stewardship Society, for example, is already active in raising awareness regarding aquatic invasive species in the Kettle watershed.

Most difficult to confront and mitigate is the potential effect of climate change on persistence of the Speckled Dace population in Canada, especially given the possibility that, for a species currently in the northernmost part of its global range, poleward translocation may actually counter potential deleterious effects associated with increased incidence of summer low flows. Careful and continuous monitoring of the scientific literature on behavioural and evolutionary responses of aquatic species under similar regime shifts could help inform recovery for the species.

7. Critical Habitat

Critical habitat is defined in SARA section 2(1) as "…*the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species*." [s. 2(1)]

SARA defines habitat for aquatic species at risk as "… *spawning grounds and nursery, rearing, food supply, migration and any other areas on which aquatic species depend* *directly or indirectly in order to carry out their life processes, or areas where aquatic species formerly occurred and have the potential to be reintroduced*." [s. 2(1)]

For the Speckled Dace, critical habitat is identified to the extent possible, using the best available information, and provides the functions and features necessary to support the species' life cycle-processes. The critical habitat identified in this Recovery Strategy is sufficient to achieve the species' population and distribution objectives. The Schedule of Studies outlines the research required to acquire more detail about the critical habitat identified.

7.1 Information and Methods Used to Identify Critical Habitat

The critical habitat for Speckled Dace is based on the research paper *Information in support of the identification of critical habitat for speckled dace (Rhinichthys osculus)* (Brown et al. 2012). This publicly available document reflects the outcomes of the related peer review undertaken through DFO's CSAS process. Further details on critical habitat features were gained during a technical workshop on the species in December 2013.

The specific methodology used to establish the length and siting of critical habitat required for Speckled Dace follows the recommendations of Brown et al. (2012) and is summarized below:

1. A population target of 7,000 adults for long-term persistence based upon Reed et al. (2003) for listed vertebrate species was used, and adopted as a conservative target for the maintenance of the population, i.e. this supports the population objective for the species as specified in Section 5.
2. An estimate of 3.0 mature fish/m or 3,000 mature fish/km from Batty's 2010 work was used.
3. Based on 7,000 adults divided by 3,000 adults/km, the critical habitat length required equals 2.4km.
4. The objective was to maintain viable populations of 7,000 adults in each of three locations (West Kettle, Kettle and Granby Rivers), therefore 2.4km of critical habitat was located in each of these three rivers, for an overall total length of 7.2km.
5. The critical habitat was sited in the upper watersheds of the three rivers in order to: minimize potential threats of water withdrawal and sedimentation from land clearing; facilitate downstream dispersal of larvae to maintain genetically diverse downstream populations; and provide potential rescue in the event of a catastrophic or transient threat to lower sections of the rivers.

Enough critical habitat has been identified to ensure the species does not fall below the 7,000 individuals lower limit identified by Reed et al. (2003), an event that, given the present abundance and distribution, seems unlikely. However, the large confidence intervals on Batty's estimate support the precautionary population target of 7,000 mature adults in each of three separate river sections, rather than just one. COSEWIC

(2002) suggested that Speckled Dace are rapid colonizers of new habitat with at least moderate dispersal ability. Batty (2010) noted that Speckled Dace were found throughout their range. Having three target populations of 7,000 adults rather than one also takes into account any uncertainty about whether fish in the Granby River could be expected to exert any rescue effect upon those in the West Kettle and Kettle Rivers.

7.1.1. Identification of Critical Habitat: Biophysical Functions, Features and Their Attributes

Specific critical habitat biophysical features and attributes that allow the Speckled Dace to perform their essential life functions are identified based on the best available information: Brown et al. (2012) and a December 2013 technical workshop on the species which led to the addition of a “pools” feature for mature rearing Speckled Dace, and a “food availability” feature for both mature and immature rearing Speckled Dace. Table 3 summarizes the best available knowledge of the functions, features and attributes for each life-stage of the Speckled Dace. Note that not all attributes in Table 3 must be present in order for a feature to be identified as critical habitat. If the features as described in Table 3 are present and capable of supporting the associated function(s), the feature is considered critical habitat for the species.

Table 3. Summary of the critical habitat biophysical functions, features, and attributes for Speckled Dace

Life stage	Function(s)	Feature(s)	Attribute(s)
Immature	Rearing	Pool, run, margin, food availability	• Small gravel / cobble substrate with low to moderate embeddedness • Water velocity below 0.24 m/s • Water depth below 0.4 m • Sufficient filamentous algae and bottom dwelling invertebrates
Mature	Rearing	Run, riffle, pool, food availability	• Boulder / cobble substrate with low embeddedness • Water velocity 0.18 - 0.45 m/s • Water depth 0.2 - 0.5 m (although may be found over 1 m deep) • Sufficient filamentous algae and bottom dwelling invertebrates
Mature	Spawning	Run and riffle	• Characteristics unknown, likely unembedded substrate

While the features and attributes listed in Table 3 were identified by Brown et al. (2012) and based on information presented in Section 3.3 (Needs of the Speckled Dace), there remains uncertainty regarding a few of the features in Table 3. For example, the use of pool habitat by mature Speckled Dace for rearing has not been documented because of sampling difficulties, but is considered very likely (Andrusak pers. comm. 2013).

Similarly, inadequate documentation of spawning behavior makes identifying substrate features and attributes impossible, although a requirement for interstitial spaces is likely. Batty (2010) provides much information on dietary needs, which include bottom feeding of adults on filamentous algae and the larval stages of aquatic insects from the Orders Ephemeroptera, Plecoptera and Tricoptera, as well as the Family Chironomidae. However, diet preferences of young of the year remain a significant knowledge gap.

7.1.2. Identification of Critical Habitat: Geographic Extent

The critical habitat's functions, features and attributes summarized in Table 3 above are found in three geographic locations and have been identified using a Critical Habitat Parcel Approach (DFO 2012). Critical habitat is the full and exact area delineated by the identified boundaries and it is understood that this area supports the functions and features necessary for the species' survival or recovery. The sections of rivers described below are areas that the Minister of Fisheries and Oceans considers necessary to support the species' survival or recovery objectives.

Three 2.4 km long sections of the West Kettle, Kettle and Granby Rivers are identified as critical habitat, beginning at the uppermost (farthest upstream) site where Speckled Dace were captured by Batty (2010) during the distributional component of his study (Figures 2, 3 and 4). Critical habitat extends landward to the high water mark as defined for streams in the Schedule of Riparian Areas Regulation Assessment Methods attached to the *Riparian Areas Regulation* (B.C. Reg. 376/2004).[5]

[5] The Schedule of Riparian Areas Regulation Assessment defines the high water mark for streams as "the visible high water mark of a stream where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the stream a character distinct from that of its banks, in vegetation, as well as the nature of the soil itself, and includes the active floodplain."

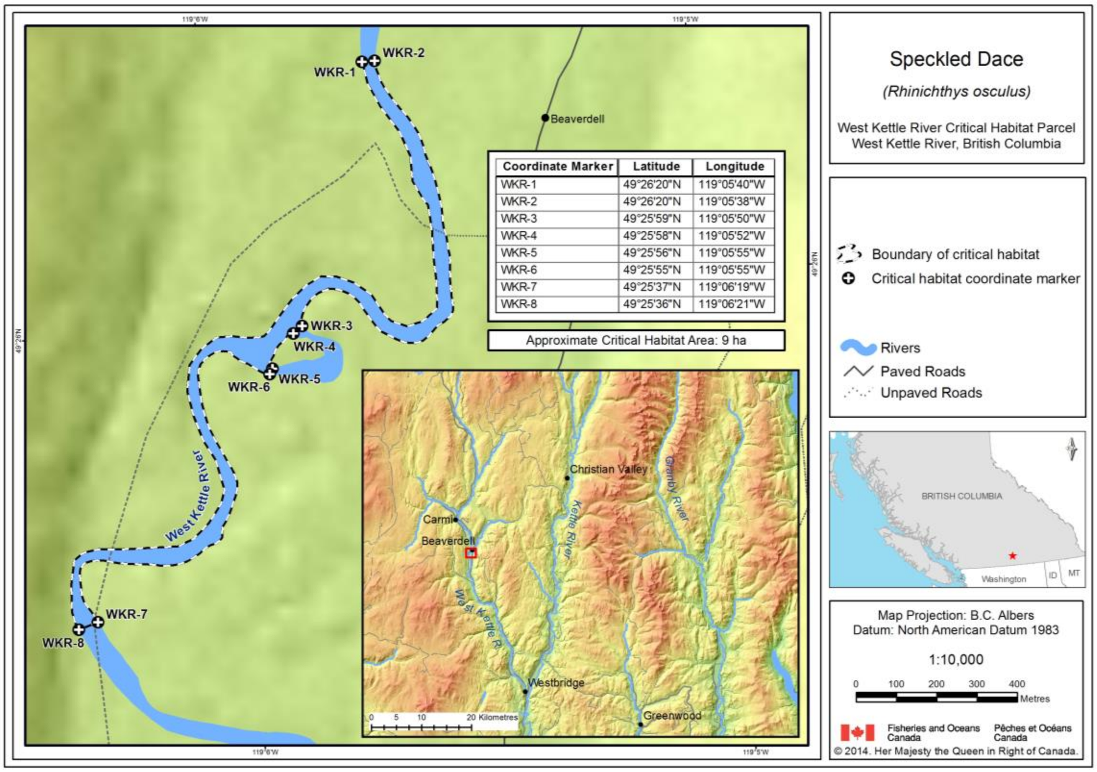

Figure 2. West Kettle River critical habitat parcel for Speckled Dace

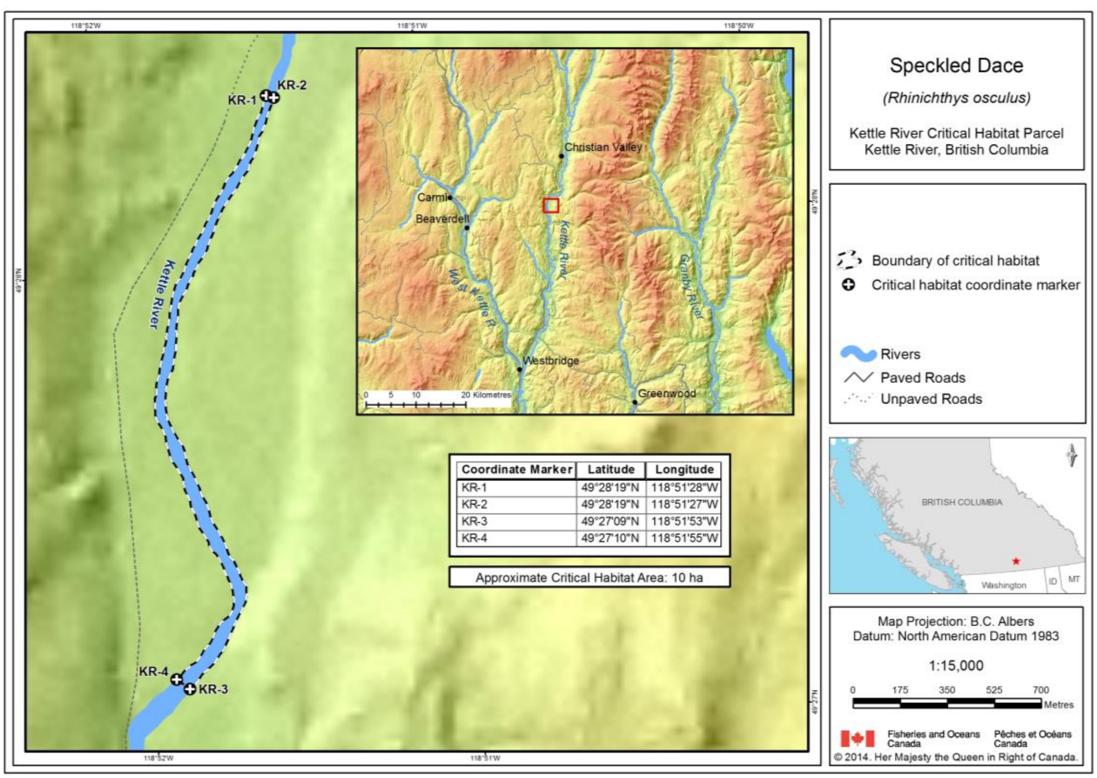

Figure 3. Kettle River critical habitat parcel for Speckled Dace

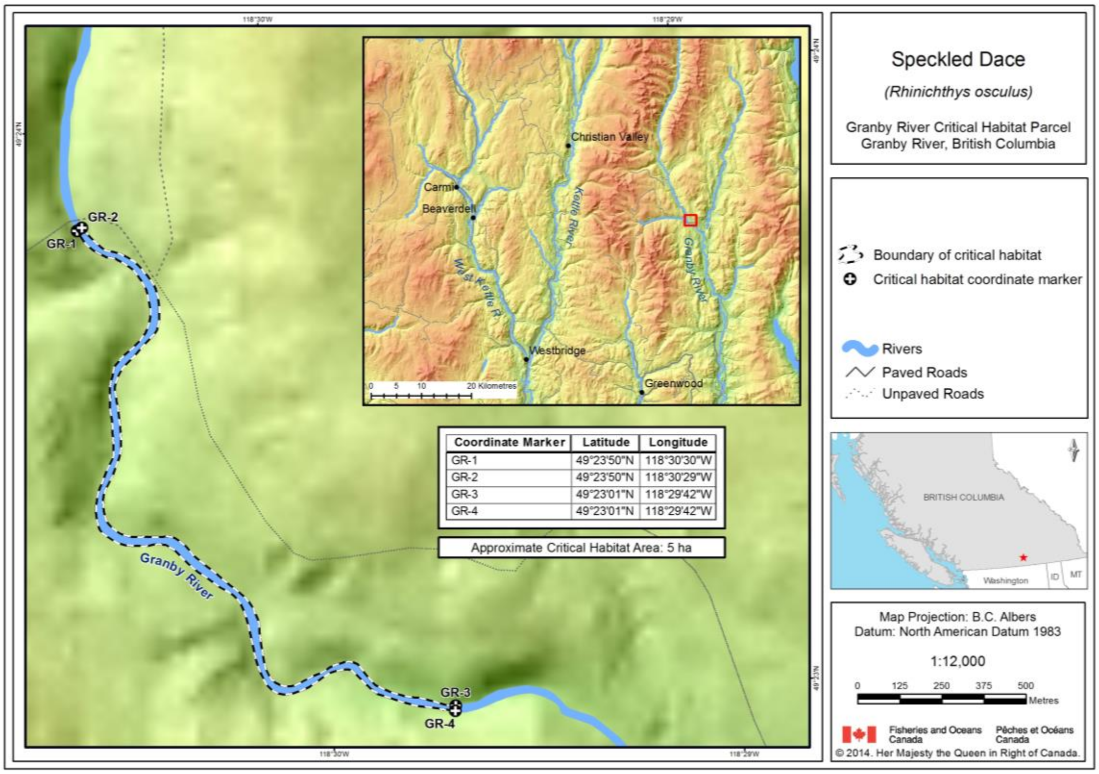

Figure 4. Granby River critical habitat parcel for Speckled Dace

7.2 Schedule of Studies to Identify Critical Habitat

Further research is required to identify and/or refine additional critical habitat necessary to support the species' population and distribution objective and protect the critical habitat from destruction. This additional work includes the studies found in Table 4 below. The studies primarily involve "ground-truthing" of the three river sections identified as critical habitat to ensure that each is capable of sustaining the production of 7,000 adults. Migration in or out of these areas, primarily for overwintering but also passive larval downstream translocation, has not been studied but remains a possibility. Because such translocations could affect the identification of critical habitat, their investigation is included in the schedule of studies in Table 4.

Table 4. Schedule of studies to identify critical habitat

Description of Activity	Rationale	Timeline
Verify that the three selected river sections contain the required features and attributes, and adjust boundaries as required.	Ground-truthing of selections has not been done. Each must be capable of maintaining 7,000 adults.	2018-2019
Test hypothesis that Speckled Dace undergo downstream migration in winter and may overwinter in locations removed from feeding and spawning areas.	Downstream migration may require modification of geographic boundaries of critical habitat.	2019-2021
Establish index sampling sites in each of the three river sections identified as critical habitat.	Index sites allow monitoring of the area's ability to continue generating 7,000 adult fish, and also serve as experimental sites for other studies.	2020

7.3 Examples Of Activities Likely to Result in the Destruction of Critical Habitat

Under SARA, critical habitat must be legally protected from destruction within 180 days of being identified in a recovery strategy or action plan. For the Speckled Dace critical habitat, it is anticipated that this will be accomplished through a SARA Critical Habitat Order made under subsections 58(4) and (5), which will invoke the prohibition in subsection 58(1) against the destruction of the identified critical habitat.

The activities likely to destroy critical habitat described in Table 5 below are neither exhaustive nor exclusive and have been guided by the threats described in section 4.2 of this recovery strategy. The absence of a specific human activity from Table 5 does not preclude or restrict the Department's ability to regulate it pursuant to SARA. Furthermore, the inclusion of an activity in the table does not result in its automatic prohibition since it is the destruction of critical habitat that is prohibited. Activities that impact critical habitat but do not result in its destruction are not prohibited. Since habitat use is often temporal in nature, every activity is assessed on a case-by-case basis and site-specific mitigation is applied where it is available and reliable. In every case, where information is available, thresholds and limits are associated with attributes to better inform management and regulatory decision making. However, in many cases the knowledge of a species and its critical habitat may be lacking and, in particular, information associated with a species or habitat's thresholds of tolerance to disturbance from human activities is lacking and must be acquired.

Table 5. Examples of activities likely to result in the destruction of critical habitat

<table>
<tr><th>Threat/Activity</th><th>Effect Pathway</th><th>Function Affected</th><th>Feature(s) Affected</th><th>Attribute Affected</th></tr>
<tr><td rowspan="3">Reduced flows in summer and autumn due to irrigation and other consumptive uses.</td><td rowspan="3">Reduced flows can: change velocity and depth beyond preferred ranges, decreasing use or eliminating access to habitat features (e.g. for use as cover); reduce benthic invertebrate production thus decreasing food availability; decrease the ability of the river to flush sediments from the substrate, increasing embeddedness and thereby reducing aquatic invertebrate production and decreasing food availability; potentially limit suitable spawning habitat and success of spawn by decreasing the ability of the river to flush metabolic wastes away from eggs.</td><td>Rearing (immature)</td><td>Pool, run, margin and food availability</td><td>• Small gravel/cobble substrate with low to moderate embeddedness
• Water velocity below 0.24 m/s
• Water depth below 0.4 m
• Sufficient filamentous algae and bottom dwelling invertebrates</td></tr>
<tr><td>Rearing (mature)</td><td>Run, riffle, pool and food availability</td><td>• Boulder/cobble substrate with low embeddedness
• Water velocity 0.18-0.45 m/s
• Water depth 0.2-0.5 m although may be found over 1 m deep
• Sufficient filamentous algae and bottom dwelling invertebrates</td></tr>
<tr><td>Spawning</td><td>Run and riffle</td><td>• Likely unembedded substrate</td></tr>
<tr><td rowspan="3">Increased siltation and substrate embeddedness from agricultural land-clearing.

Increased siltation and substrate embeddedness from forestry activities.</td><td rowspan="3">Increased siltation can increase embeddedness thus reducing cover, reducing aquatic invertebrate production and decreasing food availability, and potentially limiting suitable spawning habitat and success of spawn by decreasing the ability of the river to flush metabolic wastes away from eggs.</td><td>Rearing (immature)</td><td>Pool, run, margin and food availability</td><td>• Small gravel/cobble substrate with low to moderate embeddedness
• Sufficient filamentous algae and bottom dwelling invertebrates</td></tr>
<tr><td>Rearing (mature)</td><td>Run, riffle, pool and food availability</td><td>• Boulder/cobble substrate with low embeddedness
• Sufficient filamentous algae and bottom dwelling invertebrates</td></tr>
<tr><td>Spawning</td><td>Run and riffle</td><td>• Likely unembedded substrate</td></tr>
</table>

8. Measuring Progress

The performance indicators presented below provide a way to define and measure progress toward achieving the population and distribution objectives.

- A sustained summer adult abundance greater than 7,000 individuals confirmed within each of the three river sections identified as critical habitat starting in 2015.
- Continued presence of adult Speckled Dace in summer confirmed in appropriate sites outside the three river sections identified as critical habitat starting in 2015.

9. Statement on Action Plans

An action plan for the recovery of Speckled Dace will be completed within five years of posting the Recovery Strategy on the Species at Risk Public Registry.

10. References

Anderson, B.J., H.R. Akcakaya, M.B. Araujo, D.A. Fordham, E. Martinez-Meyer, W. Thuiller and B.C. Brook, 2009. Dynamics of range margins for metapopulations under climate change. Proc. R .Soc. B. 276(2009):1415–1420.

Andrusak, G., pers. comm. 2013. *Telephone discussion with H. Stalberg*. December 2013. Vice President/Fisheries Biologist, Redfish Consulting Ltd., Nelson, British Columbia.

Andrusak, G., and H. Andrusak. 2011. Identification of habitat use and preference of speckled dace within the Kettle River watershed-2011. Prepared for the Department of Fisheries and Oceans Canada and the Ministry of Environment, Penticton, British Columbia. vi + 75 pp.

Andrusak, G., H. Andrusak, and G. Pavan. 2012. Assessment of habitat for Speckled Dace within the Kettle River watershed. Prepared for the Department of Fisheries and Oceans Canada and the Ministry of Forests, Lands and Natural Resource Operations, Penticton, British Columbia. 47 pp.

Aqua Factor Consulting Inc. 2004. Potential effects of the Cascade Heritage Power Project on the allocation of water in the Kettle River basin. Prepared for the British Columbia Environmental Assessment Office, Victoria British Columbia. 96 pp.

Batty, A. 2010. Examination of Speckled Dace abundance, biology and habitat in the Canadian range. M.Sc. thesis, Simon Fraser University, Burnaby, British Columbia, Canada. vii + 87 pp.

Bothwell, M., D.R. Lynch, H. Wright, and J. Deniseger. 2009. On the boots of fishermen: the history of didymo blooms on Vancouver Island, British Columbia. Fisheries 34(8):382-388.

Bradford, M. 2006. Impact of the proposed hydroelectric development at Cascade Falls on the conservation status of speckled dace (*Rhinichthys osculus*) in the Kettle River, British Columbia. Report prepared for British Columbia Environmental Assessment Office, Victoria, British Columbia. 25 pp.

Brown, T., B. Harvey, and M.J. Bradford. 2012. Information in support of the identification of critical habitat for speckled dace (*Rhinichtys osculus*). DFO Can. Sci. Advis. Sec. Res. Doc. 2012/065. iv + 29p.

COSEWIC. 2002. COSEWIC assessment and update status report on the speckled dace *Rhinichthys osculus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 36 pp.

COSEWIC. 2006. COSEWIC assessment and update status report on the speckled dace *Rhinichthys osculus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 27 pp.

Davidson, T.M., V.E.F. Brenneis, C. de Rivera, R. Draheim, and G.E. Gillespie. 2008. Northern range expansion and coastal occurrences of the New Zealand mud snail *Potamopyrgus antipodarum* (Gray, 1843) in the northeast Pacific. Aquatic Invasions 3(3):349-353.

DFO. 2008. Recovery potential for the speckled dace (*Rhinichthys osculus*). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/030. 8 pp.

DFO. 2012. [Draft] Operational guidelines for the identification of critical habitat for aquatic species at risk, Species at Risk Act (SARA). Government of Canada, Ottawa. 51 pp.

Epp, P. 2012. West Kettle River fish protection recommendations. Prepared for the British Columbia Ministry of Forests, Lands and Natural Resource Operations, Penticton, British Columbia. 29 pp.

Epp, P., and G. Andrusak. 2012. Results of 2011 West Kettle River, Kettle River and Granby River flow, temperature, usable fish habitat and snorkel enumeration survey. Prepared for the British Columbia Ministry of Forests, Lands and Natural Resource Operations, Penticton, British Columbia. 73 pp.

Forest Practices Board. 2011. Audit of forest planning and practices. International Forest Products Limited, Grand Forks Woods Division. FL A18969. Victoria, British Columbia. i + 13 pp.

FREP (Forest and Range Evaluation Program). 2011. Chief Forester's 2010 annual report on the forest and range evaluation program. British Columbia Ministry of Forests, Lands and Natural Resource Operations, Victoria, British Columbia. 10 pp.

FREP (Forest and Range Evaluation Program). 2012. Assistant Deputy Minister resource stewardship report: results and recommendations of the Forest and Range Evaluation Program. British Columbia Ministry of Forests, Lands and Natural Resource Operations, Victoria, British Columbia. 12 pp.

Gillespie, G., pers. comm. 2014. *E-mail to H. Stalberg*. March 2014. Section Head, Shellfish, Fisheries and Oceans Canada, Nanaimo, British Columbia.

Government of Canada. 2009. Species at Risk Act Policies. Overarching Policy Framework [Draft]. Species at Risk Act Policy and Guidelines Series. Environment and Climate Change Canada, Ottawa. ii + 38 pp.

Harvey, B. 2007. Scientific information used in the recovery potential assessment for the Speckled Dace (*Rhinichthys osculus*). DFO Can. Sci. Advis. Sec. Res. Doc. 2007/074. 17 pp.

Kaya, C.M. 1991. Laboratory spawning and rearing of speckled dace. Progressive Fish-Culturist 53(4):259-260.

McPhail, J.D. 2003. Report on the taxonomy, life history, and habitat use of the four species of dace (*Rhinichthys*) inhabiting the Canadian portion of the Columbia drainage system. Report prepared for BC Hydro, Castlegar, British Columbia. 24 pp.

McPhail, J. D. 2007. The freshwater fishes of British Columbia. University of Alberta Press, Edmonton, Alberta. 620 pp.

MFLNRO (British Columbia Ministry of Forests, Lands and Natural Resource Operations). 2014. Water rights scanned licence directory. Available online at: Water Rights Scanned Directory (**en anglais seulement**) [accessed February 2014].

Peden, A.E, and G.W. Hughes. 1981. Life history notes relevant to the Canadian status of the speckled dace (*Rhinichthys osculus*). Syesis 14(1981):21-31.

Platts, W.S., W.F. Megahan, and W.G. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. General Technical Report INT-138. United States Department of Agriculture Forest Service, Ogden, Utah. 70pp.

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

Scott, W.B., and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada Bulletin 184(1973):966 pp.

Shawn Hamilton and Associates Ltd. 2005. Appendix C: status of Kettle River speckled dace (*Rhinichthys osculus*). Prepared for the British Columbia Environmental Assessment Office, Victoria British Columbia. 5 pp.

S.E.C. Inc. (Summit Environmental Consultants Inc). 2012. Kettle River watershed management plan: phase 1 technical assessment. Prepared for the Regional District of Kootenay Boundary, Trail, British Columbia. xvii + 186 pp.

Tedesco, L., pers. comm. 2014. *Telephone and e-mail communication with H. Stalberg*. January 2014. Habitat Biologist, British Columbia Ministry of Forests, Lands and Natural Resource Operations, Nelson, British Columbia.

Therriault, T.W., A.M. Weise, G.E. Gillespie, and T.J. Morris. 2011. Risk assessment for New Zealand mud snail (*Potamopyrgus antipodarum*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/108. vi + 93 pp.

Van der Gulik, T., D. Neilsen, R. Fretwell, A. Petersen, and S. Tam. 2013. Agriculture water demand model. Report for the Kettle Watershed. Prepared for the British Columbia Ministry of Agriculture, Victoria, British Columbia. 49 pp.

White, T., pers. comm. 2013. *Telephone discussion with H. Stalberg.* December 2013. Senior Fisheries Biologist, British Columbia Ministry of Forests, Lands and Natural Resource Operations, Penticton, British Columbia.

Wooding, F.H. 1994. Lake, river and sea-run fishes of Canada. Harbour Publishing, Madeira Park, British Columbia. 303 pp.

Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making and to evaluate whether the outcomes of a recovery planning document could affect any component of the environment or achievement of any of the Federal Sustainable Development Strategy (FSDS) goals and targets.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that implementation of recovery strategies may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the strategy itself, but are also summarized below in this statement.

This recovery strategy will benefit the environment by promoting the recovery of Speckled Dace, thereby contributing to FSDS Goal 4 (Conserving and Restoring Ecosystems, Wildlife and Habitat, and Protecting Canadians). Specifically, it will help to attain the associated Target 4.1 which is to have populations of federally listed species at risk exhibit trends that are consistent with recovery strategies and management plans. In addition, it could help to meet the target associated with 4.6, whereby pathways of invasive alien species introductions are identified, and risk-based intervention or management plans are in place for priority pathways and species.

The potential for the strategy to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this strategy will clearly benefit the environment and will not entail any significant adverse effects. For information on how the recovery strategy and the Speckled Dace potentially link to, or interact with, other species and the ecosystem, refer to the following sections of the document, in particular: Species Description, Needs of the Speckled Dace, Strategic Direction for Recovery, and Identification of Critical Habitat: Biophysical Functions, Features and their Attributes.

More specifically, within the distribution of the Speckled Dace, it is unlikely that the broad strategies to recovery recommended within this document will negatively impact other fish or wildlife species. The broad strategies to recovery suggested in Table 2 will help to address threats to the Speckled Dace and their habitat, such as improving water quality by limiting sediment inputs, which will also benefit other native species. Furthermore, recovery efforts may benefit species downstream of the distribution of Speckled Dace as improvements in water quality could be conveyed to these areas.

Appendix B: Record of Cooperation and Consultation

The Speckled Dace (*Rhinichthys osculus*) was listed as Endangered on Schedule 1 of the *Species at Risk Act* (SARA) in March 2009. The Minister of Fisheries and Oceans (DFO) is the competent Minister under SARA for the Speckled Dace and prepared the Recovery Strategy, as per section 37 of SARA. To the extent possible, it has been prepared in cooperation with the Province of British Columbia (B.C.) as per section 39(1) of SARA. Processes for coordination and consultation between the federal and B.C. governments on management and protection of species at risk are outlined in the *Canada-British Columbia Agreement on Species at Risk*. The draft document was also sent to the Parks Canada Agency and Environment and Climate Change Canada for review and comment.

In December 2013, DFO held a technical workshop to seek comments and input on the draft Recovery Strategy, and ensure the document incorporated the best technical and scientific expertise on this species. First Nations, industry, environmental consultants, academia, community stewardship groups, and government representatives were invited to participate. Participants were Fugu Fisheries, Redfish Consulting, Christina Lake Stewardship Society, the Province of B.C., both Forest, Lands, and Natural Resources, and Ministry of Environment, and DFO.

Consultations on the draft recovery strategy occurred between August 28 and October 14, 2014. Consultation activities included:

- on-line posting of the draft recovery strategy, background information and a comment form,
- letters, e-mails and faxes with information on the draft recovery strategy consultations and offering opportunities for further discussions sent to 14 First Nation organizations,
- letters regarding the draft recovery strategy consultations sent to approximately 80 private landowners located near the proposed critical habitat,
- e-mails regarding the draft recovery strategy consultations sent to approximately 125 stakeholders including agricultural associations, industry (agriculture, forestry, property development, and recreation), academia, environmental non-government organizations, community stewardship groups, environmental consultants, and government representatives (municipal, regional, provincial, federal and United States federal and state),
- advertisements of the upcoming consultations published in local newspapers, and
- social media tweets notifying of consultations with links to the on-line postings.

No comment forms were received. One letter from a First Nation was received providing technical information on the species, the ecological connectivity of species, and the importance of water to their community. One inquiry was received in relation to the recovery planning process and critical habitat protection.

Additional stakeholder, Aboriginal, and public input was sought through the publication of the proposed document on the Species at Risk Public Registry for a 60-day public comment period.

All feedback received was considered in the finalization of the Recovery Strategy.