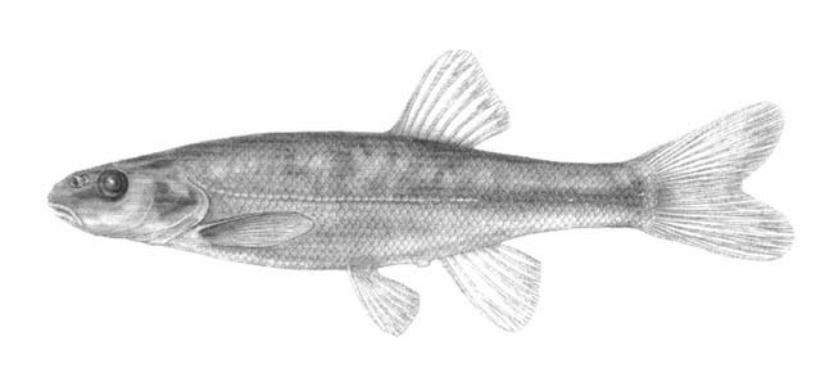
COSEWIC
Assessment and Update Status Report

on the

Speckled Dace
Rhinichthys osculus

in Canada



ENDANGERED
2006

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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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. (www.sararegistry.gc.ca/status/status_e.cfm).

Peden, A. 2002. COSEWIC assessment and update status report on the speckled dace *Rhinichthys osculus* in Canada, *in* COSEWIC assessment and update status report on the speckled dace *Rhinichthys osculus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-36 pp.

Peden, A.E. 1980. COSEWIC status report on the speckled dace *Rhinichthys osculus* in Canada. Committee on the Status of Endangered Wildlife in Canada. 1-13 pp.

Production note:

COSEWIC would like to acknowledge Juanita Ptolemy for writing the update status report on the speckled dace *Rhinichthys osculus* in Canada, prepared under contract with Environment Canada, overseen and edited by Robert Campbell, Co-chair, COSEWIC Freshwater Fishes Species Specialist Subcommittee.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEPAC sur le naseux moucheté (*Rhinichthys osculus*) au Canada – Mise à jour.

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Speckled dace — Illustration of *Rhinichthys osculus* from Kettle River, British Columbia (Photograph courtesy of Royal BC Museum).

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COSEWIC
Assessment Summary

Assessment Summary – April 2006

Common name
Speckled dace

Scientific name
Rhinichthys osculus

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.

Occurrence
British Columbia

Status history
Designated Special Concern in April 1980. Status re-examined and designated Endangered in November 2002 and in April 2006. Last assessment based on an update status report.

COSEWIC
Executive Summary

Speckled dace
Rhinichthys osculus

Species information

The speckled dace (*Rhinichthys osculus*) is a small minnow (usually less than 70 mm in total length) with a robust elongate body. It is grey to brownish grey in colour with dark flecks. Speckled dace in Canada are isolated above a 30.5-m high barrier at Cascade Falls, Columbia drainage, British Columbia. The absence of barbels and high scale counts around the caudal peduncle differentiate them from populations in the United States below the barrier. Many subspecies and distinct populations are recognized in the United States, and many of these isolated populations are considered to be at risk.

Distribution

Speckled dace are only found in western portions of the United States and Canada. In the United States, populations occur as far south as California, Arizona and New Mexico. In Canada, they reach the northern limit of their distribution and are confined to the Kettle River system (Kettle, West Kettle, and Granby rivers) of south central British Columbia (BC).

Habitat

In Canada, speckled dace are found among the larger bottom substrates of riffle habitats where they can hide from predators and feed on aquatic insects. They have been captured at depths of over 1 m. Small young-of-the-year fish are often reported from shallow stream edge habitat. In the Kettle River system, extreme low flows occur during the winter months while low summer flows occur during August and September. Peak flows occur in the April to June period with snowmelt conditions.

Biology

Existing data indicate that they breed in July at sizes larger than 40 mm standard length, probably spawning for the first time at the age of 2+ or 3+. Speckled dace are not likely to live beyond the age of four. Depending on their size, mature females can carry between 400 and 2,000 eggs. Newly hatched fry can be seen in August and September.

Population sizes and trends

No quantitative sampling throughout the Kettle River system has been completed in Canada. Numbers may be declining based on inferred trends in the amount of limiting habitat.

Limiting factors and threats

Limited range within a single river system and lack of abundance are major risk factors for speckled dace in Canada, where they are isolated above a natural barrier from other populations. A single natural or man-made event could be disastrous for a significant portion of the total population. Abundance appears to be limited by the availability of good quality habitat for adults, which is presumed to be decreasing partly as a consequence of low summer flows.

Special significance of the species

The range of the species in Canada consists of only a few (probably less than 10) populations that represent the most northern extent of the species range. Speckled dace above the barrier at Cascade differ morphologically from other populations in the United States as they lack barbels and have much higher scale counts.

Existing protection

Speckled dace in Canada receive general protection under federal legislation, the federal Fisheries Act, and provisions of various provincial statutes designed to protect the environment, water quality and fish. None of this legislation specifically protects speckled dace or its habitat.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5th 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2006)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and it is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canadian Wildlife Service | Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

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in Canada

2006

TABLE OF CONTENTS

List of figures

SPECIES INFORMATION

Name and classification

Phylum:	Chordata
Class:	Actinopterygii (ray-finned fishes)
Order:	Cypriniformes
Family:	Cyprinidae
Genus:	*Rhinichthys*
Species:	*Rhinichthys osculus* (Girard 1856)
Common name	
English:	Speckled Dace (Nelson *et al*. 2004)
French:	*Naseux Moucheté* (Coad 1995)

Morphological description

The speckled dace (*Rhinichthys osculus*) (Fig. 1) is a small minnow (usually < 70 mm; females occasionally > 90 mm (McPhail 2003)) with a robust elongate body. It is grey to brownish grey in colour with small dark flecks.

McPhail (2003) provides the following description: a blunt nosed dace with the snout barely overhanging the upper lip; the mouth is oblique and the upper lip free from the snout; the caudal peduncle is moderately narrow; the dorsal and anal fins, and the lobes of the caudal fin, are rounded; the fork of the caudal fin is shallow with a depth about 6% of the total length; it has 8 or 9 dorsal rays and 59-69 scales along the lateral line; the back and sides of juveniles and females lack irregular, dark spots; however, males develop markings similar to those seen in Umatilla dace.

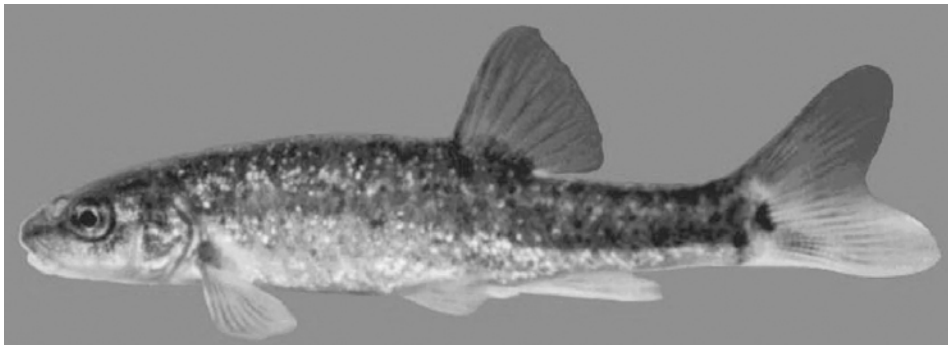

Figure 1. Speckled dace, *Rhinichthys osculus* (photograph by P. Mylechreest courtesy of Dr. J.D. McPhail).

Peden and Hughes (1988) differentiated *R. osculus* in Canada from all others by its absence of barbels and high scale counts around the caudal peduncle. It differs from other *Rhinichthys* species in Canada as its snout does not extend beyond the premaxillae and its mouth morphology suggests dissimilar foraging behaviours (Peden and Hughes 1988). McPhail and Carveth (1993) also noted that the speckled dace in

British Columbia does not have barbels at the corner of the mouth and the origin of the anal fin is almost directly below the hind end of the base of the dorsal fin. Peden (2002) described differences between Canadian and American populations in additional detail.

Haas (2001) describes additional features to help distinguish *R. osculus* from *R. falcatus* and *R. umatilla* based on appearance. Among these species, speckled dace is the least streamlined and most robust in body form and the darkest in colouration; the eyes are smaller; its fins and fin bases are smaller and rounder in shape; its tail is smaller in size and degree of fork, and caudal peduncle thicker; the pelvic fin stays are generally weaker or absent. He also notes that in Canada, speckling can be greatly reduced or not obvious.

Genetic description

Mitochondrial and ribosomal DNA studies based on sequences from the cytochrome-b region (306 base pairs), internal transcribed spacer (250 base pairs), and the ribosomal region (80 base pairs) support the distinction of *R. osculus, R. falcatus* and *R. umatilla* (Haas 2001). Canadian populations of speckled dace also show evidence of meristic differences from other populations in the Columbia River drainage; however, limited DNA studies completed by Haas (2001) have not provided additional support for this distinction. To date, no hybrids between speckled dace and Umatilla dace have been documented in the Canadian sector of the river below Cascade Falls, where they occur together (Peden 2002).

DISTRIBUTION

Global range

The range of speckled dace is restricted to western North America (Fig. 2); it is found in Pacific drainages from the Columbia River south to the Colorado River system, and in coastal drainages between the Olympic Peninsula and southern California in a variety of morphological forms (Scott and Crossman 1973, McPhail 2003).

Canadian range

Speckled dace reach their northern limit in south central British Columbia (BC) (Fig. 3) where they are found only in the Kettle-Granby river system (Columbia drainage) of BC (Peden and Hughes 1981 and 1984; Peden 2002). The vast majority of their Canadian distribution is isolated from other speckled dace populations and other *Rhinichthys* species (Haas 2001; McPhail 2003) by a 30.5 m barrier at Cascade. Specifically, they have been collected or observed from Cascade Falls to 194 km upstream in the Kettle River (including the 46.7 km U.S. loop), and the lower 37 km section of the Granby River near Grand Forks, BC (BC Ministry of Environment unpubl. Data), as well as about 75 km of the West Kettle River to Carmi. Peden and Hughes (1981, 1984, 1988) also observed small numbers of speckled dace in the 5 km Canadian section downstream of Cascade Falls to the U.S. border.

Figure 2. The global distribution of speckled dace, *Rhinichthys osculus* (with permission of Dr. J.D. McPhail).

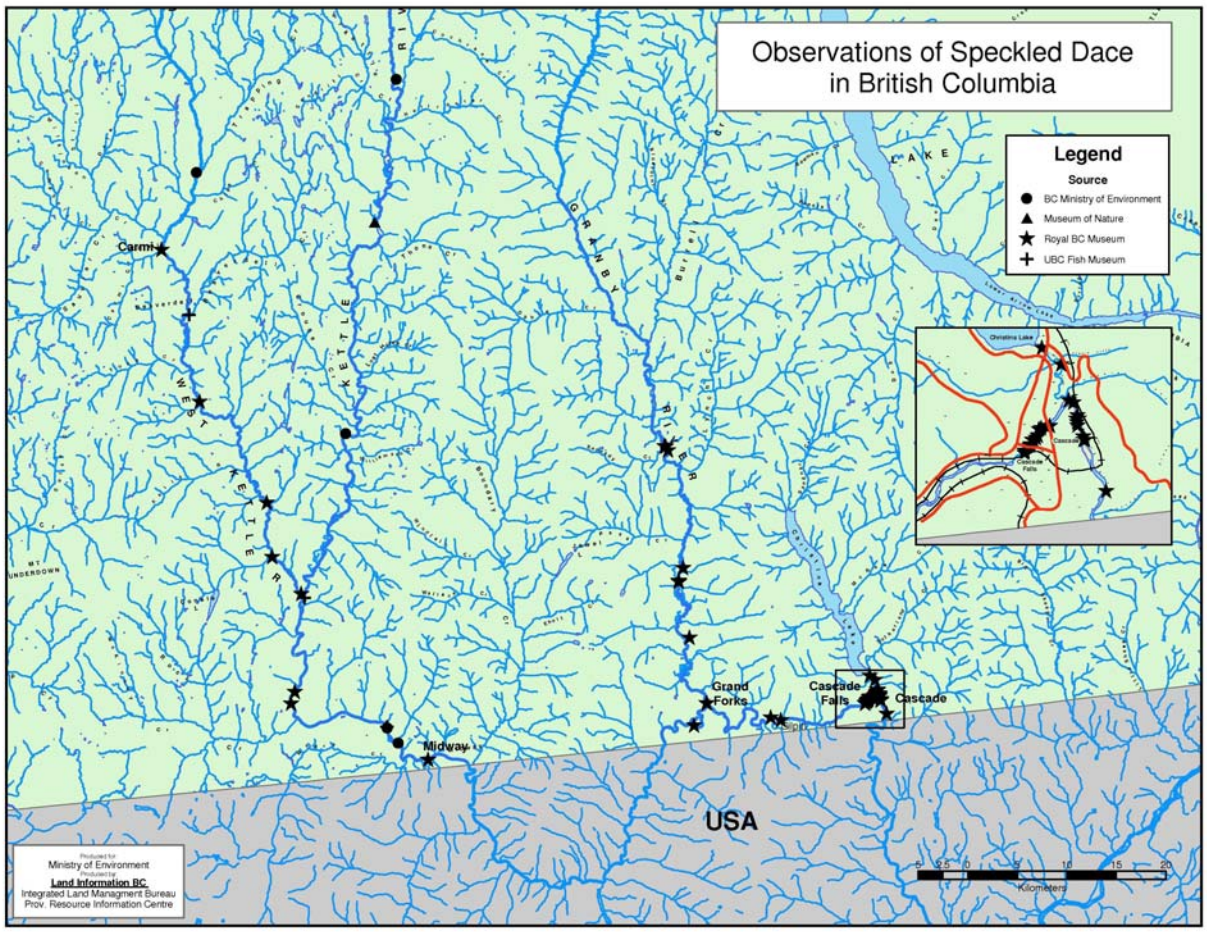

Figure 3. Kettle River system of south central British Columbia showing the distribution of speckled dace, *Rhinichthys osculus* (B.C. Ministry of Environment map).

Although the data collected to date have been adequate to determine the general range of speckled dace within Canada (known extent of occurrence ~ 3,000 km^2, based on a best fit polygon), additional survey work could extend the distribution particularly in the mainstem Granby River, as well as headwaters areas of the Kettle and West Kettle rivers and other tributaries. No comprehensive surveys have been completed to accurately determine the area of occupancy. General impressions from snorkeling surveys for salmonids (conducted in 27 km of mainstem river habitat in October 2005) suggest no more than 20% of the mainstem habitat in the Kettle and West Kettle rivers is likely to be occupied by speckled dace, based on the proportion of riffle habitat relative to glide and pool habitat in the river mainstem (A. Wilson pers. comm.). Oliver 2001) stated that the weighted average riffle area for 160 km of the Kettle River is 25%. Extrapolating these observations to the Granby River gives an approximate total area of occupancy of 7.47 km^2. With respect to limited surveys in other tributaries, no dace were observed during electrofishing surveys that were conducted in Rendell, Rock, Boundary and McCarthy creeks (within 2 km of confluence with Kettle River) in August 2005 (BC Ministry of Environment unpubl. Data).

HABITAT

Habitat requirements

Available information on habitat is based on seasonal observations, but only during daylight hours, nocturnal use of habitat has not been described. Speckled dace habitat in the Kettle River during spring, late summer and fall has been described as follows (Peden and Hughes 1981, 1984; Peden 1994, 2002): in general, dace were collected on the bottom in rocky substrates with riffles and slow to relatively fast water velocities depending on fish size. In March they are likely exhibiting overwintering behaviour due to low water temperatures. At this time of year they have been found in relatively deep water (>1.0 m) runs behind structures such as large rocks, logs and bridge abutments.

The following observations were made during the summer-fall period. Concentrations of young-of-the-year (age 0+) dace were found along the river edge in shallow, low velocity habitat where they were observed in clean cobble substrates with ample interstitial spaces (clean spaces between the stones) that appeared to offer cover from predators. Adult *R. osculus* (> 40 mm SL) appear to be associated with larger substrates and swifter currents. Adults were found immediately above Cascade Falls in boulder substrate (30-40 cm diameter). Large particles are characteristic of steep riffles, rapids and cascades (which are uncommon in the system, particularly in the low gradient reaches of the mainstem rivers). Flushing flows would be required to maintain interstitial spaces in this type of habitat. No large concentrations of speckled dace were found in the lower Granby River, where bottom substrates were predominantly sand, although some fry were found in this area in the early 1980s. Most of the adults found were located in the section of the river between the highway bridge crossing at Grand Forks and the confluence with the Kettle River. The authors reported that large speckled dace were most frequently observed in water depths >0.5 m. Water deeper than 1.5 m was not sampled, but Peden (2002) speculated that speckled dace do occur at greater depths. Speckled dace were more abundant in areas where only a thin film of algae occurred on the rocks than where algae growth was thick.

Recently speckled dace were collected in the spring and fall in side channels and in edge habitat upstream of the Kettle River canyon (located southwest of Christina Lake, the canyon (Figure 4) is 900 m long and lies immediately below Cascade Falls) [PDI 2005]. The data indicated that juvenile speckled dace used side channel habitat throughout the year, and edge habitat during the spring and fall, while adult speckled dace utilized shallow water habitat primarily during the summer, in years of low flow side channel and edge habitat would not be available and the fish would be confined to shallow water. In periods of severe drought dace would be isolated in areas of whatever shallow areas remained or perish. Very few speckled dace were collected from similar habitat below the canyon. During October (2005) snorkeling surveys, speckled dace were observed in riffles or other fast water areas (A. Wilson pers. comm.).

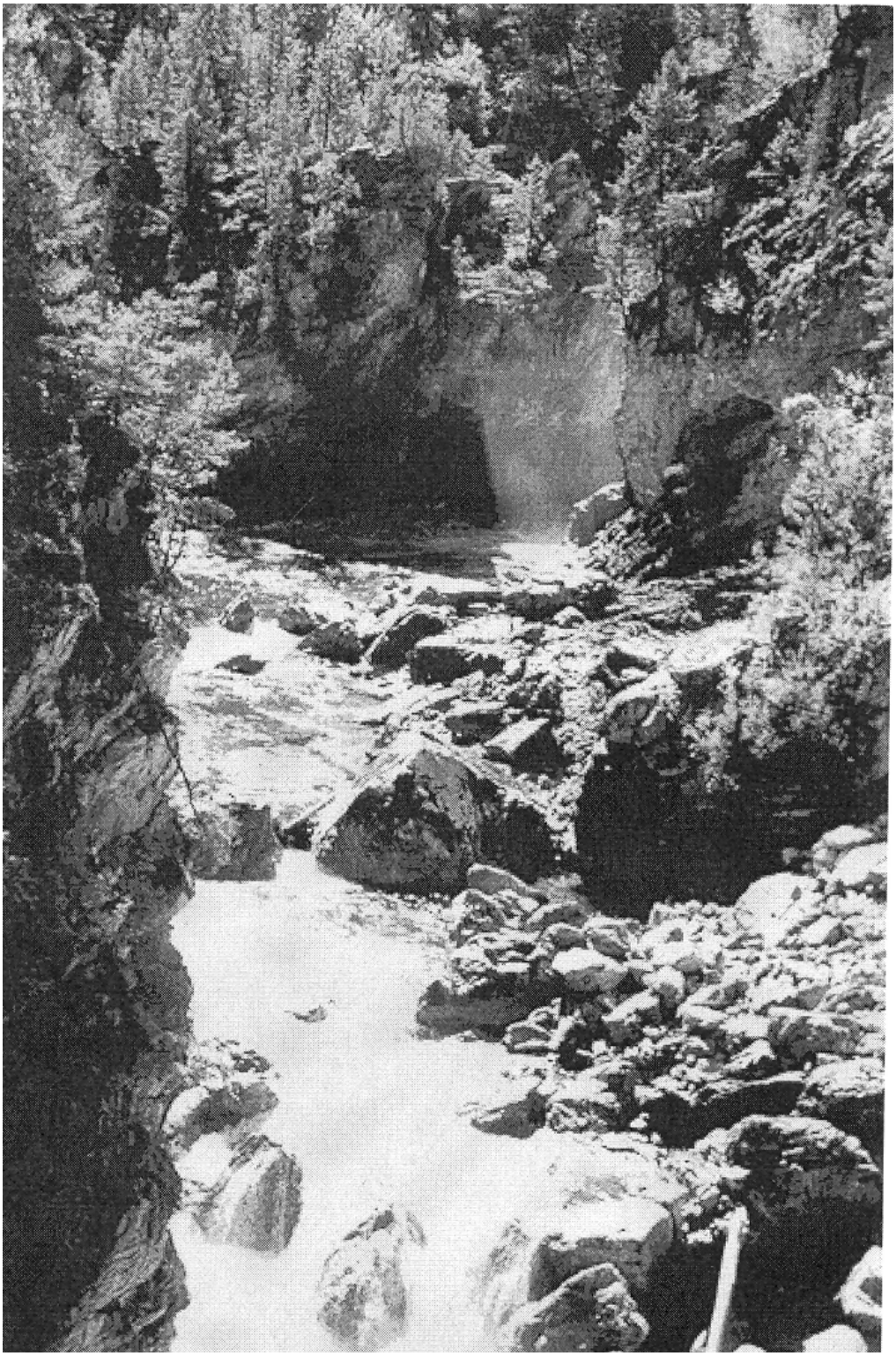

Figure 4. Canyon below Cascade falls, Kettle River [photograph from Okanagan Nation Alliance presentation to Powerhouse Energy Corporation, September, 1999 (EAO 1999)].

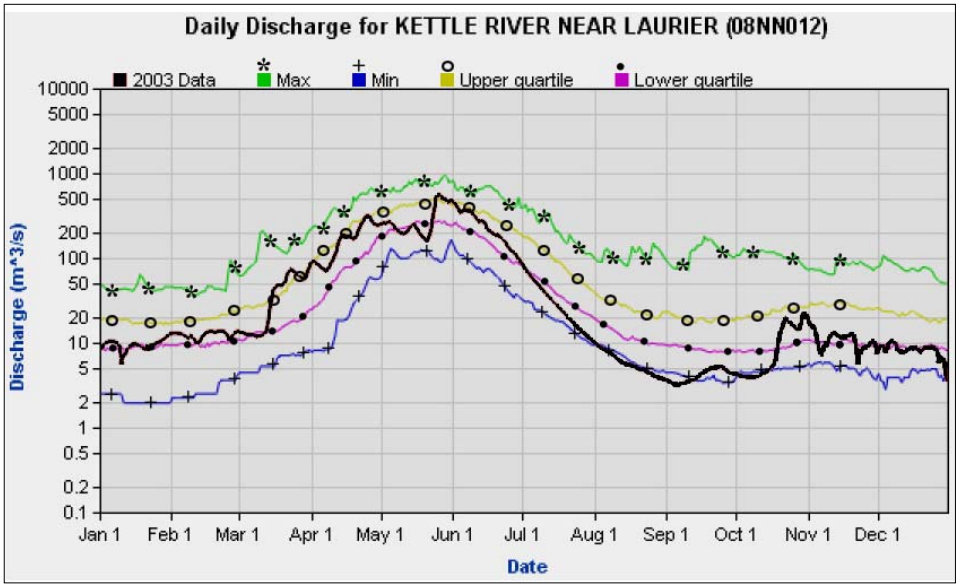

Figure 5. Summary of daily discharge for the Kettle River showing the 2003 drought year against the average daily maximum, minimum, and the upper and lower 25%. Flows in September 2003 were the lowest experienced over the 75 year period of record.

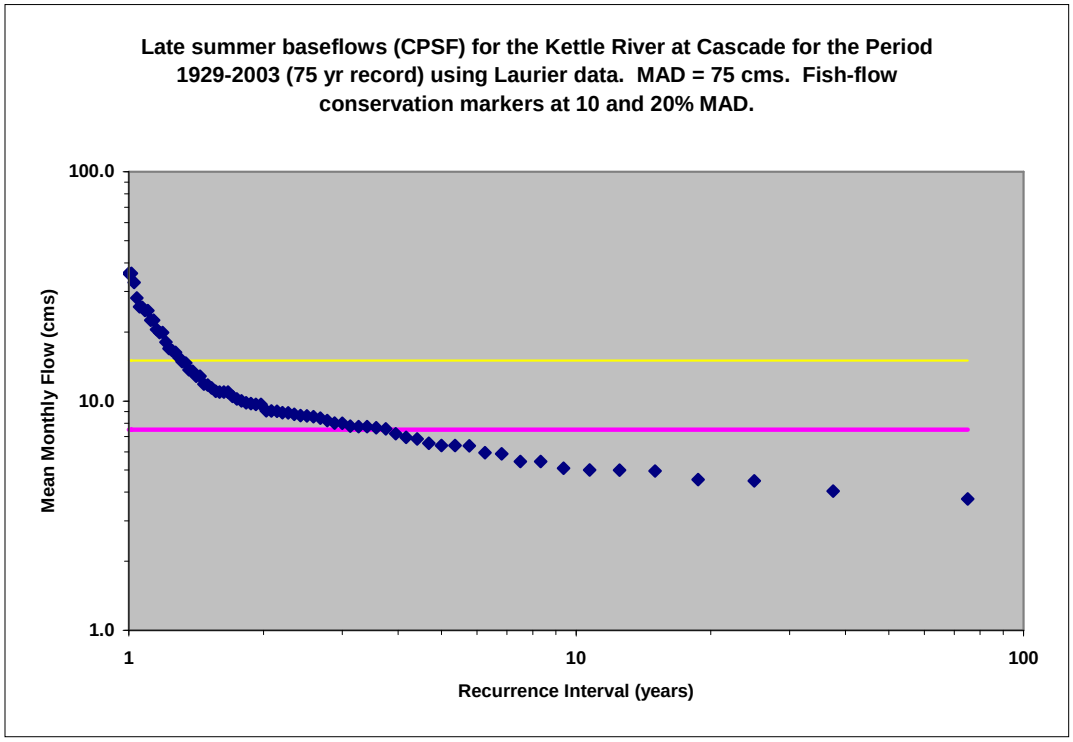

Figure 6. Late summer base flows at Laurier, Kettle River, showing the recurrence interval of instream flows below standard fish conservation flows of 10% and 20% MAD. The extreme low (September 2003) was 5% MAD and well below recognized fish conservation levels. The dashed line represents the recurrence interval of a Mean Monthly discharge of 10 cms.

Peden and Hughes (1981) found juvenile speckled dace throughout most of the Kettle River below 884 m in elevation in appropriate habitat. They noted that smaller fish tended to occur higher up in the system than larger fish, which they attributed to different opportunities for growth related to temperature conditions. Delayed spawning at lower temperatures may also be a factor. The authors noted that the comparatively smaller size range in the Granby River may indicate a less productive river.

Haas (2001) tested water velocity preferences for mature speckled, leopard and Umatilla dace in the field, during the low flow period in the fall, and velocity tolerances for mature speckled dace (50 to 70 mm size range) under laboratory conditions (at 18ºC). Field data were collected in the mainstem Kettle River and the Granby River. In the wild, Haas (2001) found speckled dace at the lowest water velocities. On the bottom of the stream (where speckled dace were found) water velocity ranged from 0 to 15 cm/sec (median velocity ~ 3 cm/sec) compared with 0 to 30 cm/sec (median of 15 cm/sec) at 60% mean depth. In the lab, Haas (2001) found that speckled dace tolerate the lowest velocities of all three dace species at a maximum of about 60 cm/sec (at both the bottom and 60% mean depth). The median depth preference for speckled dace was about 30 cm (range of 5 to 65 cm) in the wild. Sampling was limited to the maximum depth attainable wearing chest waders. For larger dace it is possible that the depth preference was biased by the difficulty of sampling in deeper water or that variations in substrate size influenced the results. Only very small speckled dace were found along the stream margins. In early August, fry (about 10 mm long) can be dip-netted from shallow (<2 cm) still water over silt or sand substrates (McPhail undated).

Depth and water velocity preferences (HSI curves/Habitat Suitability Index curves) in the wild likely vary between systems depending on habitat availability, water temperature, food supply, fish size, abundance and the other fish species present (Baltz *et al.* 1982; Moyle and Baltz 1985). HSI curves developed by Moyle and Baltz (1985) for Deer Creek, California (mean annual stream discharge (MAD) of 9.096 m^3/s, a much smaller stream than the Kettle River) indicate a preference for habitat with a water column water velocity of <70 cm/sec (mean <29 cm/sec) with water depths of 5 to 65 cm for juveniles (mean 27 cm); and velocity of <120 cm/sec (mean <44 cm/sec) and water depths from 5 to 75 cm (mean 27 cm) for adult speckled dace. Speckled dace were found most often in larger substrates, primarily cobble and boulder. HSI curves, however, can be biased by stream-specific hydraulic diversity and stream size.

MAD for the Kettle River at Cascade is about 75 m^3/s (Powerhouse Energy Corp. 1999). Annual flow patterns in the Kettle River system are similar to most interior streams with high flows in spring under snowmelt conditions (May to July) and low flows during the fall-winter period (October through March). Peden (2002) observed evidence of the extent of peak flows in flood debris caught in trees 6 m above fall water levels near Cascade (an area where the channel is confined by a bedrock canyon).

Water Survey of Canada temperature records for the Kettle River near Ferry (USA), downstream of Midway BC, suggest a mean annual water temperature of about 8ºC and a maximum temperature of 23ºC. Low water temperatures (<5ºC) occur during

the November to March period. Water temperatures during summer are cooler in the tributaries than in the mainstem rivers. In August water temperatures in two tributaries averaged around 13-15ºC compared with 19-20ºC in the mainstem Kettle and West Kettle rivers; in September temperatures in seven tributaries ranged from 8-12ºC while averaging 12 and 14°C in the Kettle and West Kettle rivers (Sebastian 1989). Oliver (2002) reported maximum daily temperatures during the summer of 23°C at Midway, 24°C at Grand Forks and 25°C at Cascade. Cool water temperature may limit distribution within the system by preventing the use of tributaries. Sebastian (1989) did find dace in one tributary, Rock Creek, immediately above the confluence with the Kettle River. More recent surveys of the Kettle River, including Rock Creek, did not find dace in four major tributaries of the Kettle River (A. Wilson pers. comm.).

Most of the year water clarity is high. BC Ministry of Environment water quality data for September, 1988, suggested a moderately productive system with total alkalinity in the range of 50-65 mg/L and total dissolved solids of 80-116 mg/L for the Kettle and West Kettle rivers; pH ranged from 7.9 near Midway to 7.4 in the headwaters for the Kettle River (Sebastian 1989). Environment Canada (2005) website data for Kettle River at Carson Road Bridge indicates similar total alkalinity levels during the summer months over the period of record. In October of 2005 alkalinity ranged from 78 to 82 mg/L and 46.5 to 77.9 in the Kettle. Total phosphorus was below the detectable limit (0.002 mg/L) except in the Cascade Canyon where it was slightly above (0.003 mg/L), while total nitrogen ranged from 0.06 mg/L in upstream areas to 0.24 mg/L at the Cascade Canyon, and nitrate from 0.011 mg/L to 0.115 (Wilson pers. comm). This illustrates high annual variability of water chemistry correlated with changes in stream flow. Flow analyses demonstrated that stream discharge is particularly limiting in late summer (Sebastian 1989) for aquatic species. The Kettle-Granby system was a strong candidate for “sensitive stream” designation under the BC Fish Protection Act (1997) because summer flows are substandard for fish requirements with prolonged, dewatered habitats in some streams (B.C. Ministry of Environment unpubl. data).

Habitat trends

Trends in the availability of suitable habitat can be inferred from patterns of human activity in the watershed. Information on the area is available on the Regional District of Kootenay Boundary (2003) and City of Grand Forks (2005) web sites (http://www.rdkb.com/siteengine/activepage.asp?PageID=1 http://www.city.grandforks.bc.ca/).

The first Europeans to settle the area were farmers, but around the turn of the 20th century an industrial boom occurred that included the construction of railroads, mines, a smelter and a power plant. Slag piles and remnants of the smelter can still be seen near town. Today, the economy of Grand Forks is based on the lumber industry, although agriculture, mining and tourism are also important contributors. The population of Grand Forks has grown from about 200 in the mid-1890s to around 4,000 today (currently about 10,000 in the Kettle-Granby basin or Kootenay Boundary area).

Significant water withdrawals for agricultural purposes, particularly for irrigation, have an impact on habitat availability during the summer months when flows are already naturally low. Aqua Factor Consulting Inc. (2004) analyzed demand and water availability in the Kettle River basin. Irrigation accounts for between 75 and 85% of total demand. Low flows have worsened in the last 75 years, partly due to the increase in water allocations, to a point where the system is now considered 'regulated' (the system is considered regulated, rather than natural, due to the amount of water being withdrawn from the system as the result of diversionary structures and run-of-the-river withdrawals) (R.A. Ptolemy). In the BC portion of the watershed above Cascade, the rate of growth in the area of land under irrigation licences increased gradually from about 5 to over 160 acres/year between 1929 and 1962; between 1963 and 1981 the area under irrigation grew at an average rate of 585 acres/year then declined at an average rate of 65 acres/year as water users in the basin switched from diverting surface water to using groundwater (Aqua Factor Consulting Inc. 2004). There appears to be a strong linkage between the aquifers and the flow in the mainstem rivers, and the switch to groundwater sources may not resolve the chronic low flow problems in the system. The growth in use of groundwater cannot be determined since a licence to use groundwater is not required in BC. Surface water withdrawals of about 60,000 acre-feet/year are licensed from BC and Washington combined; much of the demand is in the summer-fall period, and most licences are unsupported by storage. In Washington, which requires a licence for removal of groundwater, an additional ~ 9,000 acre-feet/annum has been allocated for this purpose. The licensed water allocations are about twice the amount taken during 2003. Aqua Factor Consulting Inc. (2004) estimates that the unused portion of the water allocation may be sufficient to supply the increase in demand over the next 30 to 40 years.

Peden and Hughes (1981) reported low fish abundance, including speckled dace, in the Kettle River near the lumber mill at Midway, and an absence of speckled dace immediately downstream from the sewage treatment plant at Grand Forks (at the junction of the Kettle and Granby rivers), possibly due to changes in water quality. These human activities may have affected fish abundance and probably continue to have impacts (Peden 2002). The empirical data may also be an artifact of low stream gradient and the lack of steep riffles in these two sections.

A proposal to develop a run-of-river hydroelectric generation project at Cascade Falls, downstream of Grand Forks, was submitted to the provincial government in 1999. (A run-of-river project does not require a large reservoir to store water inflow from the catchment area, as the river flow and vertical drop provide the pressure to turn the turbine; it does require a diversion of water to the turbine.) Cascade Falls is located in the middle of the Kettle River canyon. If it proceeds, this project will be built on the historic site of an abandoned power station, which was constructed in 1899 and operated until 1919. After an analysis of fish habitat impacts based on the initial proposal at a weir crest elevation of 485.5 m, the company brought forward a second proposal (PDI 2003). This proposal lowered the weir crest elevation to 483.2 m and incorporated a rubber dam. This design change significantly reduces the impoundment area and allows for the passage of bed load through the system, they have been utilized with success elsewhere in the province for small or micro-hydro projects (B.C. Hydro

2000). At a mean annual discharge of 75 m^3/s the proposed backwater effect has been reduced to 750 m (compared to 1.7 km under the original weir height proposal). At the lower weir crest height the water surface elevation at the weir is projected to be 0.7 m higher than under natural conditions and mean annual flow and 1.1 m higher than under natural conditions at a reduced flow of 10 m^3/s. The footprint of the weir will result in the loss of 537.5 m^2 of potential speckled dace habitat (PDI 2005). The weir, however, is located in an area considered to be marginal habitat as speckled dace could be susceptible to flushing downstream over the falls and lost to the population.

The canyon is only 900 m long and lies immediately below the weir site. The distance from the lower end of the canyon to the USA border is 5 km. Potential impacts below the flow return point in the powerhouse tailrace are nil. This is because generation flows are combined with assured canyon flows to equal the natural flow at the upstream end of the lower 5 km section. According to the fisheries technical reviewers (see for example EAO 2004) of the Cascade Project the chances for dewatering are nil even though there is a small chance of a short flow disruption through stalled flow routing with power outages, basically because flow disruptions due to rerouting back through the natural channel will not last long enough for dewatering to occur. Peden (2001) indicates that the population below the falls does not appear to be self-sustaining, which may be due to reproductive isolation or competition with Umatilla dace.

Although the proponent recognizes that there is a level of uncertainty in predicting the response of speckled dace to creation of the head-pond, they have discussed project changes with Dr. J.D. McPhail (UBC) and Dr. Alex Peden, both academics with expertise in BC dace (PDI 2005). The results of HEC-RAS modeling [hydraulic modeling of depth-velocity changes at different flows and backwater effects (US. Geological Survey 2004)] have been discussed with Dr. J.D. McPhail and have been reviewed by both federal and provincial fisheries agencies as part of the ongoing environmental assessment process. McPhail and Peden (PDI 2005) have indicated that impacts to speckled dace habitat may not be significant under the new configuration. Mitigating reasons include: important areas including possible spawning habitat and areas where the highest densities of speckled dace have been found are located upstream of the backwater area; the head-pond will remain flowing; and the weir can be deflated during high flows to allow flushing of any fine sediment accumulations from the head-pond area. More recently (Bradford 2006), an allowable harm assessment report indicates that only a small fraction of the speckled dace population would be affected by the project because of the small impact of the headpond and the facility operation, and concluded that the proposed project would, at most, represent nothing other than a very minor increment in the risk of extinction. In response to the uncertainty, a monitoring plan has been proposed as part of a compensation program to assess any changes to speckled dace habitat, abundance and entrainment, if the project proceeds (PDI 2005).

Habitat protection/Ownership

Known speckled dace habitat receives general protection under federal legislation, such as the fish habitat section of the Federal Fisheries Act, and habitat related

provisions of various provincial statutes designed to protect the environment, water quality and fish. None of this legislation specifically protects speckled dace habitat. In addition to these broad protection measures, speckled dace habitat receives consideration by both the provincial and federal government (e.g. under environmental assessment procedures) due to its recognition by the BC Conservation Data Centre and COSEWIC as a species at risk.

The Kettle River has been designated a Heritage River by the provincial government as part of British Columbia's Heritage Rivers System in recognition of its outstanding natural, cultural and recreational values. The main objective of the Heritage Rivers System is to raise awareness and promote good stewardship of BC's rivers. The management guidelines for the river are: to protect habitat for rare fish species; to establish and maintain an integrated sustainable approach to land and water use within the watershed, with specific consideration for the agriculture industry; to protect and monitor the health of natural processes in the river; and to manage and monitor recreational use so as to maintain the quality of the experience with minimal environmental impact. Once a river is designated, the vision and management guidelines for the river are considered in planning processes; however, while they are intended to guide the process they do not dictate the outcome.

The waters inhabited by speckled dace in Canada are owned by the crown; however, the private use of surface water is licensed.

BIOLOGY

There is very little information on the basic biology of speckled dace. The only published sources of information on the biology of speckled dace in Canada are Peden and Hughes (1981, 1984) and Peden (1994). McPhail (undated) produced a summary on speckled dace that is available on the UBC website (http://www.zoology.ubc.ca/~etaylor/nfrg/dace.pdf).

Life cycle and reproduction

Laboratory studies (Kaya 1991) have shown that both increasing photoperiod and increasing water temperature induce spawning in speckled dace. Individuals kept at 15ºC in a photoperiod of 14 h light and 10 h dark after June spawned within 1 to 2 days once the water temperature was increased to 18 or 24ºC. Speckled dace kept in aquaria spawned from April to July when maintained at 21 to 29ºC under a natural photoperiod, indicating that spawning can be protracted. Newly fertilized eggs are about 1.8 mm in diameter, adhesive and denser than water; in aquaria eggs were deposited at the base of available stones, on filters and in corners.

No spawning behaviour or spawning sites have been documented in BC. Peden and Hughes (1981) examined ovarian maturity in female speckled dace and suggested that spawning probably starts in mid-July. Data collected on fish in spawning condition during sampling are consistent with this timeline (PDI 2005). Peden and Hughes (1981)

also reported that females considered to be in spawning condition contained relatively few large eggs (usually <500) around 1.5 mm in diameter. The number of large eggs in fall-caught females ranged from about 450 to 2,000 suggesting a single ovarian cycle per year. Egg development is rapid following fertilization as hatching occurs in 4-5 days at 24ºC and 6-7 days at 18ºC; newly hatched larvae are about 6 mm long and become free swimming about a week later (depending on temperature); at about 8 mm they emerge from the substrate and begin to actively feed (McPhail 2003).

Newly emerged fry appear in the river in early August at a size of around 9 mm; by late October they are about 20-30 mm in fork length (McPhail 2003). Length frequency histograms from sampling in July and August of 2000 and 2001 suggest the presence of at least three size classes or age groups (PDI 2005). Most males in the Kettle River mature at the end of their second summer (at age 1+) and spawn for the first time the next summer (age 2+). Females typically become sexually mature one year later than the males. Speckled dace do not mature until they are around 40 to 50 mm in length (Peden and Hughes 1984). While there are no detailed data on age structure, field sampling indicates that the adult population is comprised mostly of fish <60 mm in fork length (those in their second or third summer); females, which occasionally reach fork lengths over 90 mm are likely in their fourth summer (age 3+) (Peden and Hughes 1981, 1984; Peden 1994; McPhail 2003).

Peden and Hughes (1984) observed an abundance of young fish in the Kettle River and suggested that reproductive potential was high. Although they caught fewer males than females, they were unable to effectively sample faster water sites where larger males might be found. Males are rare in most collections, suggesting possible sex-related differences in microhabitat utilization (Peden and Hughes 1984; McPhail 2003).

Herbivory/Predation

The stomach contents of adult speckled dace show that they consume the larvae of aquatic insects and significant amounts of filamentous green algae; some specimens collected in September contained winged insects (Peden and Hughes 1981; Peden 1994, 2002; McPhail 2003). Peden (2002) noted that the intestine of speckled dace is not long and coiled as typically found in herbivores and suggested that algae had been ingested inadvertently. The small number of juveniles that have been examined suggest a diet similar to the adult fish; however, they did contain a larger proportion of algae, diatoms and chironomids (McPhail 2003).

Physiology

No studies have been documented on the physiology of speckled dace.

Dispersal/Migration

There are no reports of speckled dace migrations in the literature, although Minckley (1973) did refer to the ability of speckled dace to re-colonize isolated refuges

in Arizona rivers following devastating floods. Young-of-the-year speckled dace do disperse from shallow, low velocity habitat to deeper, faster water as they grow (Peden and Hughes 1981, 1984). Speckled dace in Canada are reproductively isolated from other populations downstream of Cascade Falls (a 30.5 m natural barrier preventing upstream migration). Movement across the US border between the Canadian and American sections of the Kettle River above Cascade Falls is possible. Any speckled dace that move or are flushed over the falls are unable to return to the population upstream.

Interspecific interactions

Speckled dace co-occur with chiselmouth (*Acrocheilus alutaceus*), pikeminnow (*Ptychocheilus oregonensis*), redside shiner (*Richardsonius balteatus*), longnose sucker (*Catostomus catostomus*), bridgelip sucker (*Catostomus columbianus*), largescale sucker (*Catostomus macrocheilus*), rainbow trout (*Oncorhynchus mykiss*), introduced brook trout (*Salvelinus fontinalis*), mountain whitefish (*Prosopium williamsoni*), mottled sculpin (*Cottus bairdii*), and slimy sculpin (*Cottus cognatus*) in the Kettle River system above the falls. Speckled and Umatilla dace coexist for a short section below Cascade Falls, but Umatilla dace appear to replace speckled dace about 10 km below the US border likely through competitive exclusion (Peden and Hughes 1988).

Species interactions have not been studied in the Kettle River system. Baltz *et al.* (1982) found that competitive interactions between speckled dace and riffle sculpin (*Cottus gulosus*) for preferred microhabitat in a California stream were influenced by water temperature.

Adaptability

Adaptability to changes in habitat has not been investigated in speckled dace in Canada. Generalizations from case studies in the US may be misleading due to the extent of adaptive diversity observed among populations in different drainages (Peden 2002, McPhail 2003). Since speckled dace are warm-water adapted they may be able to benefit from the warmer temperatures associated with climate warming; whether they can also adapt to the associated decrease in summer flows and the consequential degradation of habitat and reduction in food supply from riffles is unknown. Peden (2002) speculated that the current presence of large speckled dace in the area above the old dam near Cascade Falls may demonstrate the ability of the species to respond to habitat improvement or the restoration of natural flows following weir/dam removal.

POPULATION SIZES AND TRENDS

Search effort

The known distribution within the Kettle River system is a result of field work conducted during museum collections and rainbow trout population assessment studies.

It is possible that speckled dace occur in areas of the mainstem upstream of the known distribution that have not been systematically surveyed. Recent rainbow trout surveys in the Kettle and West Kettle systems have not found dace in tributaries (BC Ministry of Environment upubl. data). Peden and Hughes (1981) found young-of-the-year speckled dace were widely distributed and relatively easy to capture during September and October, whereas adults were more difficult to find. More recent sampling has focused on the area of the power project at Cascade Falls where a relatively high abundance was found (Peden 2002, PDI 2005, BC Ministry of Environment upubl. data). Swim surveys conducted in 2005 suggest that speckled dace are found in the Kettle and West Kettle rivers in areas where specific riffle habitat is available (Ron Ptolemy, Aquatic Ecosystem Science, Ministry of Water, Land and Air Protection, Victoria, BC; pers. comm. 2006).

Abundance

No systematic quantitative sampling has ever been completed over the range of speckled dace in Canada.

Fluctuations and trends

There have been no long-term studies of speckled dace or detailed studies of their habitat that could provide information on trends in abundance. Surveys during 1978 to 1980 indicated populations were stable over that short period (Peden and Hughes 1981). Peden and Hughes (1984) speculated that there may be fluctuations in survival of young-of-the-year fish as a consequence of variability in spring flooding, but also noted that speckled dace evolved within the natural flood regime of the river and may have developed adaptations to cope with natural patterns of disturbance. In other systems annual estimates of specked dace abundance can fluctuate considerably (e.g. Pearsons *et al*. 1992). Fish habitat problems related to low summer flows are a result of a combination of irrigation/diversion, land use practices and low summer flows; to some extent it is not a natural phenomenon and is likely to get worse over time. As a consequence of such habitat reduction, invertebrate production in riffles and speckled dace numbers may be declining.

Rescue effect

Speckled dace in Canada are isolated above a 30.5 m high barrier at Cascade Falls. The Kettle River above Cascade Falls does loop down into the US and speckled dace in this section are likely able to move across the border into Canada. This section is only about 45 km long with an extent of occurrence of about 2 km^2. These fish, however, could also be affected by the same event affecting speckled dace in Canada, if the event were to occur upstream of the US section of the river.

LIMITING FACTORS AND THREATS

Haas (1998) listed the limited distribution and small total population size as important risk factors for speckled dace in Canada. Additional threats on the list included forest harvesting activities, habitat loss, exotic species introductions, urbanization, agricultural and industrial pollution, hydroelectric development (see Habitat trends above) and accumulations of coal slag on the Granby River at Grand Forks, BC.

The entire range of speckled dace in Canada is found within a single drainage system (known extent of occurrence = 7.47 km^2). Of the habitat sampled to date the 11.4 km section just above Cascade Falls supported the highest densities of speckled dace and may represent a significant proportion of the adult Canadian population (Peden 2002). This requires confirmation by additional sampling of habitat in the upper watershed. A major catastrophic event, capable of causing downstream impacts, could threaten a significant portion of the population in this area (Peden 2002). It is unlikely, however, that a single catastrophic event could affect all of the speckled dace in Canada as they occur in more than one river. Re-colonization would most likely be possible from portions of the distribution that were not impacted.

Due to low summer flows, the dominance of small particles (gravel and sand) and limited instream cover, adult habitat may be the limiting factor for several fish species in the Kettle and West Kettle rivers (Sebastian 1989). Habitat in the lower Granby River is similar. Significant numbers of large speckled dace have only been found in areas that contain cover (undercut banks and larger substrates such as cobbles and boulders) with an absence of fine materials, in good depth and current (Peden 1981, 2002).

The Kettle River system by nature is considered a flow sensitive system with threats from water abstraction. It occurs in an ecoregion of relatively low, normal unit run-off (265 mm/year). This problem has become increasingly accentuated by increasing draws on water for urban, agricultural and industrial needs in the watershed. Climate warming has the potential to further exacerbate this condition. Based on the observed frequency of drought-like conditions in the system (Fig. 5 and 6) additional extraction cannot in reality meet fish needs (R.A. Ptolemy pers. comm.). The Tennant Method for instream flow assessment describes instream flows of 10% MAD as poor or minimum habitat for fish and wildlife (short term survival only in most cases); at flows below 10% MAD habitat is considered severely degraded (Tennant 1976; Annear *et al.* 2004). Tennant described 30% MAD as the generic threshold at which depth and velocity in riffles are adequate for fish and aquatic insects; below 10% MAD the depth, velocity and width of riffles were described as severely degraded. Figure 5 shows that during the 2003 drought, flows dropped below the minimum of record for an extended period of time (weeks). In addition to the loss of riffle habitat, low-flow conditions can result in elevated water temperatures, reduced dilution potential and degraded water quality (waste discharge), reduced dissolved oxygen levels, and increased vulnerability to terrestrial and aquatic predators. In the winter low-flow conditions can increase the risk of freezing and low dissolved oxygen levels. Increasing water temperatures are not

expected to impact speckled dace; it is the other conditions which may impact abundance through habitat loss and impacts to food supply.

Increasing water allocations may not be the only factor affecting low flows; climate change may also play a role in the decrease in low flows seen between the years prior to 1963 and the period after 1981 (Aqua Factor Consulting Inc. 2004). Both provincial and federal fisheries agencies have expressed concerns that low water flows combined with high temperature are causing excessive stress, reduced rearing capacity, and mortality in fish residing in the Kettle River system.

Climate warming has the potential to increase the severity, duration and frequency of drought conditions. The flows measured in the Fraser River at Hope indicate that the date by which one-third and one-half of the annual cumulative flow occurs has advanced by 11 and nine days respectively each century (Aqua Factor Consulting Inc. 2004). Streams in south central BC show a similar trend with an earlier spring freshet and lower flows in late summer and early fall (Aqua Factor Consulting Inc. 2004).

Early summer fish kills within the areas of the river occupied by speckled dace were reported in the Kettle River in 1991, 1992 and 1998 (Aqua Factor Consulting Inc. 2004). The dead fish reported included whitefish, trout, and suckers. These three incidents took place prior to the low flow period of late summer and early fall and they appeared to be localized. The cause of these fish kills has not been determined.

Peden and Hughes (1981) found speckled dace were absent or low in abundance in apparently suitable areas downstream of the sewage treatment plant at Grand Forks and what may have been usable habitat near the lumber mill at Midway, suggesting that changes in water quality may have had an impact in these areas. Peden (2002) listed additional threats including the activities in the US (upstream of Cascade Falls) that could have deleterious impacts downstream in Canada, and road construction or agricultural practices that could cause siltation of substrate materials and/or chemical contamination.

The proposed power project has been dealt with under Habitat trends above, but it should be noted that the current proposal is only expected to impact a very small percentage of speckled dace habitat in the Kettle system.

SPECIAL SIGNIFICANCE OF THE SPECIES

The speckled dace is a warm water adapted species (Moyle 1976) and reaches the northern limit of its geographic range in south central BC; in Canada it occurs only in the Kettle-Granby river system (Peden and Hughes 1984; Haas 2001; McPhail 2003). Speckled dace in Canada are isolated from other populations downstream by a 30.5 m natural barrier at Cascade Falls. Peden (2002) reported that the morphology of speckled dace in Canada is distinct from populations in the US downstream of Cascade Falls. A complex series of morphological forms (perhaps subspecies) occur in many

isolated drainages that lie along the coast from the Olympic Peninsula to California (McPhail 2003). The speckled dace is also of great scientific interest as it is thought to have been one of the parental species in the origin of a third species, the Umatilla dace (*R. umatilla*), by hybridization between *R. osculus* and *R. falcatus* (Haas 2001). Canadian populations of the Umatilla dace are also restricted to a small area in Canada (Haas 2001).

The Kettle River area is a rich and important Aboriginal site. Documentation of the views of the Elders of the Okanagan Nation Alliance regarding issues related to the land, the river and its faunal resources including the speckled dace may be accessed through the Environmental Assessment Office Web Site (http://www.eao.gov.bc.ca/epic/output/html/deploy/epic_project_home_55.html)

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Speckled dace in Canada receive general protection under federal legislation, such as the fish habitat section of the federal Fisheries Act, and provisions of various provincial statutes designed to protect the environment, water quality and fish. None of this legislation specifically protects speckled dace. In 2003 and 2004 fisheries agencies did take the step of advising water licencees in the Kettle River basin that failure to provide sufficient flows to maintain fish throughout all life stages, and other actions that affect fish, are offences under the federal Fisheries Act. Currently, BC water licences are issued with a condition that allows use to be curtailed if water is required to protect fish; however, analysis indicates that this restriction may not protect fish under the current level of use (Aqua Factor Consulting Inc. 2004).

The speckled dace was originally designated Special Concern by COSEWIC in 1980; status was re-examined in November 2002, based on an update status report, and the species was designated as Endangered. The Nature Conservancy Global Rank is G5 as it is abundant in many areas of the western US (NatureServe 2005). The BC Conservation Data Centre ranks it as S1 (Red).

There are several forms of speckled dace that are listed under the Endangered Species Act in the US. Foskett speckled dace, *R. osculus* ssp. 3, (from Oregon) is listed as Threatened. Subspecies *nevadensis*, *oligoporus*, and *lethoporus* are listed as Endangered. Subspecies *reliquis* is extinct (NatureServe 2005). In addition 11 other subspecies of speckled dace are ranked at risk on the NatureServe website: *R. o. lariversi*, Big Smokey Valley, Nevada; *R. o. moapae*, Moapa River, Nevada; *R. o*. ssp., Amaragosa River, California; *R. o.* ssp., Diamond Valley, Nevada; *R. o.* ssp., Meadow Valley, Nevada; *R. o*. ssp., Owens speckled dace, California; *R. o.* ssp., Monitor Valley, Nevada; *R. o.* ssp., Oasis Valley, Nevada; *R. o.* ssp., White River, Nevada; *R. o*. ssp., Santa Ana speckled dace, California; *R. o. velifer*, Pahranagat speckled dace, Nevada. *R. o. reliquus* of Grass Valley, Nevada, is presumed extirpated.

TECHNICAL SUMMARY

Rhinichthys osculus
speckled dace naseux moucheté
Range of Occurrence in Canada: British Columbia

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Calculated from Figure 3 using best fit polygon	~ 3000 km²
• *Specify trend in EO* **Decline is inferred from increasing frequency and severity of summer drought conditions.**	Possibly Declining - inferred
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* **Based on total stream length of 245 km and mean wetted width of 30.5 m (estimated from sub-drainage areas and average water yields)**	7.47 km²
• *Specify trend in AO* **Decline is inferred from increasing frequency and severity of summer drought conditions**	Possibly Declining - inferred
• *Are there extreme fluctuations in AO?* **Low flow conditions in extremely dry summers or drought conditions may reduce adult habitat, particularly riffles (see Candian Range).**	Possible
• *Number of known or inferred current locations* Kettle, West Kettle and Granby rivers	3
• *Specify trend in #*	Stable
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat* **Decline is inferred from increasing frequency and severity of summer drought conditions.**	Declining
Population Information	
• *Generation time (average age of parents in the population)*	2 or 3 years
• *Number of mature individuals*	Unknown
• *Total population trend:* **Inferred from decrease in riffle habitat with worsening drought conditions.**	Declining - inferred
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	Unknown
• *Is the total population severely fragmented?* **If fragmentation occurs, it is not severe.**	No
• *Specify trend in number of populations*	Stable
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each:	
Threats (actual or imminent threats to populations or habitats)	
Decreasing summer low flows; the limited distribution, which can be impacted by a single large event; and cumulative habitat degradation including possible water quality issues related to industrial activity (forestry related), urbanization (sewage) and agricultural run-off, i.e., irrigation/water diversion in terms of changing run-off patterns and demand in relation to climate change leading to extended low-flow periods.	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA:** The Nature Conservancy – Global Rank G5; 4 ssp. listed under U.S. ESA; 12 ssp. ranked at risk by The Nature Conservancy	
• *Is immigration known or possible?* Possible, from the part of population that resides in the 45 km of river above Cascade Falls that loops south into USA (EO = ~ 2 km^2). Would depend on whether this area was impacted as well. Not possible from outside populations located below Cascade Falls.	Possible but limited

• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Appears limited
• *Is rescue from outside populations likely?* Cascade Falls is a 30.5 m high barrier to upstream movement.	Not Likely See above
Quantitative Analysis Analysis has not been done.	None

Existing Status

Nature Conservancy Rank (NatureServe 2005**)**
Global – G5
National:
U.S. - N5, PS under Endangered Species Act (several subspecies are threatened or endangered in the U.S). One subspecies (*R. osculus reliquus*) is extinct.
Canada – N1N2
Regional:
U.S. – AZ – S3S4, CA – S5, CO – S5, ID – S5, NN – S5, NV – S5, NM – S3, OR – S4, UT – S5, WA – S4
Canada: B.C. S1S2 (Province lists as Red)

Wild Species 2000 (Canadian Endangered Species Council 2001)

National – 6
Regional – BC – 3

COSEWIC Vulnerable (Special Concern) 1980
Endangered (2002)
Endangered (2006)

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code**: B1+2ab(iii)

Reasons for Designation:
The species is restricted to the Kettle River mainstem and two main tributaries in south-central 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.

Applicability of Criteria

Criterion A: (Declining Total Population): Not Applicable – Decline is inferred, but the rate of decline is not known.

Criterion B: (Small Distribution, and Decline or Fluctuation): Meets Endangered under criteria B 1+2ab(iii) – The area of occupancy is 7.47 km^2, and exists at 3 locations with continuing decline observed or projected in the extent and quality of available habitat as a result of increases in water extraction and drought conditions.

Criterion C: (Small Total Population Size and Decline): Not Applicable – Number of mature individuals is not known.

Criterion D: (Very Small Population or Restricted Distribution): Meets Threatened D2 – Area of occupancy is 7.47 km^2 and is known from only 3 locations.

Criterion E: (Quantitative Analysis): Not Applicable – No data.

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Authorities Contacted

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COLLECTIONS EXAMINED

No collections were examined in the preparation of this report.