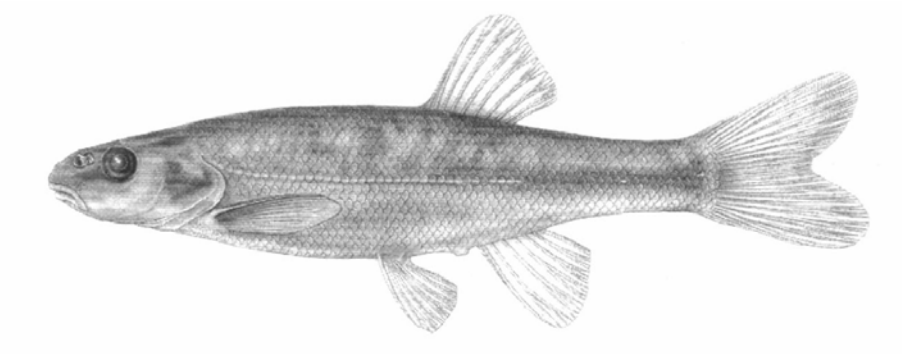
COSEWIC
Assessment and Update Status Report

on the

Speckled Dace
Rhinichthys osculus

in Canada



ENDANGERED
2002

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE IN
CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

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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.

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.

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

For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

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 — Photograph courtesy Royal B.C. Museum.

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COSEWIC
Assessment Summary

Assessment Summary – November 2002

Common name
Speckled dace

Scientific name
Rhinichthys osculus

Status
Endangered

Reason for designation
The speckled dace has a very restricted Canadian range where it is subject to deteriorating water quality as a result of urban and industrial development, as well as to loss of preferred habitat and fragmentation due to construction of a proposed dam.

Occurrence
British Columbia

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

COSEWIC
Executive Summary

Speckled Dace
Rhinichthys osculus

Species Information

Canadian speckled dace (*Rhinichthys osculus*) differ from American populations by having higher scale counts and lacking barbels. Many subspecies are recognized in the United States with many of these isolated populations considered threatened or endangered.

Distribution

In British Columbia, speckled dace occur in the Kettle River south of Carmi as well as its tributaries (East Kettle, West Kettle rivers and Granby rivers). In the USA, populations occur as far south as Arizona and California. Many distinct populations are recognized in the USA, where they inhabit isolated mountain ranges or warm, desert springs.

Habitat

Canadian speckled dace occur in riffle habitats where they take refuge under stones and feed on aquatic insects near the bottom. Spring freshets from snowmelt create seasonal floods in the Kettle River. Water level in the Kettle River is low during August and September. Speckled dace are reported to inhabit water depths up to one meter. However, deep riffles are hard to collect and better techniques are required to reliably assess populations in deeper portions of the Kettle River.

Biology

Speckled dace breed in spring. Fry appear along river edges where they scatter amongst stones when approached. Breeding occurs in fish over 40 mm standard length. Data on aging were not available; however, dace are likely breed after their 2nd or 3rd year. Female dace produce 400 to 2,000 ova depending on size.

Population Size and Trends

Excluding young-of-the year, 10,000 to 20,000 speckled dace may occur in the Kettle River. Construction of a new dam at Cascade Falls will be detrimental to the largest population of adult-sized speckled dace in the Kettle River.

Limiting Factors and Threats

Restricted to a single Canadian river. Any single catastrophic event within the Kettle River could affect populations downstream. Presently, the Cascade Power Project and Dam will likely reduce the largest known population of dace occurring in the river basin.

Existing Protection

Minimal protection other than current fishery, environmental or water quality regulations.

Special Significance

Although systematics of American *Rhinichthys* requires more analyses, theCanadian population is uniquely different by having an absence of barbels and much higher scale counts, not only making it unique as the only Canadian population, but morphologically different from most American populations as well.

Summary of Status Report

The outlook for speckled dace is of concern. Because of their restricted distribution (only a single Canadian river) the entire population is increasingly vulnerable to major catastrophic events; as well as habitat loss resulting from the building of impoundments and reservoirs, and habitat degradation resulting from water pollution. There are no secondary isolated populations to restock the unique Canadian form of speckled dace into the Kettle River should the Canadian populations be lost.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* 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.

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.

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Canada

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

Update
COSEWIC Status Report

on the

Speckled Dace
Rhinichthys osculus

in Canada

2002

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SPECIES INFORMATION

Name, Classification and Taxonomy

Phylum:	=	Chordata
Class:	=	Osteichthys
Order:	=	Cypriniformes
Family:	=	Cyprinidae
Genus:	=	*Rhinichthys*
Species:	=	*Rhinichthys osculus* (Girard 1857)
Common name	=	Speckled Dace Naseux Moucheté

This report demonstrates the status of *Rhinichthys osculus* (Figure 1) which are now considered to be biologically distinct from the sympatric *R. umatilla* (Peden and Hughes 1988). Umatilla dace have been recognized as a distinct species (Canadian populations represent the end of the range of morphological variation for *R. osculus* and there is no hybridization where these species meet sympatricly). This will be reflected in the next edition of the American Fisheries Society's (AFS) list of common and scientific names of fishes in the US and Canada (J.S. Nelson, Department of Biological Sciences, University of Alberta, Edmonton, Alberta; personal communication 2001).

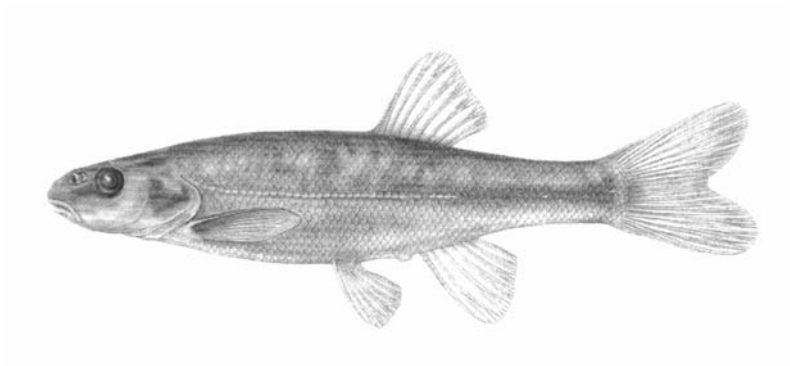

Figure 1. Illustration of *Rhinichthys osculus* from Kettle River, British Columbia (Collection BCPM 979-II273; standard length 67 mm). Note incomplete lateral line. This feature is variable in Canadian population, some incomplete, others with complete lateral lines. (Photograph courtesy of Royal BC Museum.)

Description

In North America, there are numerous taxa of *Rhinichthys.* Some 20 subspecies of *R. osculus* are listed; not all are named (Texas Natural History Collections 2001). Within Canada, *Rhinichthys* differs from most cyprinid fishes by having: 6 to 7 anal fin rays; pelvic fins in advance of dorsal fin; lining of the body cavity not black; and lateral line usually incomplete. The upper jaw possesses a groove separating the upper lip from snout in contrast to the frenum present on *R. cataractae. Rhinichthys osculus* is the only Canadian species of *Rhinichthys* without barbels and one of the few populations of *R. osculus* throughout North America without barbels. Peden and Hughes (1988) differentiated Canadian *R. osculus* from all other congeners by: the absence of barbels; nearly terminal

mouth; snout not extending beyond pre-maxillae as in other Canadian *Rhinichthys*; as well as differences in mouth morphology suggesting foraging behaviors different to that of other Canadian *Rhinichthys* sp. However, the latter behavioural differences have yet to be properly documented. Robins et al. (1991, p 78) did not recognize *Rhinichthys umatilla* as a species distinct from other *Rhinichthys,* as has the British Columbia Conservation Data Centre, BC Fisheries Renewal (see CDC Web Page 2001), and Haas (1998). Earlier literature referred to *R. falcatus* hybridizing with *R. osculus* in the Similkameen River of British Columbia (Carl, Clemens and Lindsey 1959; Scott and Crossman 1973), although these alleged hybrids are undoubtedly *R. umatilla* (see Peden and Hughes $1981_{a,b}$ and Peden et al. 1988). Within Canada there is no evidence of *R. osculus* occurring anywhere other than in the Kettle River basin and the population does not hybridize where they are sympatric with *R. umatilla. Rhinichthys* probably spill over Cascade falls, and survive for a while in habitat occupied by *umatilla,* but hybrids have yet to be documented. Page and Burr (1991) recognized *R. umatilla* as a valid species. In conclusion, hybridization in the Canadian portion of the lower Kettle River is not significant (if it occurs at all). Each form behaves as biological species where they co-occur (see electrophoretic evidence, Table 1). In the Similkameen River, *R. falcatus* and *R. umatilla* similarly co-occur without hybridization. There may be introgressed alleles suggesting historic hybridization during the Pleistocene and hybridization may have been the process by which *R. umatilla* differentiated and evolved into the form found today as a good species (D.E. McPhail, Department of Biology, University of British Columbia, Vancouver, B.C.; personal communication).

Differences to American Populations

The nearest U.S. populations of *R. osculus* are effectively isolated from the Canadian population by an 80 km stretch of river and reservoirs (Figures. 2 - 4). These southern populations have lower scale counts and had at least one, usually two barbels (Table 2). Extensive sampling by Peden and Hughes (1988) found the closest non-Kettle populations to Canada occurred in Stranger Creek and mouth of Hall Creek on the Colville Indian Reservation in Washington State (see Table 2). Those in Chamokane Creek (west of the Little Spokane River) also had higher scale counts closer to those in the upper Little Spokane and Colville rivers. However, comparison of nearby populations in American creeks indicted Canadian populations have the highest scale counts and a complete absence of barbels (Table 2). Peden and Hughes (1988) speculated that the Grand Coulee Dam and Roosevelt Reservoir probably flooded water falls and inundated lower sections of tributaries such as the Colville River, thus eliminating some downstream populations and habitats of *R. osculus.* Downstream populations of *Rhinichthys umatilla* likely dispersed upstream as far as Myer's Falls as the reservoir rose [see Table 2, also Peden and Hughes 1988, also California Academy of Sciences collection SU 02083]**.** Farther south, habitats in Washington State have different looking speckled dace possessing larger and fewer scales (Table 2) and/or conspicuous barbels. Intermediate specimens occur in the Sanpoile River (Colville Indian Reservation) where the barbels are particularly variable and with the total of right and left sides having 0, 1 or 2 barbels. In most cases, *R. osculus* with high scale counts occur above escarpments and falls and are isolated from lowland habitats. Populations near Walla Walla, Washington had the largest scales and lowest scale counts.

Table 1. Allele frequencies of polymorphic loci for *Rhinichthys cataractae*, *R. falcatus*, *R. osculus*, and *R. umatilla*. Localities listed are in British Columbia unless otherwise stated.

			PGI							LGG			AGP					
	1,2				3			1,2										
Location	**Species**	**N**	**40**	**-20**	**0**	**20**	**80**	**90**	**100**	**110**	**40**		**66**	**100**	**40**	**100**	**160**	**240**
*Kettle R.	*osculus*	44	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.55	0.01		0.44	0.02	0.98	0.00	0.00	0.00
Similkameen R.	*umatilla*	55	0.00	0.01	0.99	0.00	0.00	1.00	0.00	0.00	0.00		0.23	0.77	0.03	0.97	0.00	0.00
Kettle R.	*umatilla*	47	0.00	0.16	0.84	0.00	0.00	1.00	0.00	0.00	0.15		0.20	0.65	0.00	1.00	0.00	0.00
Columbia R.	*umatilla*	13	0.00	0.00	0.96	0.04	0.00	1.00	0.00	0.00	0.00		0.04	0.96	0.00	0.96	0.04	0.00
Colville USA	*umatilla*	50	0.01	0.09	0.85	0.05	0.00	1.00	0.00	0.00	0.01		0.14	0.85	0.00	1.00	0.00	0.00
POOLED DATA	*umatilla*	165	0.00	0.08	0.90	0.02	0.00	1.00	0.00	0.00	0.05	0.18	0.77	0.01	0.99	0.00	0.00	
Similkameen R.	*falcatus*	51	0.03	0.03	0.72	0.21	0.01	0.99	0.00	0.00	0.00		0.07	0.93	0.00	0.90	0.10	0.00
Fraser at Hope	*falcatus*	49	0.08	0.01	0.89	0.02	0.00	0.99	0.01	0.00	0.00		0.12	0.88	0.00	0.99	0.01	0.00
*Pooled Data	*falcatus*	100	0.06	0.02	0.81	0.12	0.01	0.98	0.01	0.00	0.00		0.10	0.90	0.00	0.95	0.06	0.00
Similkameen R. (Otter CK)	*cataractae*	1	0.00	0.00	1.00	0.00	0.00	0.50	0.50	0.00	0.62		0.00	0.38	0.00	0.00	1.00	0.00
(lower R.)	*cataractae*	22	0.00	0.00	1.00	0.00	0.00	0.00	0.95	0.05	0.25		0.25	0.70	0.00	0.16	0.84	0.00
Kettle R.	*cataractae*	10	0.00	0.00	1.00	0.00	0.00	0.00	0.65	0.35	0.00		0.00	1.00	0.00	0.10	0.90	0.00
Columbia River (main stem)	*cataractae*	34	0.00	0.00	0.99	0.01	0.00	0.00	0.71	0.29	0.19		0.00	0.81	0.00	0.22	0.78	0.00
(Beaver Ck; above falls)	*cataractae*	50	0.00	0.00	1.00	0.00	0.00	0.00	0.57	0.43	0.07		0.23	0.70	0.00	0.19	0.81	0.00
Pooled Data	*cataractae*	117	0.00	0.00	1.00	0.00	0.00	0.00	0.69	0.31	0.35		0.06	0.58	0/00	0.18	0.82	0.00

*Data analysis by Cliff Stevens of Aqua-Diagnostics. Data reflect sizes of individual samples and number of populations sampled. Therefore data reflect relative differences between species of those samples actually sampled.
"Underline" = data with nearly 100% of alleles different to Kettle River population of *R. osculus*.
"Double Underline" = proportion of alleles apparently not significantly duplicated in sample of *R. osculus* from Kettle R.

Table 1. (cont'd)

			ME			IDH		LDH				MDH		
			1			1,2		1,2			3,4			
Location	**Species**	**N**	**100**	**130**	**300**	**A**	**B**	**-**	**75**	**95**	**100**	**100**	**118**	**C**	**D**
*Kettle R.	*osculus*	44	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Similkameen	*umatilla*	55	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Kettle R.	*umatilla*	47	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Columbia R.	*umatilla*	13	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Colville (USA)	*umatilla*	50	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	0.99	0.01	0.00	0.00
*Pooled Data	*umatilla*	165	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Similkameen R.	*falcatus*	51	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Fraser R, Hope	*falcatus*	49	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
*Pooled Data	*falcatus*	100	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
Similkameen R.															
- Otter Ck.	*cataractae*	1	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.50	0.50	1.00	0.00	0.00	0.00
- lower R.	*cataractae*	22	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.25	0.75	1.00	0.00	0.00	0.00
Kettle R.	*cataractae*	10	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.10	0.90	1.00	0.00	0.00	0.00
Columbia River															
- main stem	*cataractae*	34	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.01	0.99	1.00	0.00	0.00	0.00
- Beaver Ck;	*cataractae*	50	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	0.00	0.00	0.00
- above falls															
Pooled Data	*cataractae*	117	0.00	0.00	1.00	1.00	0.00	0.00	0.00	0.06	0.94	1.00	0.00	0.00	0.00

(see notations on previous page)

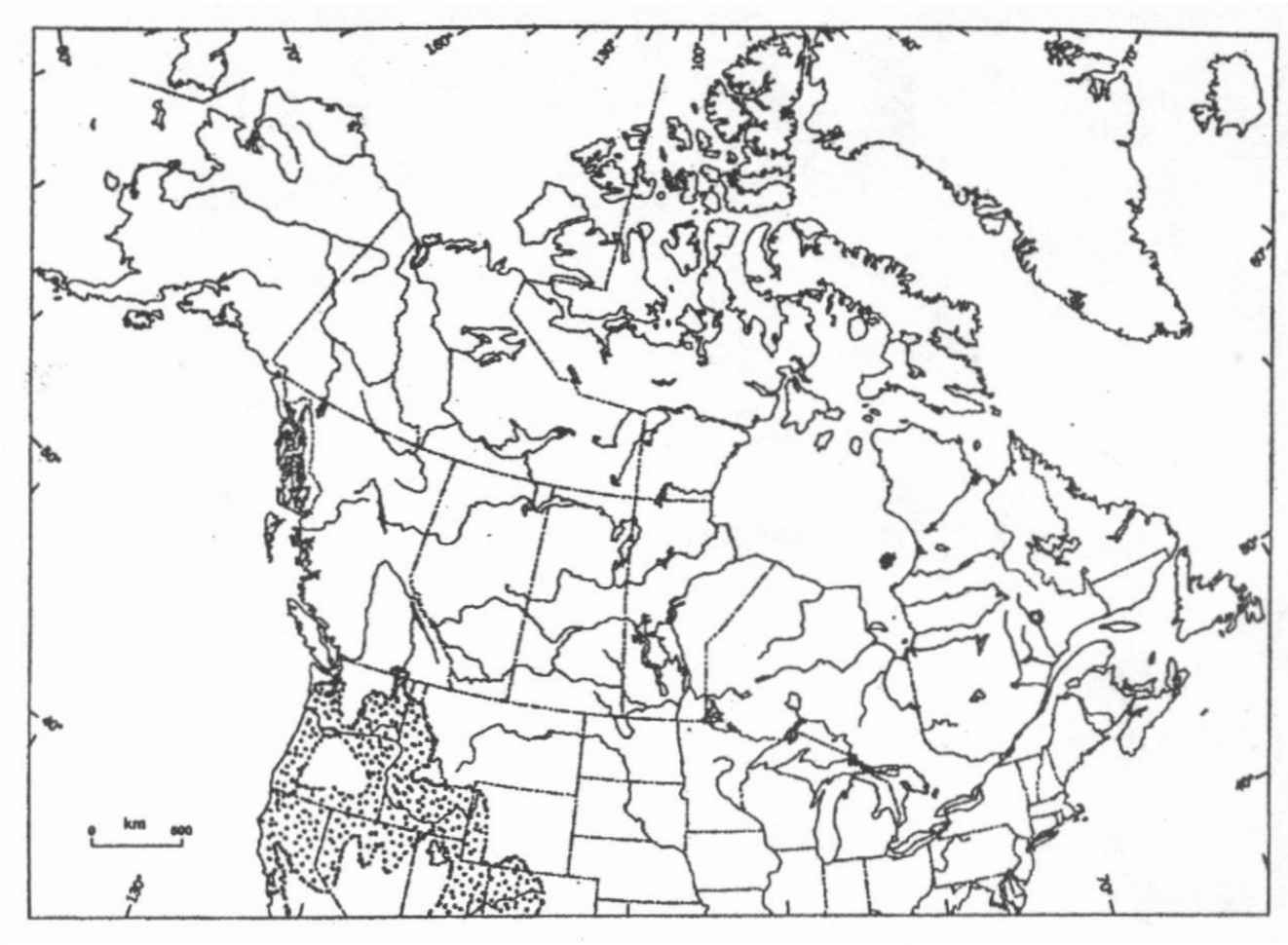

Figure 2. North American distribution of *Rhinichthys osculus* indicated in shaded area, lower left. Southernmost populations are often recognized as differentiated subspecies and are omitted (modified from Lee, et al., 1980).

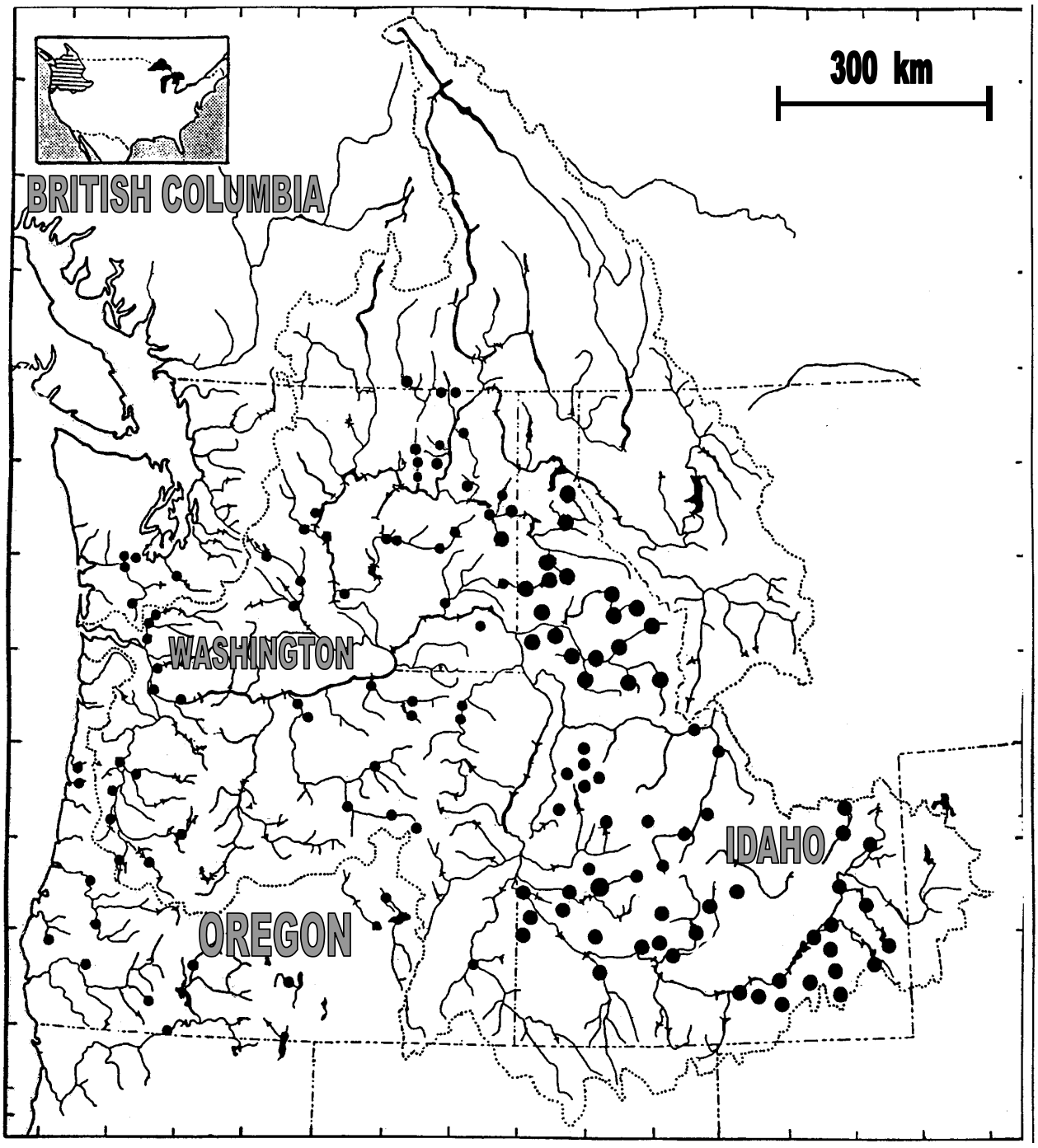

Figure 3. Distribution of *Rhinichthys osculus* in the Columbia River drainages. Dark circles indicate location of collection records. See Figure 4 for locality sites of nearby collections (i.e., the Colville River, Stranger Creek and Hall Creek are the closest known natural populations to the Kettle River populations in Canada)

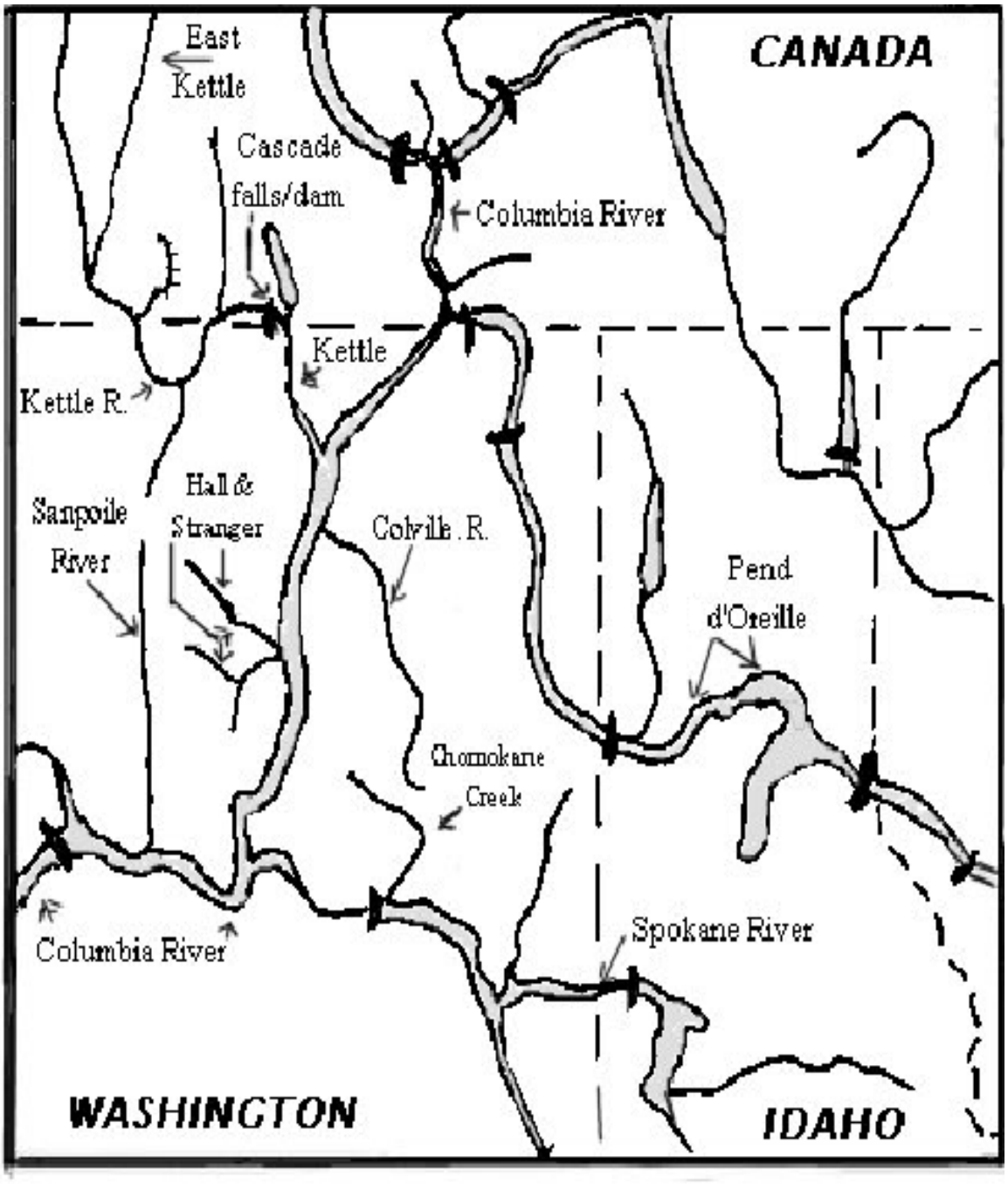

Figure 4. Map illustrates drainages closest in river distance to Kettle River populations of *Rhinichthys osculus*, namely, lowest portion of Colville River, Hall Creek, Stranger Creek, Chamokane Creek, Sanpoile River, and Spokane River system. Note that Little Spokane River is shown between Spokane River and Chamokane Creek. Myers Falls is located at mouth of Colville River, where the population is now extinct due to reservoir flooding and possibly competition from subsequent invasion of *Rhinichthys umatilla*.

Table 2. Brief overview of distribution of lateral line counts, number of scales around caudal peduncle, and presence or absence of barbels in older historical collections of *Rhinichthys osculus*.

		No. Lateral Pores			No. of Scales around Caudal Peduncle			Barbels Present or absent		
*Collection no.	Locality	n	$\bar{X}$	Range	n	$\bar{X}$	range	Both present	Only one on one side	None
	Kettle River, BC	*23	*63.8	*59-69	*23	30.4	*27-33	No	No	23
SU 37780	Warner Ck., Moscow, Idaho	10	63.5	57-68	10	33.0	31-36	10	No	No
SU37790	Paradise Ck, Moscow, Idaho	7	52.3	48-56	7	27.0	24-28	N0	3	4
UBC 64-351	Snake River Canyon, USA	10	53.4	47-58	2	27.5	26-29	5	No	4
UBC 77-2	Middle Fork, John Day R., Oregon	7	58.4	55-62	7	29.0	27-31	3	2	2
UBC 64 –384	John Day R., 7 mi. N of Canyon City, Oregon	10	62.9	56-71	3	31.3	28-35	9	0	1
UBC 64-354	Union Flat Ck., Washington	10	54.9	50-58	10	28.4	26-30	2	0	8
SU 02019	Hangman Ck., at Tekoa, S. of Spokane, Wash.	10	55.9	53-59	10	27.4	26-28	0	0	10
† SU 02279	† Little Spokane R., at Dart's Mill, Wash.	10	58.1	54-60	10	29.3	27-34	1	1	8
† SU 02083	† Colville River, Washington	**8	57.1	54-62	10	26.7	26-27	No	No	8
CAS 57161	Umatilla River , Oregon	3	52.3	51-55	3	25.7	25-26	3	0	0

†Because the purpose of table is comparison with old collections (SU 02279; SU 0208379) where *R. osculus* is now extinct, the small extant number of specimens was not sufficient for statistical comparison with other dace populations. Upriver samples cited in text from above falls on Spokane River not included in data.
*From Peden and Hughes (1988).
**Samples having some specimens whose scales could not be counted adequately.

American populations in the lower Spokane River of Washington differ from Canadian *R. osculus* in their very stubby caudal fins, an extremely robust appearance with 1 to 3% of the populations lacking the pre-maxillary groove. *Rhinichthys osculus* above water falls, dams and Coeur d'Alene Lake of the Spokane drainage, are quite similar in appearance to Canadian populations; albeit, they have barbels and average lower in scale counts.

Electrophoretic Data

Samples of *R. osculus* were tested electrophoreticly for genetic uniqueness from *R. umatilla* and *R. falcatus* (*see* Peden and Orchard 1993ms). Differences in gene frequencies occurred between *R. osculus, R. cataractae, R. falcatus*, and *R. umatilla* (Table 1). Of those tested, *R. cataractae* was most distinct of all species at alleles PG1-3 (mobilities 100 and 110), AGP (mobility l60), ME-l (mobility 300.), and IDH-l,2 (mobility 95). Between *Umatilla, falcatus* and *osculus*, the latter showed less affinity at alleles PGI-l,2 (mobilities -40, -20 and +20) and AGP (mobilities 40 and 160); however, these differences are not conclusive. Mobilities at LGG-1,2 (mobility 66) were not intermediate between *falcatus* and osculus, suggesting *umatilla* is less likely to have a recent hybrid origin. These results need to be compared with unpublished genetic data from Haas (2001, unavailable to the writer at time of writing). In a broader study, McPhail (2002 pers. comm.) used mitochondrial DNA techniques that suggest possible hybridized origins in the Pleistocene. Some headwater populations in Washington and Oregon are genetically *R. osculus*, even though convergent in morphology toward *Rhinichthys cataractae.* Carl, Clemens and Lindsey (1959) as well as Scott and Crossman (1973) speculated that *osculus*-like fish in the Similkameen River may represent hybrids between *R. falcatus* and *R. osculus*. In the field, the writer finds *R. umatilla* and *R. falcatus* occur as distinct species without obvious hybridization. *R. osculus* and *R. umatilla* below Cascade Falls on the Kettle River also occur as distinct species without obvious hybridization.

In conclusion:

- The Kettle River population of *Rhinichthys osculus* is morphologically different to American Speckled dace.
- *Rhinichthys osculus* occurs in sympatry with *R. umatilla* and possibly *R. falcatus* without reproductive isolating mechanisms breaking down.
- Issues of population status may be better revealed after ongoing research at the University of British Columbia becomes published; however, it is unlikely to diminish the context of the evolutionary significance of speckled dace in Canada.

DISTRIBUTION

Global Range

Rhinichthys osculus (speckled dace) occurs as a number of morphologically variable populations in isolated drainages between the Colorado River drainage of Arizona to Columbia River drainages of the Pacific Northwest (Minckley 1973; Scott and Crossman 1973; see Figs. 2 and 3). As many as seven populations are described as subspecies and are recognized by the American Fisheries Society as threatened or endangered (Deacon *et al* 1979; Williams et al. 1989).

Canadian Distribution

Rhinichthys osculus is restricted to a 112 km stretch of the Kettle River (Figures 3-5) between Cascade Falls and American Border to Carmi, BC (Peden and Hughes 1981a,b, 1981ms). Its geographic range in Canada includes both the East and West Kettle rivers and a 27-km section of the Granby River near Grand Forks (Figure. 5). A major section of river possessing *R. osculus* passes through Washington State above Grand Forks with presumably free gene flow upstream and downstream to Canadian populations.

The Kettle River has had a significant post-Pleistocene history, with Cascade falls isolating fish species such as *Cottus cognatus* and *R. osculus* above the falls while populations below the falls are few or absent (See Figure 6, Peden and Hughes 1981a,b, 1981ms and 1988). Haas (1998) reported largescale suckers (*Catostomus macrocheilus*) to be also morphologically distinct above the falls. Species such as *Rhinichthys umatilla*, *Cottus bairdi*, and *C. confusus* apparently arrived later, and were unable to gain access into headwaters of the Kettle River. Similar patterns are paralleled throughout the Columbia basin with *R. umatilla* typically isolated below falls and *R. osculus* above.

HABITAT

Habitat Requirements

Kettle River habitat was described in detail by Peden and Hughes ($1981_{a,b}$) and Peden (1995ms). During summer and fall, the young-of-the-year are normally found in the shallowest, stony edges of rivers (<10-cm depth) where current is reduced. Here, aquatic predators are likely fewer and productivity is enhanced due to quicker solar warming of water in shallows and pools exposed to sunlight and having slower current (Peden measured differences of 2^{o}C or more between the main current and shoreline waters where young dace occurred). Largest concentrations occurred amongst clean cobble, where inter-spaces between stones were of suitable size for dace to retreat. Large dace are infrequently seen except if electroshocked waters ½ to 1½ m deep. In all cases, *R. osculus* occurred in the cleanest riffles having moderated current refuge of stones or rocks and quickly retreated between cobble and stones when disturbed. A thin film of algae occurred in areas where dace were abundant (although thick growths of algae appeared to deter their presence).

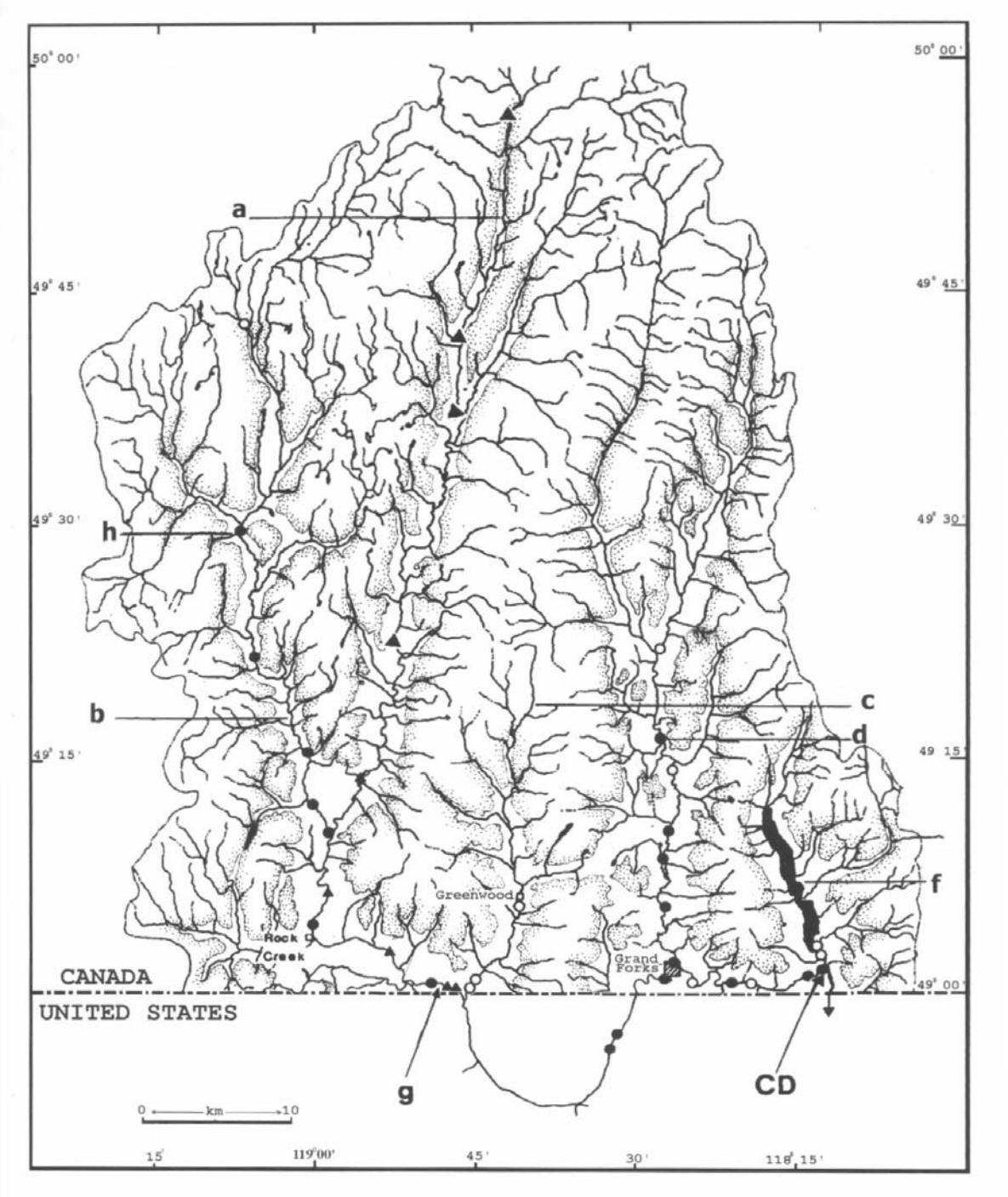

Figure 5. Distribution of *Rhinichthys osculus* in the Kettle River based on collection records: **"a"** indicates East Kettle; "**b**", West Kettle; and **"d"**, Granby rivers. **"CD"** indicates Cascade Dam; **"c"**, Boundary Ck; **"f"**, Christina Lake; **"g"**, Midway and **"h"**, town of Carmi. Solid circles indicate Royal BC Museum samples of *R. osculus*. Solid triangles indicate sites visited by ichthyologists at University of British Columbia or Canadian Museum of Nature (1980s or earlier); sampling at the four northernmost open triangles did not obtain *osculus*, remaining southernmost sites possessed *osculus*. Note: that studies at the University of British Columbia have included additional material from the Kettle River (i.e., Haas 2001), the localities of dace captures not presented on these maps.

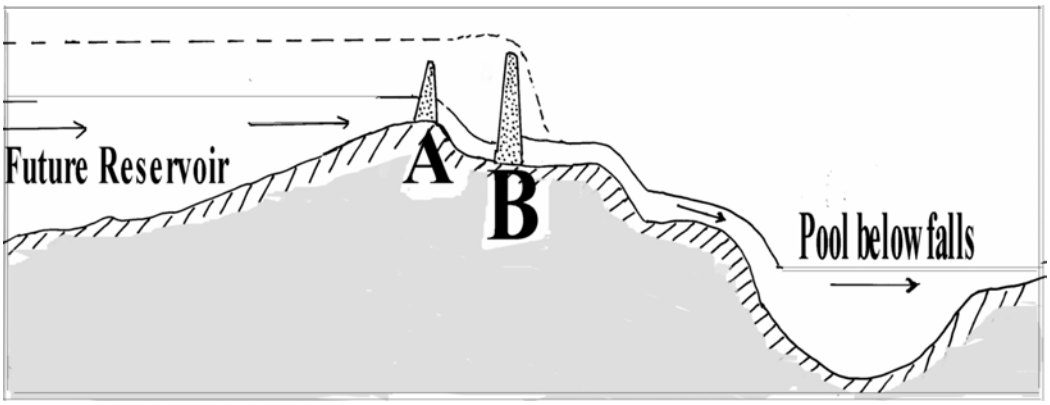

Figure 6. Diagrammatic representation of Water Falls on Kettle River with current flowing west (left) to east (right), en route to Washington state. Assumed water level before damming indicated by solid line at surface. Height of water after damming indicated by dashed line. Old wooden dam built near beginning of 19th Century indicated by "A", that of proposed dam by "B". Fishes such as *Rhinichthys osculus* and *Cottus cognatus* seemingly isolated above falls and dam. Small fishes mostly, such as *R. umatilla*, *C. confusus*, and *C. bairdi* have not immigrated above the falls. Large fish observed in pool below falls, including the alien walleye, (*Stizostedion vitreum*).

Large spring floods of melted snow-water characterize the Kettle River (Peden and Hughes $1981_{a,b}$). Debris caught in trees near Cascade suggested floods reach 6 m higher than water levels during fall (Peden pers. observ.). Only 3% of spring flow occurs during October (Peden 1994). Most of the lower Granby River where bottom habitat consists of sand had only a few sparsely distributed juveniles. In contrast, clean stones with moderate flow occurred in the Kettle River where the density of *R. osculus* was significantly high. Dace under 40 mm SL were assumed to be one to one and a half years old, and more common in smaller sized cobble than adults. Immediately above Cascade Falls where larger adults occur (> 40 mm), interspaces between rocks of 30 or 40 cm diameter provided shelter in moderate to swift current. Brownish algae darkened these rocks and strong current obviously sweeps away particles of sand and detritus in the areas dace inhabit. The fact that *Rhinichthys osculus* hides under such rocks may be the reason why Triton Consultants using snorkel and diving gear did not see many dace as did Peden using electroshockers (Table 2). Dace likely occurred deeper because swift current provided insecure footing for electroshocking by field crew, and dace in water deeper than four feet could not be easily sampled. In 1990-91, Peden noted dried and encrusted algal mats high on riverbanks suggesting significant productivity earlier in the year. Such accumulations are swept away again during spring floods in the following year.

As expected with rivers arising from mountainous snow melting, gradual warming of water occurs as it flows to lower elevation. *Rhinichthys osculus* were found at high elevation (Carmi at 884 m) where average summer water temperatures reach 14^{o} C (Fig. 7). Downstream at the American Border (Laurier, elevation 457 m), temperatures reached 18^{o}C (Peden and Hughes $1981_{a,b}$) however there is considerable year to year variation. Water is very clear for most of the year. Total dissolved solids indicated alkalinity increases (60 to 77.5 mg/L) and pH decreases (8.7 to 7.7) as water flows downstream toward the American border.

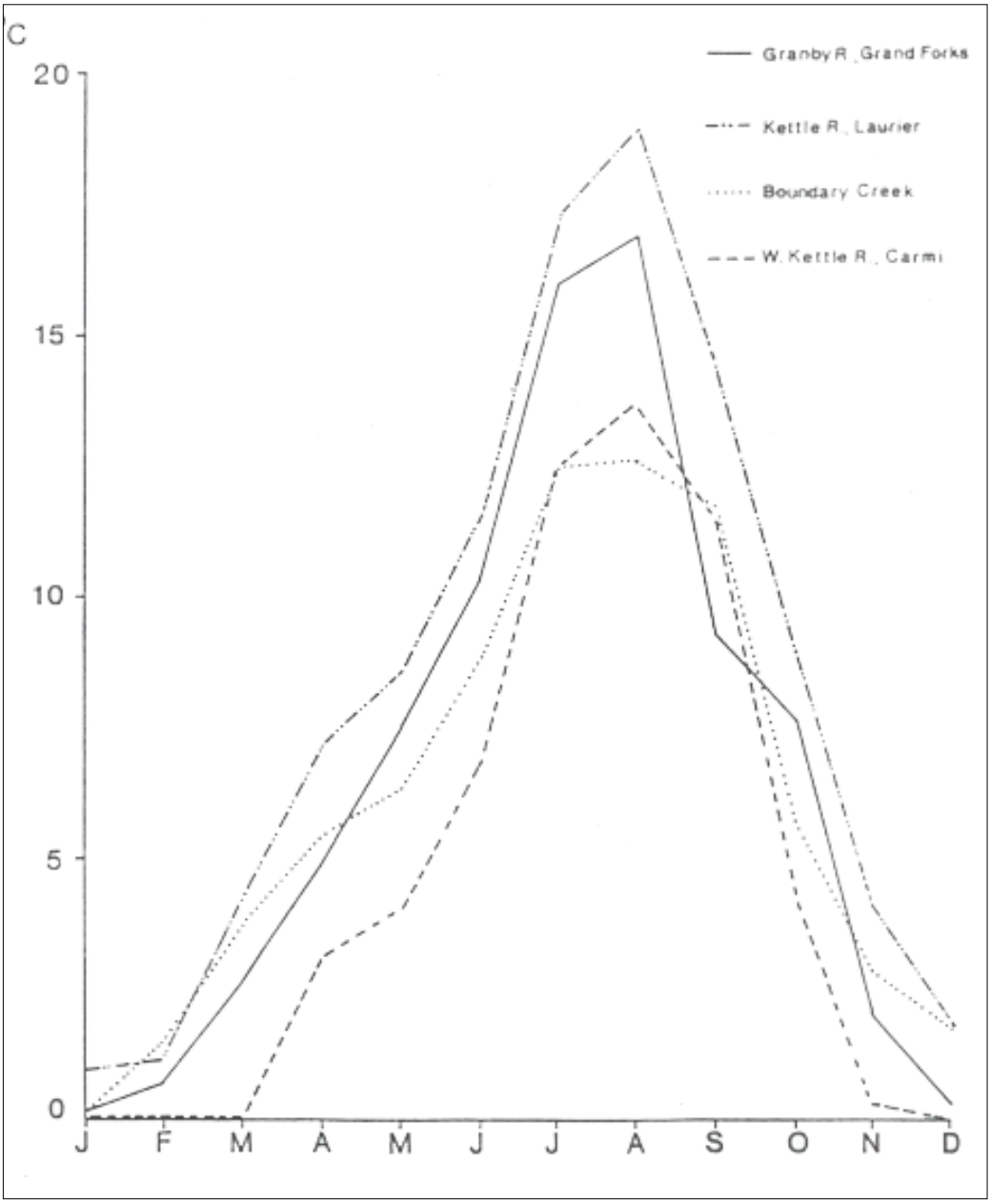

Figure 7. Annual variation of surface water temperature at four locations in the Kettle River System: (Granby River at Grand Forks; Kettle River Laurier, -U.S.A.; Boundary Creek at Greenwood; - West Kettle River at Carmi). Source: Inland Waters Directorate (1976).

Trends

Although water quality has been monitored over the years (Water Investigations Branch 1977), there are no long term studies on *R. osculus* in the Kettle River, and consistency of dace habitat quality can only be assumed. The B.C. government has proposed to build a power dam on the Kettle River at Cascade Falls (Figure 4). Construction was planned to begin in 2000, but has been delayed by the necessary

environmental impact assessment process. Presently, International Resource Consultants is monitoring fish populations as part of pre-impact studies for the Cascade Power Park Project. Their results will probably be available sometime in 2002. Previously, fish abundance was low in the area of the lumber mill at Midway where there may have been a correlation with effluents from a lumber mill and immediately downstream from the sewage plant at Grand Forks (Peden and Hughes l98l). Sections of the river near Gilpin were very clear and seemingly devoid of small fish in the 1980s. Reduction of suitable riverine habitat will likely occur after the Cascade Heritage Power Park is completed, its construction duplicating and perhaps exceeding the impacts of the historic wooden dam built during the early part of the 20th century. Logging, agriculture and coal mining have occurred over a long period of time, the latter having a long history near Grand Forks and likely affecting fish populations.

Habitat Protection/Ownership

Rhinichthys osculus habitat is not protected by any means other than existing Provincial and Federal regulations on pollution and maintenance of water quality, provisions of respective fisheries acts designation. Presently, the Kettle River has been given a status by the British Columbia government as a Heritage River, hopefully to slow down development and the rate of environmental degradation (See BC Heritage River System, Web Page, Jan. 6, 2001).

Broadening of mandates and strategic plans of BC Fisheries in 1991 accepted responsibility for all fish populations with consequent inclusion in all management plans of watersheds (See BC Fish Protection Act., Web Page, May 2, 2001). There are no formal measures specifically administrated or legislated to protect *R. osculus*, although the Fisheries Branch of the Province of British Columbia acknowledged responsibility for the management of rare indigenous fish species in its strategic plans (BC Environment, 1991) and by present monitoring by the BC Conservation Data Centre. In British Columbia, elimination of the Forest Renewal and downsizing of other environmental programs could affect protection of Kettle River habitats.

GENERAL BIOLOGY

Speckled dace spawn in their second year and probably live only a few years after that; however, the age data for Canadian populations are not available. Females possess between 450 and 2000 ova. They may breed in July with young fish appearing in shallows along the river's edge during August and September. Speckled dace feed on aquatic insects and apparently consume algae along with the invertebrates ingested. They occur near the river bottom having rocky or stony areas accompanied by riffles and moderate current. When disturbed they retreat into inter-spaces between rocks for shelter. Movements of Canadian populations are poorly studied. Peden and Hughes (1981) provided further biological information on speckled dace.

Reproduction

Peden and Hughes (1981$_{a,b}$, 1981ms) found length frequencies of fall-caught specimens were larger than those found in spring (Figure 8). A study of egg sizes (Figure 9) indicates that *R. osculus* do not mature until they are 40, if not 50 mm, in SL. Their data also suggested spawning in July or later similar to American populations (Carlander 1969). Breeding in some U.S. populations is bimodal with peaks in early spring and late summer (LaRivers 1994). Juveniles hatched in summer probably do not breed until they are 2 years of age; however, adequate aging studies have not been done on Kettle River populations. LaRivers (1994) indicated that females in Nevada become sexually mature at 2 years. Judging by prevalence of young fish, reproductive potential is high and *R. osculus* appeared to have more than adequate reproductive potential to repopulate the Kettle River (Peden and Hughes, 1981$_{a,,b}$, 1981ms). Similar annual monitoring of yearling dace was advocated by Peden and Orchard (1993ms) for *R. umatilla* as an efficient and probably cost-effective way to monitor dace population size and reproductive health. Triton Environmental Consultants (Vancouver, BC) undertook surveys reported elsewhere in this report. International Resource Consultants (=IRC) undertook the most recent pre-impact surveys for the Cascade Heritage Power Park project and particularly monitored sensitive species such as speckled dace. Their recent findings will not be available until sometime during 2002. Numbers of large eggs in ovaries of fall-caught speckled dace ranged from about 450 in small fish to 2000 in large fish (Figure 10). Fish caught in July had fewer eggs suggesting either a prolonged spawning period or some ova may have been resorbed. Peden and Hughes (1981$_{a, b}$, 1981ms) found many fewer males than females (Figure. 11), but whether this results from different habitat preferences by males is not known.

Movements

Major species movements or migrations of *R. osculus* are not documented although Minckley (1973) refers to the ability of speckled dace to re-invade isolated refuges within Arizona rivers after devastating floods. Such distant populations are undoubtedly from a divergent genetic pool and may be less relevant to British Columbia. In the Kettle River, young of the year are often observed amongst stones in spring and summer as they scurry along the river's edges when disturbed (see Peden and Orchard, 1993ms). However, they are inconspicuous in cooler weather when their metabolic activity is undoubtedly reduced. Significant size differences in dace caught by Triton Environmental Consultants (1994ms) compared to those taken by Peden and Hughes (1981) is likely due to the differing habitat having larger cobble or rocks with stronger current and inter-spaces between rocks sheltering larger fish. Existing waterfalls and the proposed dams at Cascade impede upstream migration of dace. Construction of the new dam could reduce suitable habitat upstream and the number of dace spilling over the falls.

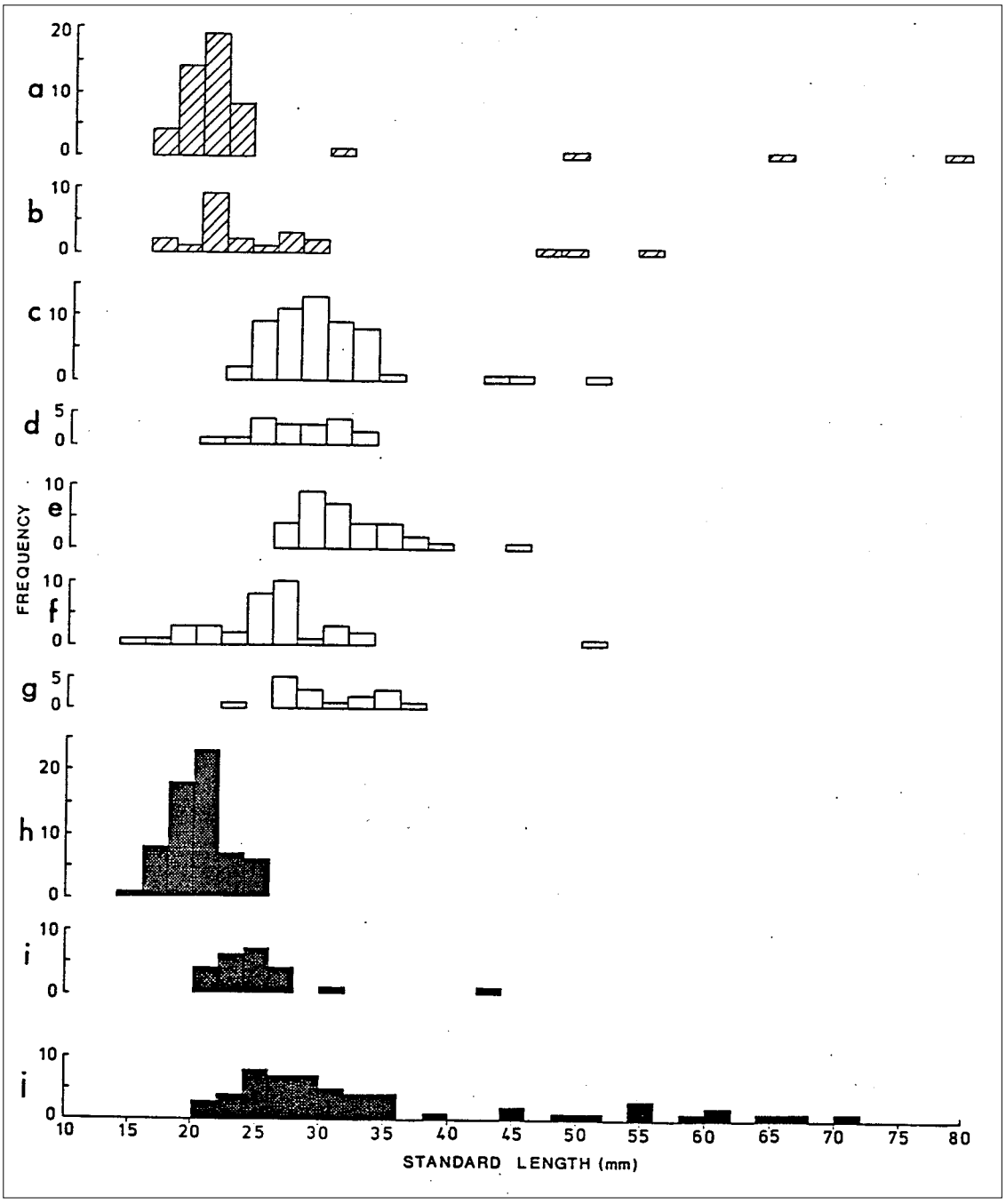

Figure 8. Variation in length frequencies of *Rhinichthys osculus* in the Kettle River during October 1977. Collections from nearby locations pooled into one sample if their mean standard lengths were determined to be not significantly different by Newman-Keuls (Zar 1874) test. "a" = West Kettle River upstream; "b" = West Kettle River downstream "c" = Kettle River at Rock Creek; "d" Kettle River at Grand Forks; "e" = Kettle River at Gilpin; "f" = isolated pool of Kettle River at Gilpin; "g" = Kettle River at Cascade (below Cascade Falls; "h" Granby River upstream; "i" Granby River downstream; "j" = Granby River at Grand Forks. Fish under 40 mm SL assumed to be first age class.

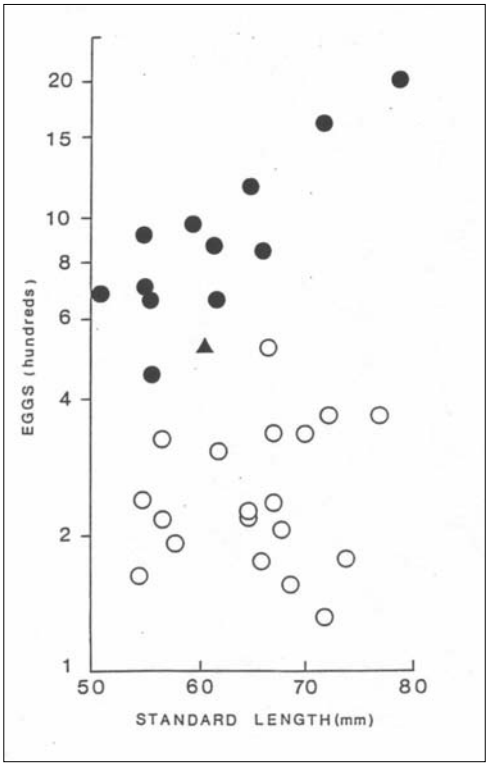

Figure 9. Number of eggs in female *Rhinichthys osculus* of different lengths. Solid circles, eggs collected October 1977. Solid triangle, June 1977. Hollow circles, July 1977.

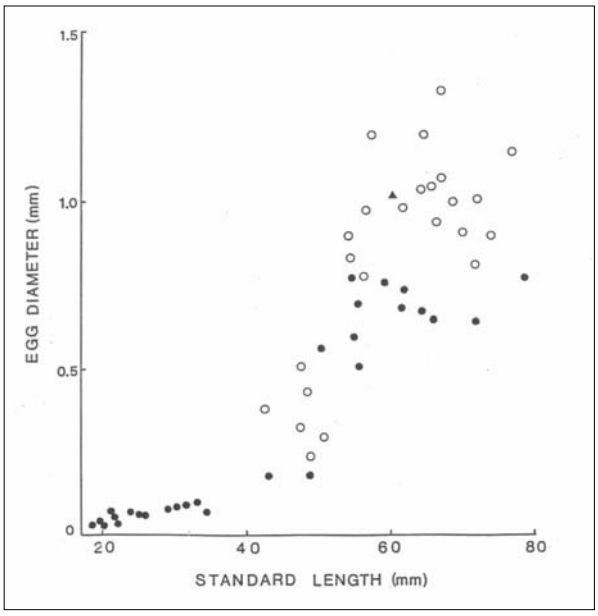

Figure 10. Egg diameter of *Rhinichthys osculus*. Each data point represents the average size of 10 largest eggs per specimen. Solid circles indicate fish collected October 1977; Solid triangle, collected June 1977; hollow circles, July 1977.

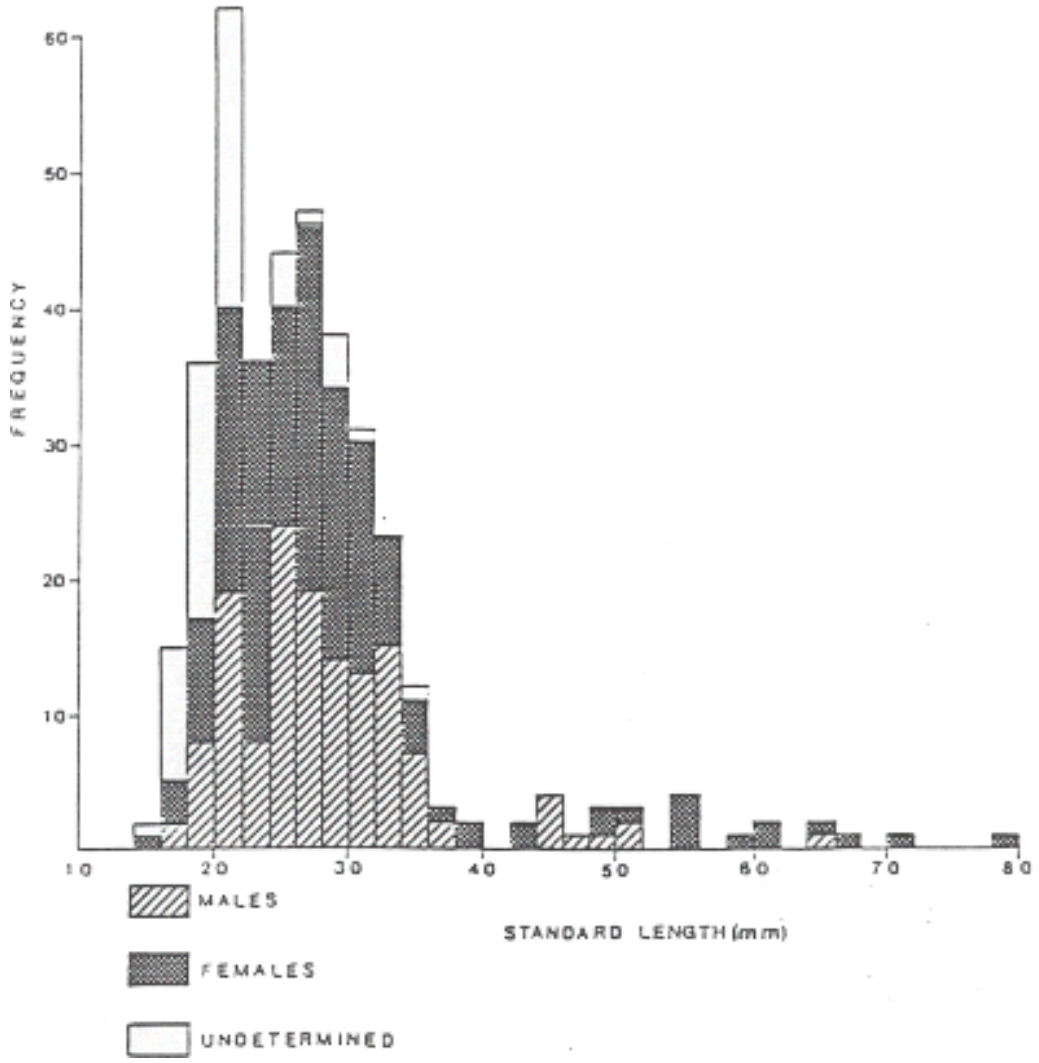

Figure 11. Standard lengths of *Rhinichthys osculus* collected October 1977.

Nutrition and Interspecific Interactions

Larger dace feed near the bottom, taking mostly aquatic insects, although they also consume a considerable amount of filamentous green algae, the latter perhaps inadvertently as they grab insect larvae. See Peden (1981_a, 1981_b, 1981_c). Their intestine is not long and coiled as is typical of herbivores.

Sculpins (Cottidae) and juvenile suckers (Catostomidae) commonly occur with, and most likely compete with *R. osculus* for some food resources. Juveniles of *Richardsonius balteatus* and *Ptychocheilus oregonensis* under 1 or 2 cm occur with schools of dace and potentially compete in shallow habitats (less than 10 cm), although their morphology and feeding habits may differ, reducing potential competition with *R. osculus*. Larger fish have more specialized mouth structure adapted to different niches and feeding behaviour within

the water column. With no other dace species above Cascade Falls, species competition with *R. osculus* is less severe as it would be below Cascade Falls. Total numbers of fishes captured with speckled dace (collected by Peden and Hughes) include: *395 R. osculus*; 403 *Richardsonius balteatus* (redside shiner); 119 juvenile *Catostomus macrocheilus* (largescale sucker); 80 juvenile *Ptychocheilus oregonensis* (pike minnow); 74 *Cottus cognatus* (slimy sculpin); 55 juvenile *Catostomus columbianus* (bridgelip sucker); 30 juvenile *Acrocheilus alutaceus* (chiselmouth); 20 juvenile *Catostomus catostomus* (longnose sucker); 8 juvenile *Oncorhynchus mykiss* (rainbow trout); 4 juvenile *Salvelinus fontinalis* (brook trout); 3 juvenile *Prosopium williamsoni* (mountain whitefish) and 2 *Cottus bairdi* (including some species co-occurring only in samples of speckled dace below the falls).

Below Cascade Falls, the overwhelming competitor for *R. osculus* may be *R. umatilla* which seem to effectively replace *osculus* down-river (Hughes and Peden 1989; Peden and Hughes 1981ms, a, b, 1988).

Although terrestrial and aquatic predators occur in the area, larger speckled dace habitually hide or retreat under rocks where they are protected. Severe spring flooding may be a major factor of mortality for juveniles before they find suitable shelter. Younger stages of dace actively move along inshore stream edges, and are visible to terrestrial predators and easily caught.

Behaviour/Adaptability

The ability of speckled dace to recover from human-caused disturbances is not fully known for Canadian populations. Comparison of cooler headwater habitat in Canada with that of American populations is speculative because of the wide diversity of American populations and habitat, and corresponding evolutionary adaptations to different headwater habitats, some dace even adapting to warm desert springs. The previous construction and destruction of the old wooden dam above Cascade Falls in the early 1900s and the present occurrence of large dace in the previously flooded area suggests *R. osculus* responds to local disturbances; however, the time needed for full population recovery is unknown. Any alteration of water clarity or silting over rock and riffles can be expected to be detrimental.

POPULATION SIZES AND TRENDS

Since this report's first draft (1994) new surveys of fish populations by consultants were mandated by provincial legislation until 2001 at least. Such data have yet to be made fully available to assess population trends. A September 2000 quarterly summary report (Cascade Heritage Power Park Project Quarterly Summary Report, September 2000: Table 8), does indicate that low numbers of speckled dace were found (by electrofishing) in the Kettle River, in the vicinity of the Dam site, from June to August 2000, juveniles being more prevalent in the August collections.

Table 3. Species composition, density and standing stock in Reach 3, Kettle River, September 1993: Electrofishing data (courtesy Triton Environmental Consultants).

	Speckled Dace	Northern Squawfish	Slimy Sculpin	Chiselmouth	Largescale Sucker	Rainbow Trout	Redside Shiner	Mountain Whitefish	Total
Standing Stock (g/m^2)	0.126	0.173	0.118	0.015	0.020	1.131	0.62	0.000	0.644
Density ($\#/m^2$)	0.047	0.039	0.062	0.002	0.053	0.023	**0.406**	0.00	0.633
# Total Standing Stock	20%	27%	18%	2%	3%	20%	10%	0%	100%
# Total Density	7%	6%	10%	0%	6%	4%	**64%**	0%	100%

Table 4. Species composition, density and standing stock, Reach 3, Kettle River, September 1993: Snorkeling data (courtesy of Triton Environmental Consultants).

	Speckled Dace	Northern Squawfish	Slimy Sculpin	Chiselmouth	Largescale Sucker	Rainbow Trout	Redside Shiner	Mountain Whitefish	Total
Standing Stock (g/m^2)	0.000	0.041	0.000	0.000	2.840	0.218	0.004	2.0148	5.252
Density	0.000	0.000	0.000	0.000	0.005	0.001	0.006	0.015	0.027
%Total Standing Stock	1%	1%	0%	0%	54%	4%	0%	41%	100%
% Total Density	0%	0%	1%	0%	19%	4%	22%	55%	100%

Table 5. Standing stock and density of fish and habitat in back watered and control sites in Reach 3 of Kettle River, September 1993: Electrofishing data (Courtesy of Triton Environmental Consultants).

		Speckled Dace	Northern Squawfish	Slimy Sculpin	Chiselmouth	Largescale Sucker	Rainbow Trout	Redside Shiner	Mountain Whitefish	Total
Standing Stock (g/m^2)	Backwater	0.077	0.284	0.127	0.030	0.005	0.088	0.056	0.000	0.667
	Control	0.175	0.062	0.108	0.000	0.035	0.173	0.068	0.000	0.621
Density ($\#/m^2$)	Backwater	0.029	0.025	0.060	0.000	0.006	0.012	0.295	0.000	0.431
	Control	0.065	0.054	0.065	0.000	0.099	0.035	0.517	0.000	0.835

Table 6. Standing stock and density of fish and habitat in back watered and control sites in Reach 3 of Kettle River, September 1993: Snorkeling data. (Courtesy of Triton Environmental Consultants).

		Speckled Dace	Northern Squawfish	Slimy Sculpin	Chiselmouth	Largescale Sucker	Rainbow Trout	Redside Shiner	Mountain Whitefish	Total
Standing Stock (g/m^2)	Backwater	0.077	0.284	0.127	0.030	0.005	0.088	0.056	0.000	0.667
	Control	0.175	0.062	0.108	0.000	0.035	0.173	0.068	0.000	0.621
Density ($\#/m^2$)	Backwater	0.029	0.025	0.060	0.000	0.006	0.012	0.295	0.000	0.431
	Control	0.065	0.054	0.065	0.000	0.099	0.035	0.517	0.000	0.835

Table 7. Habitat in backwater and control sites in Reach 3 of Kettle River in September 1993 (Courtesy of Triton Environmental Consultants).

	Distance up from US border	Reach length	Depth of Sculpins	Velocity	Site Length	Site Width	Site area	Cover %
BACKWATER	5.8 to 8.4	2700 m	0.40	0.27 m/s	3.4 m	3.4 m	80.0 m^2	56 %
CONTROL	8.4 to 17.1	8670 m	0.42	0.25 m/s	4.6 m	4.5 m	104.1 m^2	21 %

Below = particle sizes used in classification of British Columbia Ministry of Environment.

	Fines	Small Gravel	Large Gravel	Small cobble	Large cobble	Boulder	Bedrock	D90
BACKWATER	13%	03%	06%	17%	32%	31%	0%	0.78m

During September and October, Peden and Hughes (1981a,b, 1981ms) found *R. osculus* widely distributed between Carmi and Cascade, BC with juveniles far outnumbering adults throughout the river. Peden (1995ms) found the largest numbers of adults in boulder habitat immediately above Cascade Falls where access roads were extended to the proposed Ponderosa Estate development. Triton Environmental Consultants later observed greater numbers of large adults (Figure 12). Peden and Hughes (1981a,b, 1981ms) concluded that a high mortality of juveniles probably occurs during spring floods and when smaller dace are entrapped in shallow pools that dry up after waters recede in summer. Earlier surveys in 1978, 1979, and 1980 indicated dace populations to be stable (Peden and Hughes 1981a,b).

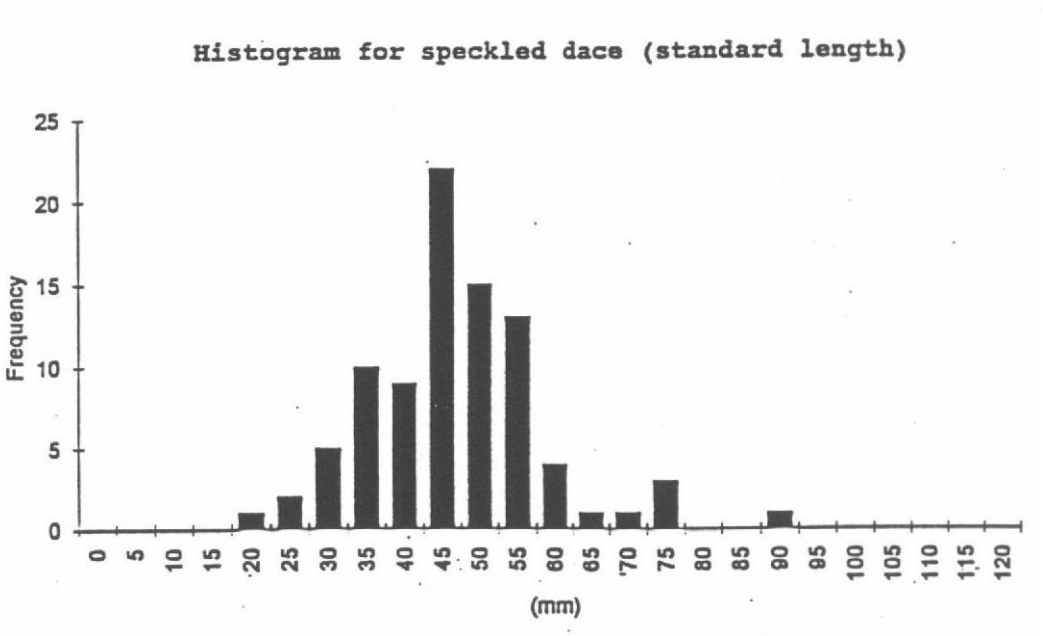

Figure 12. Standard lengths of *Rhinichthys osculus*. Copied from Triton Environmental Consultants 1994ms).

Peden subjectively estimated dace population size utilizing Royal BC Museum sampling records. These estimates utilized assumptions of distances that we covered with an electroshocker and the number of dace caught. These numbers were then projected throughout the Kettle River up to Cawston, while taking account of the area around Midway and the slough-like portion of the Kettle near Grandforks, where we had trouble finding dace. Our most meaningful estimates are summer and early fall collections when water levels were very low and we more easily sample a greater proportion of the river habitat. We usually entered distances of shoreline sampled into field records and had to extrapolate those numbers to those sections of the river that we did not sample. We swept the electroshocker back and forth from one-meter depths to shoreline rubble having only a few centimeters of water depth. In dry summers, the depths in the center of the Kettle River were as little as 20 cm. The proportion between young of the year fish (200,000) vs. maturing fish (20,000), and mature fish (2000) represents an approximate proportion of each size group in our sampling. We

electroshocked under the assumption from earlier literature that speckled dace occur in less than 1 m depths along shorelines. Later, we sampled directly above Cascade falls and retrieved dace to at least 1.6 m depths. I suspect large dace could have been found deeper but the strong current prevented sampling. In the long run, the population numbers are probably realistic, but having wide margins of possible error. The estimates require more refinement. In order to err on the side of caution, one could lower these values by half.

This rough sampling is extensive enough to provide some insight into year-to-year variation, which I suspect is quite large, depending on the degree of seasonal spring flooding and where fry disperse downstream. For example, river depths over riffles in the lowest sections of the river vary between 15 cm to one meter depths in summer and three to 5+ meter depths during spring flood, with water depths obviously shallower upstream. Until there is a direct effort to quantitatively sample dace in the Kettle River rather than estimate them as side products of stream surveys for economic species, population numbers of dace will be suspect.

Surveys (electrochocker) of dace populations along a 14.5 km stretch of river above Cascade Falls indicated that *Richardsonius balteatus* ranked highest in numbers/m (.406), whereas that species was lowest in standing stock (0.062 g/m^2 —see Table 3). *Rhinichthys osculus*, *Ptychocheilus oregonensis, Cottus cognatus* and *Oncorhynchus mykiss* ranged between 0.023 to 0.062 in number/m^2 and 0.118 to 0.173 g/m^2 (J. Pavey, Triton Environmental Consultants, Vancouver, British Columbia; personal communication).

In other parts of its geographic range such as Arizona, *R. osculus* is subjected to and apparently adapted to irregular severe flooding. Population sizes undergo drastic changes during such catastrophes (Minckley 1973). The Kettle River is similarly known to undergo severe flooding in spring (Figure 13) with young dispersing into the shallowest cobble and often isolated in pools that dry up (Peden and Hughes 1981a,b, 1981s).

LIMITING FACTORS AND THREATS

There is no standard baseline of data over a long period to document habitat loss specifically relevant to speckled dace. In 1991, Peden found a very large Canadian population of adult speckled dace immediately above Cascade Falls, much larger than that cited by Peden and Hughes ($1981_{a,b}$, 1981ms). The later reports were the basis on which COSEWIC designated *R. osculus* to be rare (Campbell 1990). Subsequently, the "Heritage Power Park Project" was proposed by "Powerhouse Development Ltd." to flood 2.5 km along the same stretch of river (BC Envir. Assess. Office 2000). Interim pre-impact assessment by Triton Environmental Consultants (1994ms) indicated adult *R osculus* are abundant in 11.4 km of suitable habitat in the same area above Cascade Falls, 2.7 km of which will be flooded by the proposed dam and associated reservoir (Pavey, personal Communication, 1993). The proposed area of flooding duplicates that

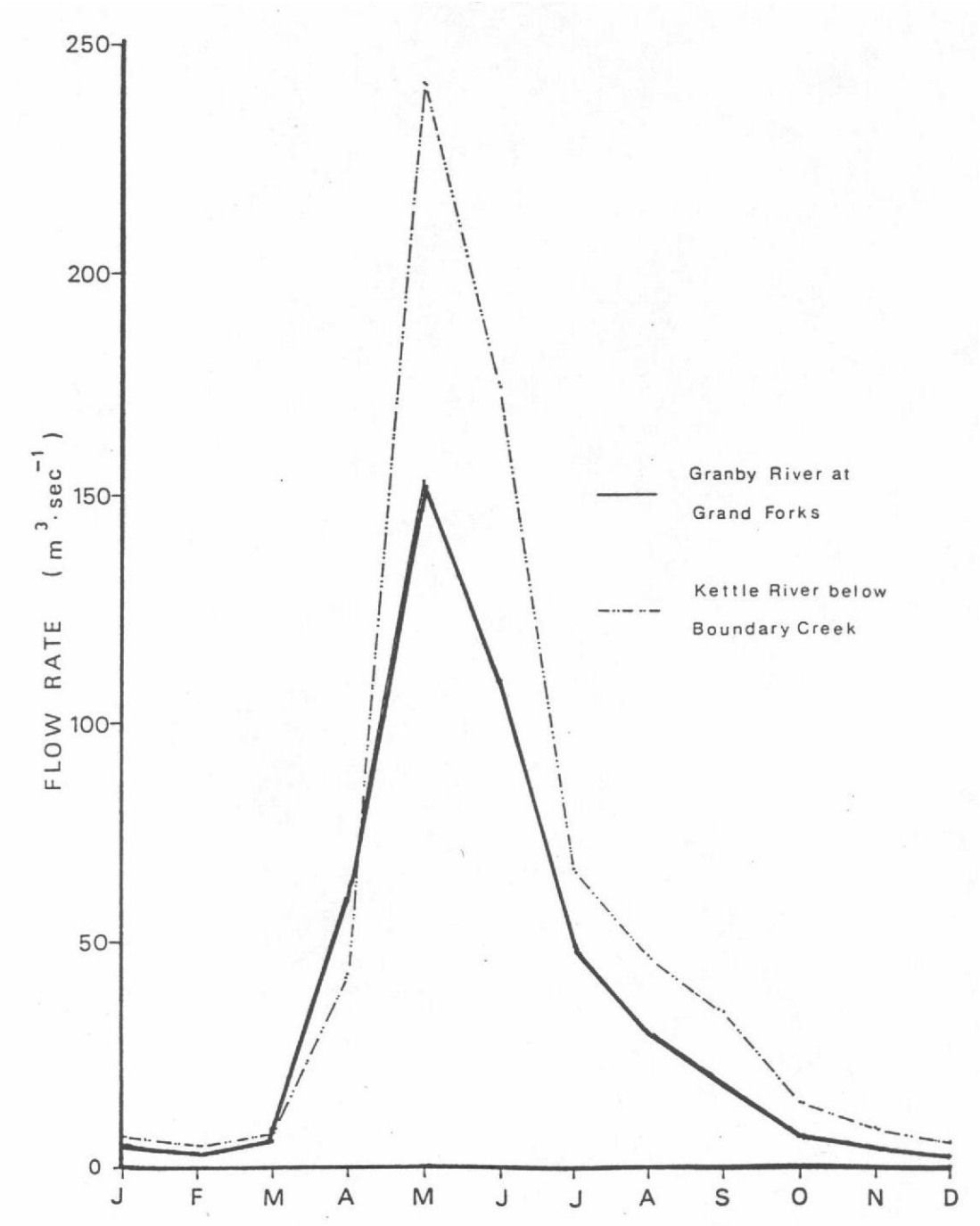

Figure 13. Variation in river flow based on average monthly rate in 1976 at two locations (Granby River at Grand Forks; Kettle River south of confluence with Boundary Creek) Source: Inland Waters Directorate (1976).

caused by an old wooden dam and impoundment destroyed by floods in the earlier 20th century. Previously Peden and Hughes (1981ms, 1988) found only small numbers of *R. osculus* in the Kettle River below Cascade Falls and presumed these fish originated from populations above the falls, with individuals forming at least temporary populations

in the lower portions of the river. If the proposed reservoir displaces riverine habitat immediately above the falls, the numbers of dace spilling over the falls will probably be reduced and the population below Cascade Falls may possibly be no longer sustainable.

The presence of very larger numbers of *Rhinichthys umatilla* downstream in the American portion of the river probably impedes abundance of *R. osculus* through competitive exclusion (Hughes and Peden 1989; Peden and Hughes 1981ms, a, b, 1988). In the long run, populations below Cascade Falls provide academic curiosity and interest relative to reproductive isolation and/or ecological exclusion between *R. osculus* and *R. umatilla*. However, this population seems incidental when compared to the conservation value of the significant populations above Cascade Falls, especially if immigrants spilling over the dam are required to sustain the population.

This area is home to some 24 species of fish, six or seven of which are threatened, have restricted habitat provides habitat. The proposal to build a new dam above Cascade will reduce the speckled dace critical habitat and locally concentrated the population. The project could result in the loss of as much as 22% of the existing Canadian habitat. Construction of the new Cascade dam would affect more than 85% of downstream habitat where other vulnerable species also occur [i.e., *R. umatilla* and *Cottus confusus, see* Peden (1991)]. The impacts of the proposal to upstream and downstream fishes have been identified as a major concern by provincial, federal and US agencies taking part in the environmental impact assessment (see for example BC Ministry Review Comments, August 1999*;* DFO Comments, August 6, 1999; and U.S. Lands Council Comments) and may have grave consequences for downstream species through the increase of water temperature and decreased flow (only 1 cms will go over the falls).

Peden and Hughes (1981a,b) noticed an absence of dace immediately below Grand Forks, suggesting adverse effects from a local sewage treatment plant. Few dace were found in the area of the lumber mill at Midway, although it is unknown if the area ever supported speckled dace. The section of the Kettle River that bends across the American border between Midway and Grand Forks could represent potential source for pollution from Washington State; however, previous abundance of dace in this section of river indicated no problem at this time. Logging road construction and agriculture could also cause silting and/or chemical contamination.

Haas (1998) lists threats such as forestry harvesting; habitat alterations/loss; exotic and other fish species introductions; urbanization; agricultural and industrial pollution; hydroelectric development; and taxonomic misidentifications. Unfortunately the population occurs largely within a single river drainage and basin without significant alternative refuges for this unique Canadian fish species. Any major catastrophic event upstream that affects water and habitat as river-water sweeps downstream could threaten most of the unique Canadian population.

SPECIAL SIGNIFICANCE

Previously, speckled dace have been rated by COSEWIC as Vulnerable, Global rank G5, British Columbia provincial rank S1S2 and Red.

Data demonstrating morphological and genetic differences between Canadian and American *Rhinichthys osculus* have yet to be confirmed; however, high scale counts and lack of barbels suggest the Canadian population is unique (Table 2). Genetic differences shown here differentiate *R. osculus* from *R. falcatus*, *R. umatilla* and *R. cataractae*. At least seven races of this polymorphic species are considered endangered or threatened (Deacon *et al.* 1979; Williams *et al* 1989) and include: *R. o. lethoporus* (Independence Valley speckled dace), *R. o. nevadensis* (Ash Meadows speckled dace), *R. o. oligoporus* (Clover Valley speckled dace), *R. o. thermalis* (Kendall Warm Springs dace), and *R. o. moapae* (Moapa speckled dace). Canadian *R. osculus* appear to be similarly significant and need recognition for conservation purposes.

Bond (1973) differentiated *R. osculus* from "*umatilla*" as subspecies in Oregon. Peden and Hughes (1988) provided ample evidence suggesting sympatry between populations. Compared with *R. osculus, R. umatilla* is more likely to be confused with *R. falcatus,* the latter two species also distinctive common in some drainages of British Columbia.

EXISTING PROTECTION OR OTHER STATUS

The British Columbia Conservation Data Center classification (Cannings 1993) noted a global rank of G5 = common; provincial rank of S1-S2 = Critically imperiled). Regulations affecting threatened species were sanctioned through BC Fisheries Renewal, Forest Renewal and Resource Inventory Committees and included monitoring and managing of all British Columbia's freshwater fishes. Retention or modification of these regulations awaiting review by the current provincial government, with agencies such as Forest Renewal eliminated, with their functions and regulations likely under review.

In Canada, *Rhinichthys osculus* populations are known only from the Kettle River watershed. With the exception of a small population within the town of Grand Forks, most records of *R. osculus* from the Granby River represent juveniles from atypical habitats of sand rather than rocks and cobble required of mature speckled dace. The Granby River may therefore, be important to younger fish as it flows down stream to the Kettle River. Without alternative rivers and streams providing insurance against the demise of uniquely Canadian *R. osculus,* its status is *"of special concern."* There are no alternative populations acting as insurance to replace the existing genome if there is a catastrophic event. If a single catastrophic event occurred upriver, it could have long term consequences for all downstream populations and reinforces the need for its "*special concern"*. Long term monitoring of the Kettle River population is recommended

within mandates and strategic plans of former BC Fisheries Renewal and Ministry of Environment (presently renamed Ministry of Sustainable Resource Development in 2001).

The proposed Cascade Heritage Power Park and dam will destroy the biggest concentration of larger speckled dace in Canada, affecting a relatively small section of the Kettle River. The effect of losing such large gene pool needs further attention (See: BC Environ. Assess. Office, Web Page 2000). Consequences of a pipeline crossing for BC Gas needs continued vigilance by BC Environmental Assessment Board. Monitoring of predatory and prey species affecting dace is required for species historically blocked by Cascade Falls and which might interact with speckled dace if they gained access above the falls. Because Peden, Triton and International Resource Consultants used different methods of monitoring dace populations, techniques of monitoring must be standardized for all species hiding under stones and in the deeper and swifter parts of the Kettle River. In view of low abundance of speckled dace below Cascade Falls, recruitment may be supplemented by dace spilling over the falls and are thus not of immediate concern to the population. Every effort must be made to prevent introductions of fish populations not indigenous above Cascade Falls.

SUMMARY OF STATUS REPORT

The status of *Rhinichthys osculus* is now more precarious than when first designated as “special concern” in 1980. The species is not only restricted to a single river basin where it is vulnerable to any single catastrophic event, but also is now threatened by the potential loss of more than 22% of the existing habitat if the proposed dam at Cascade Falls is completed.

In this report, morphological and meristic data demonstrate *R. osculus* (Figure 1) is differentiated from nearby American populations [i.e., barbels absent, fin (Peden and Hughes 1988) and scale counts higher]. Dr. J. D. McPhail (personal communication) suggested unpublished data for Kettle R. tributaries indicate allele convergence toward *R. Umatilla*; however, such data probably reflect past hybrid origins of *R. umatilla* between *R. osculus* and *R. falcatus* during the Pleistocene. *R. osculus* is an evolutionary significant unit “ESU”, with sympatry implying biological speciation.

Although widely distributed in seven western American states, Canadian populations are restricted to just a 70 mile (112 km-) section of the Kettle and Granby Rivers which is an upstream tributary of the Kettle River. This is of concern” because any catastrophe upriver could affect downstream populations. A dam proposed for construction will flood 2.5km of habitat above Cascade Falls (site of large population of adult *R. osculus*), over 22% of the existing habitat. Additional habitat occurs up-stream; however, population densities are lower than immediately above Cascade Falls.

The nearest downstream populations below the Kettle are 80 km down river in the United States where they are effectively isolated from Canadian populations. Most of those in the Kettle are isolated above Cascade Falls, with a few spilling over the falls

into pools and riffles below. Cascade Falls serves as a barrier isolating Canadian populations from American fish populations. If Canadian *R. osculus* are to survive in their present form and genetic heritage, introductions of non-indigenous species (especially other *Rhinichthys* sp.) must be prevented.

TECHNICAL SUMMARY

Rhinichthys osculus
Speckled Dace Naseux Moucheté

Range of Occurrence in Canada: British Columbia

DISTRIBUTION
Extent of occurrence:
1.12 km^2 ($\approx$ 112 linear km with average width of 10m, there is an additional 40 km of habitat in the US continuous with Canadian habitats)
Area of occupancy:
0.02 - 0.05 km^2(= juveniles and adults, assume fry more generally distributed).
Occurrence and occupancy are based on summer conditions, the area of habitat increases 3 – 400% during the spring flood.
Habitat Trend: declining
POPULATION INFORMATION (estimates without quantitative population survey):

Total number of individuals in Canadian population:	10,000 – 20,000, excluding young-of-the-year
Number of mature individuals (capable of reproduction) in the Canadian population):	2000+ (?)
Generation time:	2 or 3 years
Population trend :	Declining
Rate of population decline:	Estimated. to be at least 10%/yr
Number of sub-populations:	0
Is the effective Canadian population fragmented?	No
number of extant sites	21+ known sites at 3 localities
number of historic sites from which species has been extirpated:	1 (most productive site above Cascade Falls area flooded then restored, now facing new reservoir construction
Does the species undergo fluctuations?	Unknown

THREATS
Any event upriver affecting downstream habitat (i.e. pipeline crossing). Reservoir construction affects largest population above Cascade Falls. Urban and industrial development is also contributing to loss of habitat and deterioration of habitat quality.

RESCUE POTENTIAL

Does species exist outside Canada?	Yes
Is immigration known or possible?	No (except U.S. part above Grand Forks
Would individuals from nearest foreign population be adapted to survive in Canada?	Yes, but U.S. populations are not genetically identical).
Would sufficient suitable habitat be available for immigrants?	Very limited

Status
Nature conservancy Rank
Global – G5
U.S.: National: N5, PS under Endangered Species Act (several subspecies are threatened or endangered in the U.S).
Regional: AZ – S3S4, CA – S5, CO – S5, ID – S5, NN – S5, NV – S5, NM – S3, OR – S4, UT – S5, WA – S4
Canada: National – N1N2;
Regional: B.C. S1S2 (Province lists as Red)
COSEWIC V (SC) 1980

ACKNOWLEDGEMENTS

Dr. J. D. McPhail of the University of British Columbia deserves special thanks for providing access to UBC collections plus his extensive knowledge about *Rhinichthys*. Throughout British Columbia many personnel of the BC Ministry of Environment facilitated collecting permits, access to information and logistic support. Staff at the Royal BC Museum assisted various stages of investigations on *Rhinichthys*, particularly Tim Cleremont, Grant Hughes, Gordon Green, Brent Cooke, Kelly Sendall, Stan Orchard, and numerous summer students. Various curators in American and Canadian museums provided access to collections (foremost being the encouragement given by the late Dr. D. E. McAllister. Dr. R. L. Wallace (University of Idaho) contributed his knowledge of speckled dace in Idaho. Dr. T. Pietsch (University of Washington), D. Markle (Oregon State University) and B. Eschmeyer (California Academy of Sciences) provided printouts of American specimens and collection records of speckled dace. Julie Pavey of Triton Environmental Consultants as well as personnel of International Resource Consultants provided either information, specimens and/or sponsored field trip to lower Kettle River area. Fisheries authorities in Washington State and Idaho provided permits through which the writer was able to get a comparative overview of nearby American populations of *Rhinichthys* species. Most of this work is based on initial reports supported by the Royal BC Museum, Victoria, BC (see Peden 1994ms). Funding provided by World Wildlife Fund Canada and Canadian Wildlife Federation. Logistic support from Royal BC. Museum, Victoria, BC.

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BIOGRAPHICAL SUMMARY OF CONTRACTOR

Alex E. Peden received his master's degree from the University of British Columbia in 1964 and doctorate at the University of Texas at Austin in 1970. After receiving a postdoctoral appointment at the National Museum of Canada, he was appointed Curator of Marine Biology at the British Columbia Provincial Museum in 1971. Participated in ichthyological collection and/or fisheries work in south eastern USA, Mexico, Northwest Territories, Alaska, Bering Sea and waters adjacent to British Columbia. Has dubious distinction of describing two new species of Texan fishes (Poeciilidae) only to see them become extinct. He devoted much of his career to documenting the diversity of fish species of the Canadian West Coast, and contributed status reports of western Canadian fish species since 1980. During this period, he first documented more than 60 fish species inhabiting marine waters off British Columbia. Previously, Peden authored COSEWIC status reports on speckled dace, Umatilla dace, leopard dace, shorthead sculpins and mottled sculpins.

EXPERTS ON CANADIAN SPECKLED DACE

Dr. J.D. McPhail
Department of Zoology
University of British Columbia,
Vancouver, BC, V6T 1W5

COLLECTIONS EXAMINED

As an updated status report, collections examined are not listed as would have been the case for original COSEWIC status reports. The basis for Canadian distributional records is based on study material in the collections of the ROYAL BC MUSEUM, nearly all collected by the writer. Additional comparative material is cited in Table 2. For additional material, see Peden and Hughes (1988).