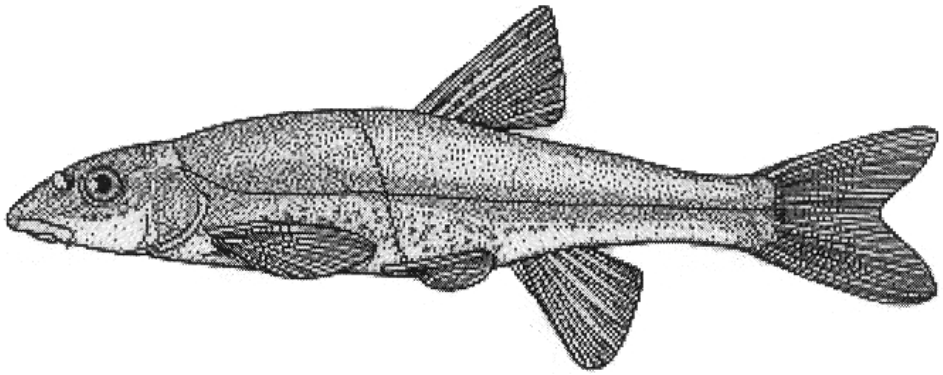
COSEWIC
Assessment and Update Status Report

on the

Nooksack dace
Rhinichthys cataractae ssp.

in Canada



ENDANGERED
2007

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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Previous report:

COSEWIC 2000. COSEWIC assessment and update status report on the Nooksack dace *Rhinichthys* sp. in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 9 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

McPhail, J.D. 1996. COSEWIC status report on the Nooksack dace *Rhinichthys* sp. in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-9 pp.

Production note:

COSEWIC would like to acknowledge Dr. Mike Pearson for writing the update status report on the Nooksack dace *Rhinichthys cataractae* ssp. in Canada, prepared under contract with Environment Canada, overseen and edited by Dr. 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 de la Nooksack (*Rhinichthys cataractae* ssp.) au Canada – Mise à jour.

Cover illustration:
Nooksack dace — Drawing of the Nooksack dace based on a specimen from Bertrand Creek (courtesy Canadian Museum of Nature).

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COSEWIC
Assessment Summary

Assessment Summary – April 2007

Common name
Nooksack dace

Scientific name
Rhinichthys cataractae ssp.

Status
Endangered

Reason for designation
The species is considered a habitat specialist dependent on stream riffles with loose, small grained substrates. This small fish is a representative of the Chehalis fauna, and considered to be a distinct subspecies of the longnose dace. It is known in Canada from only four locations in southwestern BC where its area of occupancy is severely limited, and subject to ongoing physical destruction of riffle habitat by urban, industrial and agricultural practices (e.g. dredging, channelization). Streams where the species is found are also impacted by lack of water in late summer due to ground and surface water extraction. Other activities have led to sediment accumulation in riffles caused by bank erosion resulting from gravel mining and/or runoff from urban storm drains, leading to further degradation of water quality and habitat.

Occurrence
British Columbia

Status history
Designated Endangered in April 1996. Status re-examined and confirmed in May 2000 and April 2007. Last assessment based on an update status report.

COSEWIC
Executive Summary

Nooksack dace
Rhinichthys cataractae ssp.

Species information

The Nooksack dace is a streamlined minnow, nearly round in cross-section, with a triangular head and a bulbous snout that overhangs the mouth. The pectoral fins are large, paddle-shaped, and used as hydrofoils in swift currents. Body colouration is grey-green above a dull, brassy lateral stripe and dirty white below it. Distinct pale marks occur on the back at each end of the dorsal fin. A black stripe is limited to the head in front of the eyes in adults, but continues down the flanks to the tail in juveniles. Males have slightly longer pectoral fins but the sexes are not otherwise distinguishable. The Nooksack dace is genetically distinct from other forms of *R. cataractae* in the Fraser and Columbia basin and physically separable from them in having fewer, larger scales. The largest recorded Canadian specimen measured 114 mm from snout to tail fork and weighed 16.1 g. The Nooksack dace is believed to be a subspecies of the longnose dace (*Rhinichthys cataractae)*, but may be a separate species.

Distribution

Nooksack dace are restricted to rivers and streams in northwestern Washington State and British Columbia's Fraser Valley. Populations have been confirmed in four Canadian streams: Bertrand Creek, Pepin Creek, Fishtrap Creek and the Brunette River. Some, but not all, of the *R. cataractae* in two other watersheds, the Coquitlam and Alouette Rivers, carry Nooksack dace mtDNA markers, but it is uncertain if this indicates past hybridization between the Nooksack and Columbia-Fraser forms of *R. cataractae* or their present coexistence in these watersheds.

Habitat

Nooksack dace are habitat specialists dependent on stream riffles (shallow, moderately turbulent, flowing water). They rarely occur in reaches with less than 10 percent riffle by length or in reaches where long stretches of deep pool habitat separate riffles. Adult densities are highest in depths of 10 to 20 cm, at water velocities between 20 and 35 cm/s, over loose gravel, cobble or boulder substrates. Juveniles occupy shallow (10-20 cm), calm, pools with fine substrates at the downstream end of riffles during their first summer. In Canada Nooksack dace are associated with small to

moderate sized channels (1-10 m in width), but this probably reflects available habitat in occupied watersheds rather than a preference.

Biology

Nooksack dace spawn at night between April and early July and may spawn more than once in a season. The young emerge from the gravel in mid-summer and inhabit shallow, marginal pools with sand or mud substrates where they feed on zooplankton. After approximately 4 months (about 45 mm body length) they move into riffle habitat. Lifespan is four to six years and sexual maturity is attained at the end of the second summer. Their life history characteristics (small body size, short generation time) should permit rapid population growth leading to early recovery from small–scale disturbances, and rapid expansion into nearby restored or created habitats. Most adults appear to range less than 50 m annually. Nooksack dace are largely inactive at temperatures below 11^{o} C, but forage normally at temperatures in excess of 20^{o} C. Adults feed primarily on aquatic insects and are likely eaten by coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), rainbow trout (*O. mykiss*), and prickly sculpin (*Cottus asper*). Juveniles are probably taken by these species as well as by juvenile coho salmon (*O. kisutch*).

Population sizes and trends

Insufficient data exist to reliably estimate total population size, but available evidence suggests that it is less than 10,000. Density appears to have remained relatively high since the 1960s in lower Bertrand Creek, but to have declined in Pepin Creek and Fishtrap Creek. Continuing decline is also suggested by the apparent extirpation of the species from headwater tributaries of Fishtrap Creek and Bertrand Creek since the 1960s. The recently discovered Brunette River population has not been assessed.

Limiting factors and threats

Canadian populations of Nooksack dace are limited by the availability of their primary habitat, high quality riffle habitat, and most of the identified population threats relate to its loss or degradation. Imminent threats likely to cause harm or population impacts include: lack of water in late summer (causing riffle loss through drying), physical destruction of riffle habitat (dredging, channelization, etc.), sediment accumulation in riffles, and riffle loss to beaver ponding. Imminent threats of uncertain impact include toxicity from urban storm sewer effluent, low dissolved oxygen in late summer, predation by introduced species, and habitat fragmentation by physical barriers or patches of degraded/destroyed habitat. The relative magnitude of threats varies among watersheds.

Special significance of the species

The Nooksack dace is a member of the ‘Chehalis fauna’, a group of fishes that evolved through geographic isolation during the Pleistocene glaciations in an ice-free

refuge in present-day Washington State. It is of considerable scientific interest in the study of evolutionary biology and biogeography.

Existing protection

The Nooksack dace was assigned Endangered status by COSEWIC in 1997 and the species was subsequently listed under Schedule 1 of the *Species at Risk Act (SARA).* As a federally listed species it is protected from harm or capture in all Canadian waters. Its habitat is also provided some protection by the federal *Fisheries Act*. The Recovery Team has proposed 21.3 km of the Nooksack River tributaries as critical habitat in a draft recovery strategy under SARA, but has not defined the species *'residence'* under the Act.

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 5, 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

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

Update
COSEWIC Status Report

on the

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Rhinichthys cataractae ssp.

in Canada

2007

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SPECIES INFORMATION

Name and classification

Class:	Actinopterygii
Order:	Cypriniformes
Family:	Cyprinidae
Genus:	*Rhinichthys*
Species:	*Rhinichthys cataractae*
Subspecies:	*Rhinichthys cataractae* ssp.
Common names:	
English	Nooksack dace
French	Naseux de la Nooksack

The Nooksack dace (Figure 1) is believed to be a subspecies of the longnose dace (*Rhinichthys cataractae)*, although it may constitute a separate species (J.D. McPhail, pers. comm., 2006). It is a member of the 'Chehalis fauna', a group of fishes that diverged from the Columbia fauna during the Pleistocene Epoch through geographic isolation in a glacial refuge in present-day Washington State (McPhail, 1967; McPhail, 1997). It is one of several closely related daces of uncertain taxonomic relationship found in the Pacific Northwest. The most widespread form is found in the Columbia and Fraser River systems. Divergent forms include the Umpqua dace (*R. evermanni* Snyder) of the Umpqua drainage and the undescribed Millicoma dace of the Coos drainage, both in Oregon, in addition to the Nooksack dace (Bisson and Reimers 1977, McPhail, 1967). None of the forms are known to occur in sympatry.

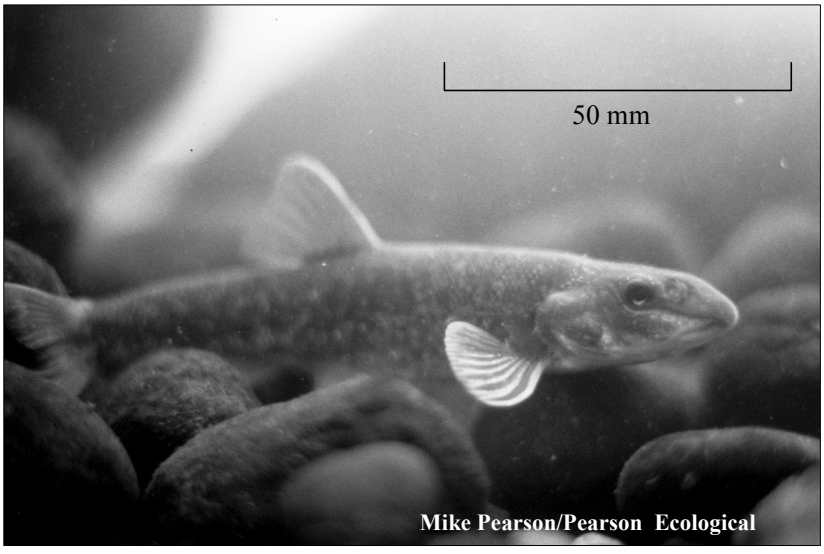

Figure 1. A male Nooksack dace (May 20, 1999, Pepin Brook, UTM 10U 539071 5428930).

Morphological description

R. cataractae morphology reflects a preference for fast flowing riverine habitats. The body is streamlined and nearly round in cross-section. The head is triangular with a bulbous snout overhanging the mouth and a slight hump at the nape. The eyes are small relative to head length. Pectoral fins are large, paddle-shaped, and used as hydrofoils in swift currents, pelvic fins are small and the caudal fin is shallowly forked with rounded lobes. Body colouration is grey-green above a dull, brassy lateral stripe and dirty white below it. The swim bladder is small and poorly developed (Scott and Crossman, 1973). There are distinct pale marks on the back at the anterior and posterior base of the dorsal fin and a distinct black stripe on the head in front of the eyes, which in juveniles continues down the flanks to the tail. Males have slightly longer pectoral fins but the sexes are not otherwise distinguishable (McPhail, 1997). Relative to other *R. cataractae* populations in the Fraser and Columbia river basins, the Nooksack dace has a more slender caudal peduncle and larger scales that are fewer in number (50-59 vs 60-73 on the lateral line; McPhail,1967; Bisson and Reimers, 1977). The largest recorded Canadian specimen measured 114 mm (snout to tail fork) and weighed 16.1 g (Pearson, 2004). Mean values for key morphological features (lateral line scale and dorsal fin ray counts) in the recently identified Coquitlam River and Alouette River populations are intermediate between the two forms and show higher variation. At present, however, sample size is insufficient to determine if distributions are unimodal or bimodal (J.D. McPhail, pers. comm. 2006).

Genetic description

Nooksack dace from the Nooksack drainage are distinguishable from the Columbia-Fraser *R. cataractae* by allelic frequency for one allozyme (Pgi-1 slow allele; McPhail and Lindsey, 1986) and genetic distance calculated from mtDNA variation. A detailed mtDNA sequencing study of the *R. cataractae* species group is in progress (J.D. McPhail pers. comm., 2006). The group includes the Umpqua dace, *R. evermanni*, (n=15; endemic to Oregon's Umpqua River) and several distinct forms of putative *R cataractae*, including the Nooksack dace (n=20), the Millicoma dace, (n=5; endemic to Oregon's Coos River; Bisson and Reimers, 1977), and the more widespread Columbia-Fraser form (n=5 x 6 sites in BC and WA). Early results show that the cytochrome b gene (1141 bp) and control region (892 bp) in Nooksack dace mtDNA differ from Columbia-Fraser *R. cataractae* at approximately 2% of sites, suggesting that divergence between Nooksack and Columbia River-Fraser River longnose dace occurred about 2 million years ago, prior to the Pleistocene Epoch. This exceeds the level of divergence between the longnose sucker, *Catostomus catostomus* and the Salish sucker, *Catostomus* sp. (1.15%; McPhail and Taylor, 1999, 2000) and is similar to that between speckled dace, *R. osculus*, the leopard dace, *R. falcatus*, and the Umatilla dace *R. Umatilla* (1.3-2.8%; McPhail and Taylor, unpub. data). There are small (0.3-0.4%) differences between populations of Nooksack dace from river systems on the Olympic Peninsula, the Puget Sound lowlands, and the Fraser Valley. The Willipa River, the only occupied drainage to the south of the Chehalis River, contains a population slightly more divergent from other Nooksack dace populations, differing at approximately 1% of sites (McPhail and Taylor, unpub. data.).

The Canadian population structure has yet to be fully clarified. Until 2004 Nooksack dace were believed restricted to tributaries of the Nooksack River, with northwestern longnose dace occupying all Fraser River tributaries. Recent genetic and morphometric work has revealed, however, that all *R. cataractae* of the Brunette River (a Fraser River tributary) are Nooksack dace (McPhail and Taylor, unpubl. data). Preliminary sampling also indicates that the Nooksack dace mitochondrial genome is found in a high frequency of individuals from two neighbouring watersheds, the Coquitlam River (47%, n=30) and the Alouette River (28%, n = 32) but is absent in the Norrish Creek population (n=30), which is somewhat further east (Fig. 3). It is not clear if this is evidence of historical hybridization or of sympatry with occasional hybridization. Clarifying the situation is the critical step in determining the taxonomic status of Nooksack dace. If populations of northwestern longnose and Nooksack dace maintain themselves as separate, sympatric entities in the Coquitlam and Alouette Rivers, full species status is probably warranted. Conversely, if these populations consist of introgressed hybrids a subspecies designation would be appropriate (McPhail pers. comm., 2006). A conservative nuclear marker for Nooksack dace has yet to be developed, but is needed.

Designatable units

Nooksack dace populations occupy two independent drainages within British Columbia, the lower Fraser River and the Nooksack River system, which enters the Strait of Georgia from Washington State. Dispersal between the drainages is extremely unlikely, although brief connections between tributary headwaters do occur during flood events in some years. However, there is no data to support distinguishing the populations as separate designatable units in accordance with the COSEWIC guidelines for recognizing designatable units below the species level (COSEWIC 2006).

DISTRIBUTION

Global range

Nooksack dace are restricted to western Washington State and southwestern British Columbia (Figure 2) where they inhabit the drainages of the east shore of Puget Sound, the western side of the Olympic Peninsula and the Fraser River Valley. The historical range is unknown, but unlikely to have been much more extensive as the Columbia-Fraser form of *R. cataractae* occupy drainages to the west and north with a zone of past or present overlap (see genetic description) and other members of the same clade occupy drainages south of the Columbia River (McPhail, pers. comm. 2006).

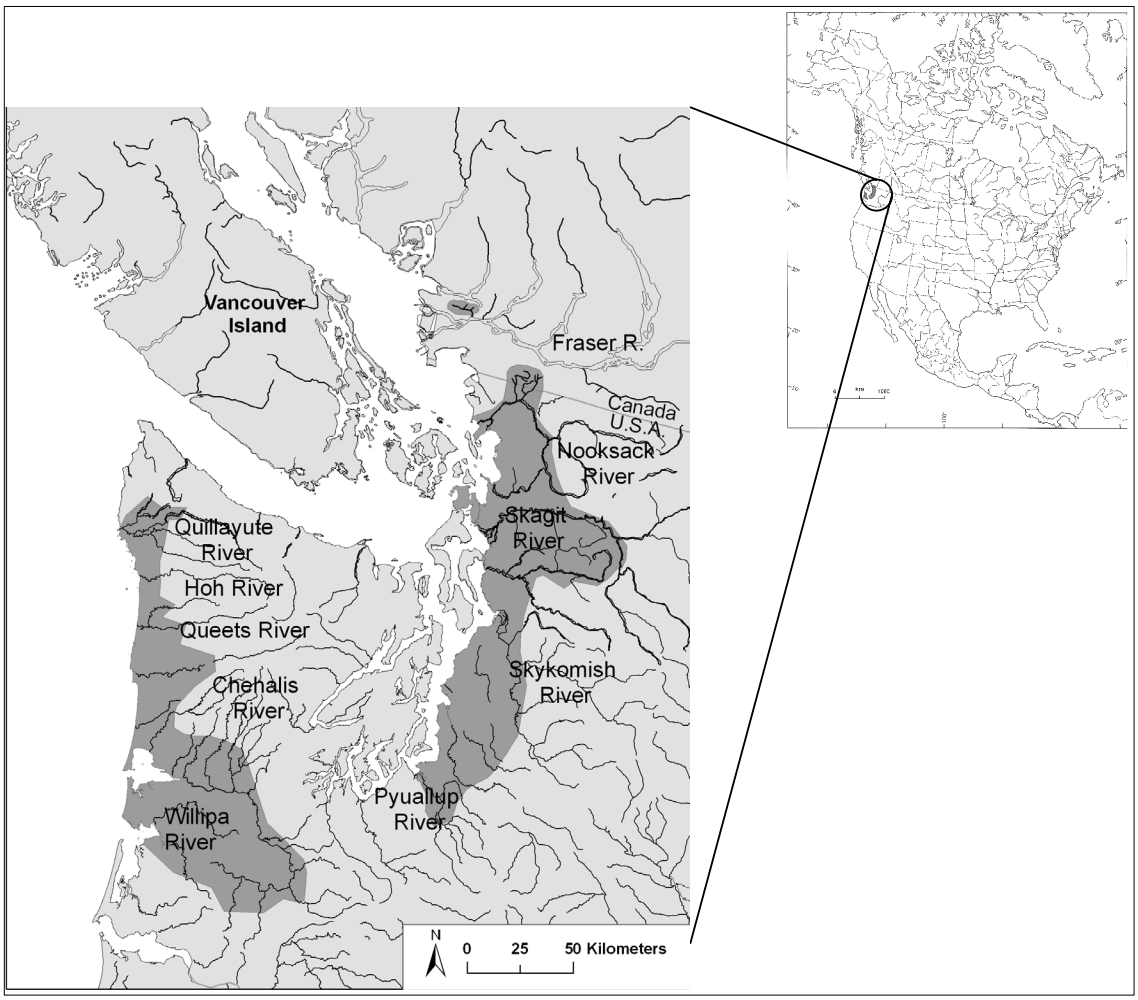

Figure 2. The global range of the Nooksack dace is restricted to northwestern Washington State and the Fraser River Valley in southwestern British Columbia. Adapted from McPhail (1997) and Mongillo and Hallock (1997).

Canadian range

Within Canada Nooksack dace occupy a restricted range consisting of four creeks in two major watersheds of the Fraser Valley (Fig. 3). Three of the creeks flow south into Washington State's Nooksack River (Bertrand Creek, Pepin Creek and Fishtrap Creek). The fourth population, discovered in 2004, occupies the Brunette River, a tributary of the lower Fraser River. The nearby Coquitlam and Alouette Rivers, also tributary to the Fraser River, contain either sympatric populations or introgressed hybrids of Nooksack dace and Columbia-Fraser *R. cataractae* (see *genetic description* above).

The extent of occurrence in Canada comprises 630 km^2, or 4.3 percent of the global extent. Potential habitat, defined as the total riffle area in reaches containing more than 10 percent riffle by length, totals 7,328 m^2 in three of the four Canadian

populations (Table 1). Much of this habitat is currently unoccupied due to seasonal drying, compaction with silt or beaver impoundment. Habitat in the fourth occupied watershed, the Brunette River, has yet to be surveyed, but the total riffle area available is 20,155 m^2. This gives a total riffle area (area of occupancy) of 0.03 km^2. The area of occupation in Washington State is unknown. Area of occupancy estimated from an overlaid grid of cell size one km^2 is in the order of 14 km^2.

Table 1. Potential habitat and population sizes for confirmed Nooksack dace populations in Canada. Potential habitat consists of riffle areas in reaches containing more than 10% riffle by length. Maximum population estimates are products of density in high quality habitat (1.9 per m^2, Inglis *et al.*, 1994) and available riffle area. A CPUE-based estimate of relative abundance among watersheds (Pearson, 2004) is used to calculate the adjusted estimate. See *Population sizes and trends* for discussion.

Drainage	Length of Riffle (m)	Area of Riffle (m^2)	Maximum Population	CPUE Ratio	Adjusted Estimate
Bertrand Creek	1199	2996	5700	18.9	5700
Pepin Creek	1050	2300	4400	2.7	800
Fishtrap Creek	1016	2032	3900	1	300
Brunette River*	10473	20155	38300	NA	NA
Total	13738	27483	52300	NA	NA

*Pearson, Unpublished data

The existence of unknown populations in other Fraser River tributaries seems plausible in light of the recent confirmation of the Brunette River population. Searches of occurrence records for *R. cataractae* in the Fraser Valley using the UBC Fish Museum database and the British Columbia Fisheries Inventory Summary System and the Royal British Columbia Museum records yielded putative records from 36 sites in the Fraser Valley (Table 2). Those from areas not yet genetically characterized are shown in Figure 3.

Within watersheds Nooksack dace distribution is extremely clumped. Pearson (2004) compared catch per unit effort (CPUE; mean number of fish per trap; 24 h sets) in 72 reaches of the Nooksack River tributaries. CPUE was zero in most (41) reaches and high densities (CPUE>0.25 fish per trap) were found in only 8 reaches, 6 of which are contiguous in lower Bertrand Creek. He estimated that this 5 km stretch of channel constituting just 12.5% of mainstem length in the Nooksack River tributaries contained more than 70% of their Nooksack dace.

Historical changes in the Canadian distribution are poorly documented, but a general decline over at least the past half-century seems likely. McPhail (1997) reports that Nooksack dace were extirpated from some headwater tributaries of Bertrand and Fishtrap creeks between the late 1960s and the mid-1990s. Pearson (2004) found them only in the main stems of these creeks, and observed that most of the tributaries run dry in late summer.

Table 2. Records of *Rhinichthys cataractae* in the Fraser Valley on the UBC Fish Museum database,[1] the British Columbia Fisheries Inventory Summary System (FISS)[2] and the Royal British Columbia Museum (RBCM).

Site	Drainage	Location	Year	Easting	Northing	Reference	Haplotypes Present[3]
1	Norrish Creek	2.6 km upstream	1959			UBC 59-0602	CF
2	Norrish Creek	8 km upstream	1959			UBC 59-0600	CF
3	Alouette River	224 ST	1998	529110	5453616	FISS HQ2030	N/CF
4	Alouette River	232 St	1980			UBC 82-0012	N/CF
5	Alouette River	Alouette Lake outlet	1996	537170	5459510	FISS HQ0717	N/CF
6	Bertrand Creek	Otter Road	1963			UBC 76-0027	N
7	Bertrand Creek		1993	537371	5434835	FISS HQ0517	N
8	Brunette River	Still Creek at Hwy 7	1956			UBC 56-0122	N
9	Brunette River	Unknown	1953			UBC55-0009	N
10	Coquitlam River	Hwy 7 bridge	1956			UBC 56-0412	N /CF
11	Coquitlam River	Unknown	1951			UBC 55-0008	N/CF
12	Coquitlam River		1996	517255	5465878	FISS HQ0498	N/CF
13	Coquihalla River	Near mouth	1956			UBC 59-0446	?
14	Fraser River	Dewdney (Nicomen Slough?)	1959			UBC 59-0601	?
15	Fraser River	Kirkland Island	1978	491215	5439571	FISS HQ0444	?
16	Fraser River	Mouth of Vedder	1959			UBC 59-0608	?
17	Fraser River	N of Chilliwack	2000	572783	5448220	FISS HQ1489	?
18	Fraser River	N of Chilliwack	2000	574938	5451237	FISS HQ1489	?
19	Fraser River	N of Chilliwack	2000	576765	5450636	FISS HQ1489	?
20	Fraser River	N of Chilliwack	2000	576533	5452159	FISS HQ1489	?
21	Fraser River	N of Chilliwack	2000	577767	5451240	FISS HQ1489	?
22	Fraser River	N of Chilliwack	2000	578363	5453036	FISS HQ1489	?
23	Fraser River	N of Chilliwack	2000	580403	5452854	FISS HQ1489	?
24	Fraser River	Coquihalla Mouth	1956			UBC 59-0002	?
25	Fraser River	S of Agassiz	2000	586617	5452439	FISS HQ1489	?
26	Fraser River	S of Agassiz	2000	590544	5451894	FISS HQ1489	?
27	Fraser River	S of Agassiz	2000	593678	5453684	FISS HQ1489	?
28	Kanaka Creek	Lower reaches	?			McPhail pers. comm.	?
29	Pitt River	Mainstem	1991	528068	5466523	FISS HQ0435	?
30	Silverdale Creek[4]		1954	547100	5443000	UBC 58-0552	?
31	Vedder River	Cultus Lake outlet	1995	574354	5436388	FISS 2FBSRY	?
32	Fraser River	Agassiz	1987			RBCM 987-00234-003	?
33	Fraser River	Agassiz	1987			RBCM 987-00235-004	?
34	Fraser River	Agassiz	1987			RBVM 987-00236-001	?
35	Fraser River	Herling Island	1992			RBCM 992-00227-002	?
36	Fraser River	Chilliwack	1987			RBCM 987-00233-001	?

[1]http://www.zoology.ubc.ca/~etaylor/nfrg/fishmuseum.html
[2]www.bcfisheries.gov.bc.ca/fishinv/fiss.html
[3]As identified by McPhail: CF = Columbia-Fraser N = Nooksack ?= not tested
[4]Mission

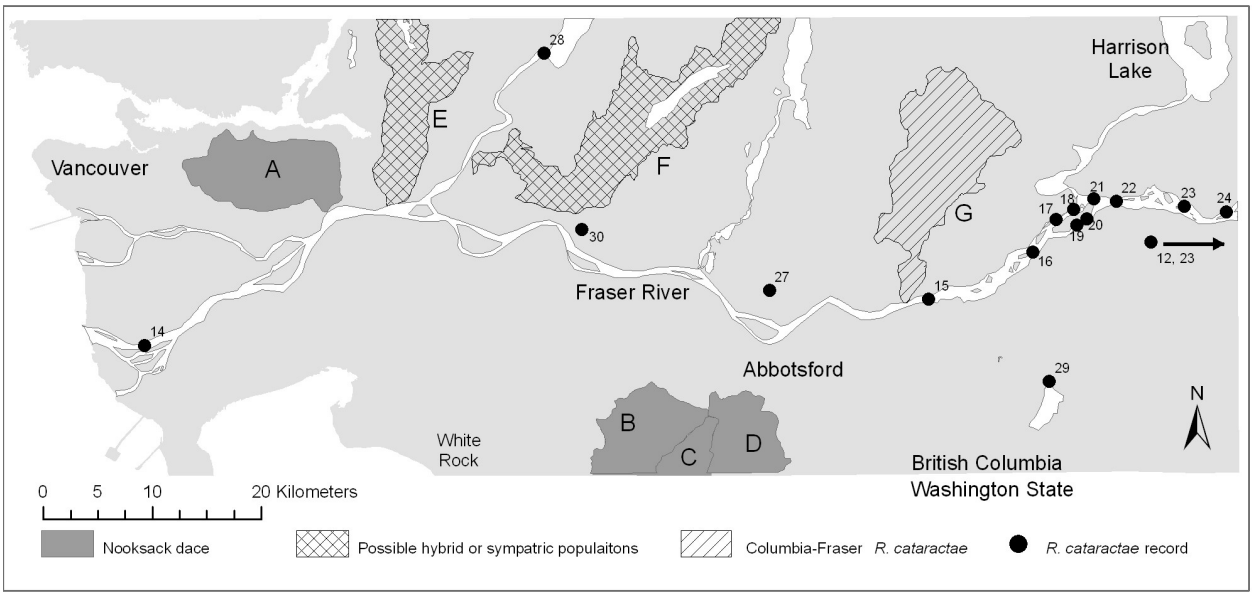

Figure 3. In Canada, Nooksack dace populations are confirmed in the Brunette River (A, 2004), Bertrand Creek (B, 2005), Pepin Creek (C, 2004), and Fishtrap Creek (D, 2004). Norrish Creek (G) contains the Columbia-Fraser form of *R. cataractae*, while the Coquitlam River (E. 2004) and Alouette River (F, 2005) contain either sympatric populations or introgressed hybrids of the two types (J.D. McPhail unpubl. data). Years refer to date of most recent captures (Pearson, unpubl. data). Numbers refer to putative *R. cataractae* records from other watersheds as detailed in Table 2.

HABITAT

Habitat requirements

R. cataractae are widely known as stream riffle specialists (Facey and Grossman, 1992; Gibbons and Gee, 1972; Thompson *et al*., 2001; McPhail, 1997). Adult densities are highest in depths of 10 to 20 cm, at water velocities greater between 20 and 35 cm/s, over loose gravel, cobble or boulder substrates (Inglis *et al*., 1994; McPhail, 1997). Overwintering Nooksack adults have been found beneath cobble substrate in fast flowing riffles (Pearson, unpubl. data). Nooksack dace typically spawn at the upstream end of riffles and young-of-the-year occupy shallow (10-20 cm), calm, pools over fine substrates at the downstream end of riffles (McPhail, 1997).

The proportion of riffle habitat in a stream reach is the strongest predictor of Nooksack dace presence. They are rarely found in reaches with less than 10 percent riffle by length, or in reaches where long stretches of deep pool habitat separate riffles (Pearson, 2004). Natural habitat fragmentation occurs where low stream gradient precludes riffle formation and where beaver ponding converts riffles to pools. Anthropogenic fragmentation, caused by channel dredging and seasonal lack of flow due to ground and surface water extraction, is also common in the Canadian range.

In Canada Nooksack dace are associated with small to moderate-sized channels (1-10 m in width), but this probably reflects available habitat in occupied watersheds rather than a preference (McPhail, 1997). On the Olympic Peninsula mean channel width at occupied sites was 45.2 m (range 14.9-76 m, n=12, Mongillo and Hallock1997).

Habitat trends

Streams in the Fraser Delta area typically have small watersheds, minimal low flows in July and August, and limited natural or artificial storage; some have significant water demands. Storage development, riparian zone management, and erosion control are all important issues (Rood and Hamilton 1994).

The Brunette River is considered to have undergone significant alteration to its hydrological regime due to urbanization. In particular, the lower portion of the Brunette River is characterized by channelization and dyking, with no instream cover, high water temperatures and low dissolved oxygen (Rood and Hamiltion 1994).

The current extent of riffle habitats and occupancy in the Nooksack tributaries is well documented (Fig. 4; Pearson 1998a,b; Pearson 2004). The trend in its quantity and quality is clearly one of decline. At least some riffles in all three creeks are compacted by sediment from bank erosion and/or urban storm sewer effluent (Pearson, 2004). The mainstem of Fishtrap Creek was dredged for flood control by the City of Abbotsford in 1990-1991, eliminating most of its previously abundant riffle habitat (J.D. McPhail, pers. comm. 2006). In particularly dry years (e.g. 2002) flow ceases completely in some occupied reaches of Bertrand Creek, eliminating riffle habitat. Reaches with strongest baseflows still lose over 80% of riffle area relative to winter levels (Pearson, unpubl.). Aquifer draw-down by local wells is estimated to have reduced the creek's baseflow by 24% since 1960 (Golder and Associates, 2004). Surface withdrawals for irrigation are also of water licences held in the Nooksack drainage is significant. These large-scale abstractions or diversions undoubtedly limit availability of nooksack dace habitat (riffles) in the low-flow summer months in some locations as all of these licences are run significant, but have not been quantified.

A number of river withdrawals occur during the dry periods for irrigation purposes. Bertrand, Fishtrap and Pepin creeks are all relatively small streams that begin to lose riffle habitat (width) when flows drop below 10% mean annual discharge (mad) and riffle quality (depth and velocity) when flows drop below 20% mad (mad; Ptolemy and Lewis 2003). In recent years (1984-2005), Betrand Creek in particular has seen 30-day summer flows as low as 1% mad (Ron Ptolemy, Standards and Guidelines Specialist, Ecosystems Branch, BC Ministry of Environment, Victoria, BC; personal communication 2007) Fishtrap Creek baseflows are also a concern with monitored flows averaging 10% mad and dropping to <1% mad in the 2003 drought. Pepin Creek flows in contrast are relatively healthy with baseflows averaging 24% mad and lows as >10% during drought periods (R. Ptolemy, pers.comm.).

Only crude estimates of habitat loss are possible, due to lack of baseline data (Table 3). They suggest that approximately half of the original riffle habitat from the Nooksack tributaries has been lost, most of it prior to 1996. Losses in the past 10 years appear to have been minimal, mostly due to beaver pond inundation of riffles in Pepin Creek (Pearson, 2004).

Table 3. Estimated losses of Nooksack dace habitat in Canada. Habitat was assumed to have comprised 20% of channel length in reaches known or believed to have lost substantial riffle area prior to 1996.

	Units	Pepin Creek	Fishtrap Creek	Bertrand Creek	Brunette River
Existing Area (from Table 1)	(m^2)	2000	2300	3000	20155
Losses to 1996	(m^2)	2500	2530	2500	?
	(m)	2780	2300	5000	?
Losses since 1996	(m^2)*	235	0	0	0
Total Loss	%	57	52	46	?

*measured by Pearson (2004)

** Areas calculated as product of mean wetted widths (from Pearson, 1998a) and 20% of reach length rounded to nearest 100 m2

Habitat protection/ownership

There is no known Nooksack dace habitat on federal or provincial lands, but approximately 2 km of occupied habitat in the Nooksack River tributaries (Table 4) and at least 5.2 km of suitable or occupied habitat in the Brunette River (Pearson unpubl. data) occur on regional or municipal parkland. This amounts to somewhat more than 10% of suitable habitat.

Virtually all of the remaining habitat is on private, urban or agricultural lands. There is limited legislative protection at present. The 'harmful alteration, disruption or destruction' of fish habitat, including that of Nooksack dace, is partially prohibited by the federal *Fisheries Act* (R.S.C. 1985, c. F-14, s. 35-36). The *Species at Risk Act* prohibits the destruction of habitat identified as critical in an approved recovery strategy or action plan (SARA*,* S.C.2002, c.29, s. 57-58), but the competent minister must make an order before the prohibitions apply.

All occupied or potential habitats in the Nooksack River tributaries (Fig. 4) are proposed by the Recovery Team for designation as critical habitat under SARA.

Table 4. Public lands bordering or upstream of occupied or suitable Nooksack dace habitat in Canada.

Watershed	Ownership	Description	Channel Length Present/ Suitable/Occupied	Status/Comments
Pepin Creek	Greater Vancouver Regional District	Aldergrove Lake Regional Park	4825 m Pepin Brook and tributaries 1660 m occupied	Regional parkland
Bertrand Creek	Township of Langley	Otter Park	225 m Bertrand Creek; 225 m occupied	Municipal parkland; Extremely vulnerable to drying
	Federal Government Dept. Nat. Defence	Naval Station Aldergrove	2850 m Bertrand Creek; 0 suitable	Military lands; Extreme headwaters
	Township of Langley	Vanetti Park	175 m Bertrand Creek; 0 suitable	Municipal parkland; Upstream of suitable habitat
	Township of Langley	Creekside Park	185 m Bertrand Creek; 0 suitable	Municipal parkland
Fishtrap Creek	City of Abbotsford	Gardner Park, City of Abbotsford	260 m Enn's Brook; 120 m suitable	Municipal parkland
	City of Abbotsford	East Fishtrap Creek Park	1500 m East Fishtrap Creek; 0 suitable	Municipal parkland; Upstream of suitable habitat
Brunette River	Greater Vancouver Regional District	Burnaby Lake Regional Park	9000 m of mainstem and tributaries; 2450 msuitable	Regional parkland
	City of Burnaby	Deer Lake Park	2400 m of Deer Lake and Creek; 515 m suitable	Municipal parkland
	City of Burnaby	Hume Park	415 m Brunette River; 415 m occupied	Municipal parkland
	City of Burnaby	East Lake Park	500 m Stoney Creek; 500 m suitable	Protected as municipal parkland
	City of Burnaby	Stoney Creek Park, City of Burnaby	825 m Stoney Creek; 825 m uitable	Municipal parkland
	Greater Vancouver Regional District	Burnaby Mountain Conservation Area	1565 m Stoney Creek; 500 m suitable	Regional park; Extreme headwaters

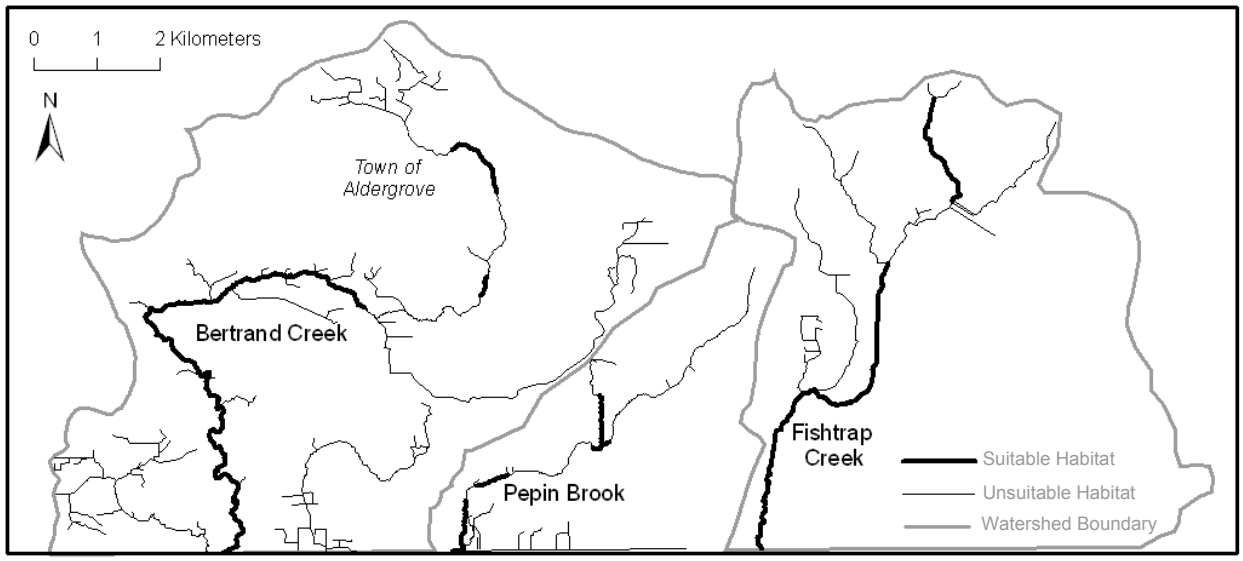

Figure 4. Occupied habitat in the Nooksack tributaries includes all reaches in occupied watersheds containing a minimum of 10 percent riffle by length at low flow. Only 3.27 km of the 21.4 km marked consists of riffle and could actually be occupied (adapted from National Recovery Team for Salish Sucker and Nooksack Dace, 2005). Pepin Brook = Pepin Creek.

BIOLOGY

Life cycle and reproduction

Nooksack dace spawn nocturnally over coarse substrate in riffles (McPhail, 1997) between April and early July (Pearson, 2004). Both male and female Alouette River *R. cataractae* establish and defend small breeding territories (approx. 10 cm in diameter), which are clustered at the upstream end of riffles. Females leave their territories at night to court and spawn with territorial males, which rarely leave, even to feed until at least 24 h after spawning (Bartnik, 1972; 1973). Fecundity ranges from about 200 to over 2,000 eggs depending upon body size and adults are believed to spawn annually (McPhail, 1997); however, given the long spawning period, females may spawn multiple clutches (Roberts and Grossman, 2001).

R. cataractae eggs hatch in 7-10 days at 15.6º C in Manitoba, but remain in the gravel for an additional week until the yolk sac is absorbed (Scott and Crossman, 1973). Young-of-the-year Nooksack dace emerge from substrate in mid-summer feeding on zooplankton and chironomid larvae in shallow, marginal pools with sand or mud substrates. After approximately 4 months (at about 45 mm body length) they become negatively buoyant and move into riffle habitat. Lifespan is four to six years and sexual maturity is attained at the end of the second summer of life, suggesting that generation time is three years (McPhail, 1997).

Hybridization of *R. cataractae* with several co-occurring cyprinids, including the redside shiner, *Richardonius balteatus*, a species that occurs with Nooksack dace in the Brunette River, are documented (Scott and Crossman, 1973).

Predation

Adults are likely taken occasionally by coastal cutthroat trout (*Oncorhynchus clarkii clarkii*), rainbow trout (*O. mykiss*), and prickly sculpin (*Cottus asper*), which co-occur with all known Nooksack dace populations (Pearson, 2000). Juveniles are likely taken by these species in addition to juvenile coho salmon (*O. kisutch*). All of the Canadian watersheds occupied by Nooksack dace are also colonized by one or more introduced predators, including bullfrog (*Rana catesbeiana)*, brown bullhead (*Ameiurus nebulosus*), pumpkinseed (*Lepomis gibbosus)*, and largemouth bass (*Micropterus salmoides)*. Population level impacts of these predators are unknown. None of them are commonly found in the riffle-rich reaches preferred by Nooksack dace. The nocturnal foraging habit of Nooksack dace (McPhail, 1997) may reduce their susceptibility to diurnal predators (Culp, 1989).

Physiology

Little information exists on tolerances or preferences of Nooksack dace for water quality parameters such as dissolved oxygen, pH, and temperature. Activity appears minimal at temperatures below 11^{o} C, and fish forage normally at temperatures in excess of 20^{o} C (Pearson, 2004). Nooksack dace were found in streams with temperatures significantly above the average during an Olympic Peninsula survey (17.6^{o} C, range 14.0 – 22.0; Mongillo and Hallock 1997). Nooksack dace are likely poorly adapted to hypoxia, as riffle habitats are typically well oxygenated.

Dispersal/migration

Nooksack dace typically have small home range sizes and show no evidence of long-range dispersal as adults. Pearson (2004) showed that the distribution of Nooksack dace movements within two 200 m long study areas was extremely leptokurtotic (biased towards short distances) relative to the distribution of detectable movements. Over 50% of recaptured, marked adult dace were caught within 5 m and 92% were found within 50 m of their initial capture positions in the 14-month study. Fully 30% were recaptured in exactly the same location, some after more than a year had lapsed since the previous capture. Fish were as likely to move upstream as downstream, and maximum displacement was 205 m. None of the recaptured fish moved the 2.2 km between study reaches. Nooksack dace colonists (n=9) did not penetrate more than 560 m into a newly constructed 960 m tributary diversion within 15 months (Pearson, unpub. data), suggesting that maximum annual range is less than 1 km. The data suggest that a large fraction of the population is sedentary. Hill and Grossman (1987) also report small home range size for *R. cataractae* (mean 13.7 m). The relatively long movements (hundreds of metres) of a few individuals, however, suggests that a fraction of the population may travel considerable distances from the

home patch, a pattern demonstrated in a number of other stream fishes (Nakamura *et al*. 2002; Gowan *et al*. 1994; Smithson and Johnston 1999). Juveniles may passively disperse downstream, but this has not been studied.

The clumped distribution within watersheds combined with limited adult dispersal raises the possibility that Nooksack dace exist as metapopulations within watersheds. Insufficient data, particularly on juvenile dispersal rates, exists for assessment, however.

Migration links between Canadian populations are highly unlikely as migrants would need to either traverse a minimum of 10 kilometres of largely unsuitable habitat in Washington State or, in the case of the Brunette River, cross the divide between the Fraser and Nooksack watersheds.

Interspecific interactions

Adult Nooksack dace feed primarily on riffle dwelling insects, while young-of-the-year dace subsist primarily on ostcracods and chironomid pupae (McPhail, 1997). Competitors are probably limited to juvenile coastal cutthroat trout and rainbow trout, the only other fishes that commonly forage in riffles inhabited by Nooksack dace (Pearson, 2004). Little data exist regarding parasitism, but most individuals have light infestations of blackspot (*Neascus* sp.), a subcutaneous trematode cyst, which appears to have little effect at low infestation rates (Vinikour, 1977).

Adaptability

In aggregate, Nooksack dace life history characteristics (small body size, short generation time, potential for multiple clutches annually) should permit rapid population growth, promoting early recovery from small-scale disturbances, rapid colonization of restored or created habitats within a few hundred metres of existing populations and successful (re)introductions into suitable habitat. Their life history strategy, however, will provide little resilience in the face of large scale or chronic disturbances (Winemiller and Rose, 1992; Detenbeck *et al.,* 1992).

POPULATION SIZES AND TRENDS

Search effort

Search effort for *R. cataractae* populations has been moderate within the Canadian portion of the range. The earliest reliable records of *R. cataractae* in the Fraser Valley date from the 1950s (see Table 2). McPhail (pers. comm., 2006) reports that intensive sampling (using rotenone) in streams across the Fraser Valley in the 1960s did not reveal any populations other than those listed in Table 2 (the samples are not catalogued). Inglis *et al*. (1994) electrofished for Nooksack dace at 158 sites in 34 Fraser Valley streams (1 pass of 50-100 m per site) during the summer of 1992. They

recorded no *R. cataractae* outside the Nooksack River tributaries, but sampled no streams on the north side of the Fraser River.

Estimates of population size have been hampered by a lack of sampling methods that are both non-destructive and effective. Pearson (2004) used CPUE in minnow traps to estimate relative abundance in the Nooksack River tributaries in 1999-2000 (minimum 10 sets in each of 74 reaches). He also attempted to quantify the size of the Bertrand Creek population using mark-recapture in two reaches in 2000-2001 (10-13 samples per reach, 32 traps per sample) but recapture rates were too low to permit an estimate.

Abundance

Insufficient data exist to reliably calculate Nooksack dace population sizes, but a likely upper limit can be estimated. High quality habitat in Bertrand Creek supported an average of 1.9 Nooksack dace/m^2 (n=20, SE=0.35, Inglis *et al*., 1994) and 1.4 /m^2 (n=5, S.E.+0.24, McPhail, 1997) in the two available estimates. The riffle area in Bertrand Creek (Fig. 4) measured 3,000 m^2 in 1999 (Pearson, 2004). If all riffle areas were populated at 1.9/m^2 the Bertrand population would be approximately 5,700. This should be viewed as an upper limit for the breeding populations because much of the habitat is of lesser quality than where the density estimates were made and the samples would have included some yearling juveniles. Extending the calculations to Pepin Creek and Fishtrap Creek using riffle area yields a total population of 14,000 at these three locations (watersheds). However, actual densities in Pepin Creek and Fishtrap Creek are much lower than in Bertrand Creek according to a CPUE-based relative abundance model (Pearson, 2004). Applying the relative abundance ratios to the Pepin and Fishtrap Creel figures gives an adjusted total population estimate of approximately 6,800 (Table 1). No data exist on current or historical abundances in the Brunette River, but extending the Bertrand Creek calculation would yield an unadjusted population of 38,295.

Fluctuations and trends

No quantitative data exist on fluctuations or trends in abundance for any of the Canadian populations. Density in Bertrand Creek south of 16th Avenue appears to have remained high since the 1960s. McPhail (1997) reports ‘healthy’ populations in Pepin Creek and Fishtrap Creek in a 1993 survey, but density was very low in most reaches of these creeks by 1999-2000 (Pearson 2004). This corresponds with known losses of riffle habitat over the past 10 years in these creeks (see habitat trends above). Continuing decline is also suggested by the apparent extirpation of Nooksack dace from headwater tributaries of Fishtrap and Bertrand Creek since the 1960s (McPhail 1997).

Rescue effect

The three Nooksack tributary populations all straddle the United States border and individuals undoubtedly move across it, although downstream movement is more likely.

A rescue effect benefiting Canadian populations is highly unlikely due to the very limited amount of suitable habitat in the Washington portion of these creeks (McPhail 1997), and its location downstream of the Canadian habitat. This is a sedentary species; individuals hold very small home ranges (< 1 km), and are not likely to either traverse over 10 km of unsuitable habitat, or cross the divide between the Fraser and Nooksack watersheds (*see* **Dispersal/Migration**). A catastrophic event (e.g. chemical spill) that caused extirpation in the Canadian portion of a creek would also likely eliminate the corresponding American population.

LIMITING FACTORS AND THREATS

Populations in Canada are probably limited by the availability of high quality riffle, their primary habitat, and most of the identified population threats relate to its loss or degradation (McPhail 1997, Pearson 2004). The following sections are adapted from a recent comprehensive threats assessment for Nooksack dace (Pearson, 2004; Pearson *et al*. 2006).

Imminent threats likely to cause harm or population impacts

Lack of water in late summer is the most serious threat to the largest known population, that of Bertrand Creek. Riffle area is reduced by 80 to 100% in the best habitats during the most productive time of year (Pearson unpubl.). Aquifer draw-down by local wells is estimated to have reduced baseflow by 24% since 1960 (Golder and Associates, 2004) and significant pumping from the creek occurs for irrigation, but has not been quantified (Pearson pers. obs.). The Brunette River also has inadequate summer flows due to the high proportion of its watershed that is impermeable (41%, Lavkulich *et al*., 1999).

Physical destruction of habitat has likely been the most serious threat to Nooksack dace in Canada historically. As the 'high spots' in a stream, riffle habitats tend to be targeted for removal or alteration in drainage projects, which are common in the urban and agricultural landscapes that dominate these watersheds. Both authorized and illegal alterations occur annually in these watersheds (McPhail 1997; Pearson pers. obs.).

Sediment accumulation in riffles clogs the spaces between and under coarse riffle substrate where Nooksack dace spawn, forage and rest. It also inhibits the flow of oxygenated water through the substrate to eggs. Where reed canary grass (*Phalaris arundinacea*), an invasive species, occurs in the channel, sod forms. This narrows the channel, greatly reducing riffle area. Significant sediment deposition originating from bank erosion, urban storm drains, or gravel mining operations occurs in all four Nooksack dace streams (Pearson pers. obs.).

Riffle lost to beaver ponds is an imminent threat to one population, that of Pepin Creek. An estimated 600 m^2 of riffle (10% of total available habitat for population) was

inundated due to beaver damming between 1999 and 2001 (Pearson 2004). Beaver activity poses no threat to Nooksack dace in other watersheds within the Canadian range. Removal of any dams in Pepin Creek will require full consideration of effects on other species, particularly Salish sucker and salmonid populations, and authorization under the *Fisheries Act*.

Imminent threats of uncertain impact

Toxicity is a known problem in the Brunette River, where levels of copper, lead, zinc, and manganese commonly exceed federal guidelines for aquatic life in both water and sediments (Hall *et al*., 1998). Similar conditions presumably prevail in the urbanized headwaters of Fishtrap Creek and Bertrand Creek, but their impacts on Nooksack dace are unknown.

Severe hypoxia is documented from some reaches of all four watersheds. In some highly eutrophic reaches oxygen levels remain low (<2 mg/l) throughout the year, while hypoxic episodes are limited to late summer. Riffles tend to have higher oxygen levels than other stream habitats during episodes of hypoxia (due to water turbulence), but little data exist and critical levels for the species are unknown.

Increased predation by introduced species is a concern, as all occupied watersheds are known to contain introduced predators (see predation above). In some watersheds they have coexisted with Nooksack dace for at least ten years (Pearson, 2000), but their impacts are unknown. All would undoubtedly prey upon Nooksack dace given the opportunity, but there is little habitat overlap. These predators thrive in warm water littoral zones (Scott and Crossman, 1973; Corkran and Thoms, 1996) and are rarely found in riffles. Lack of water could, however, force Nooksack dace out of riffles and into pools where predation risk is likely to be much higher.

Habitat fragmentation likely has some long-term impacts to Nooksack dace populations, but the magnitude is difficult to assess. All occupied streams contain some physical barriers (e.g. perched culverts, beaver dams, agricultural weirs) and are fragmented, at least seasonally by one or more of the threats discussed above. On a larger scale, connections between watersheds during floods were undoubtedly more common prior to the extensive dyking and drainage works of the past century. Most barriers and habitat fragmentation in Nooksack dace watersheds date from 50 to 130 years ago, and surviving populations have shown some resilience (Pearson, 2004). The effects of less movement between populations/metapopulations and reduced ability to colonize new habitat, however, may occur over longer time frames.

SPECIAL SIGNIFICANCE OF THE SPECIES

The Nooksack dace is part of the Chehalis fauna, a group of fishes that diverged from Columbia fauna populations while isolated during the most recent glaciations in an ice-free refuge located south of Puget Sound and north of the Columbia River. It and

the Salish sucker, also listed as endangered by COSEWIC (and listed under SARA), are the only two members of this distinctive fauna to have dispersed, post-glacially, as far north as British Columbia (McPhail, 1997). Like most members of the Chehalis fauna the Nooksack dace is closely related to, but genetically and morphologically distinct from, the western North American (Columbia-Fraser) form of a continentally distributed species (longnose dace). Its distribution is also characteristic of Chehalis isolates, scattered populations in the Chehalis River and rivers draining the west side of the Olympic Peninsula and the east side of Puget Sound (McPhail 1997). As the geographic distribution of Chehalis isolates does not usually overlap with their closest relatives, determination of their taxonomic status is difficult. Their genetic, morphologic and distributional distinctiveness, however, indicates that they should be considered evolutionarily significant units for conservation purposes (cf. McPhail and Taylor, 1999). They are of some scientific interest in the study of evolutionary biology and biogeography (McPhail, 1967; Bisson and Reimer, 1977; McPhail, 1997).

Searches of the UBC library catalogue, and a number of zoological, First Nations, and anthropological data bases yielded no reports of Aboriginal use or traditional knowledge of *R. cataractae* or longnose dace.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The conservation status of the Nooksack dace is summarized in Table 5. As a federally listed species at risk under SARA, it is protected from harm or capture in all Canadian waters. The *Species at Risk Act* prohibits the destruction of habitat identified as critical in an approved recovery strategy or action plan (SARA, S.C.2002, c.29, s. 57-58), but the competent minister must make an order before the prohibitions apply. However, its habitat is provided some protection by the federal *Fisheries Act*. The Recovery Team has proposed 21.3 km of the Nooksack River tributaries as critical habitat in a draft recovery strategy under SARA, but has not defined the species '*residence'* under the Act Pearson *et al*. 2006). The Nooksack dace is not protected in Washington State or by the American *Endangered Species Act*.

Table 5. Conservation status of the Nooksack dace, *Rhinichthys cataractae* ssp.

Authority	Status
Natureserve	G1
B.C. Conservation Data Centre	S1
Washington State	S3
COSEWIC (1997)	Endangered
SARA	Endangered; Schedule 1
American Fisheries Society	Threatened

TECHNICAL SUMMARY

***Rhinichthys cataractae* ssp.**
Nooksack dace naseux de la Nooksack
Range of Occurrence in Canada: Fraser Valley, British Columbia

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Calculated by GIS adaptation of maps from McPhail 1997 and Mongillo and Hallock 1997; changed to incorporate Brunette River watershed.	630 km²
• *Specify trend in EO*	Unknown
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* – calculated from measurements of riffle area in 4 occupied watersheds (Pearson 2004; unpubl. data) – based on overlaid grid of cell size one km², total AO is the number of occupied squares that are intersected by the rivers	< 0.03 km² 14 km²
• *Specify trend in AO* • *Trend in last 10 years*	Decline
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	4
• *Specify trend in #*	Unknown
• *Are there extreme fluctuations in number of locations?*	No
• *Specify trend in area, extent or quality of habitat*	Decline
Population Information	
• *Generation time (average age of parents in the population)*	3 years
• *Number of mature individuals (based on known populations)*: (These may be overestimates as some juveniles may have been included in the survey) **Unadjusted** **Adjusted** • Pepin Creek 4400 800 Bertrand Creek 5700 5700 Fishtrap Creek 3900 300 Brunette River 38300 Not Available	Unknown
• *Total population trend:*	Decline
• *% decline over the last/next 10 years or 3 generations.*	Unknown
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	Yes
• *Specify trend in number of populations*	Unknown
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: • Bertrand Creek: <5700 • Pepin Creek: <800 • Fishtrap Creek: <1000 • Brunette River: Unknown	
Threats (actual or imminent threats to populations or habitats)	
Physical destruction of riffle habitat (e.g. dredging, channelization) Lack of water in late summer due to ground and surface water extraction and impermeable urban areas. Riffle loss to beaver ponding. Sediment accumulation in riffles caused by bank erosion, gravel mining and/or urban storm drains.	

Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **Washington State: S3**	
• *Is immigration known or possible?*	Yes
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	No (assumed to be at capacity)
• *Is rescue from outside populations likely?*	No
Quantitative Analysis	NA

Existing Status

Nature Conservancy Ranks (NatureServe 2006)

Global – G3

National

US – N3

Canada – N1

Regional

U.S: WA – S3

Canada: BC – S1

Province: BC – Red

American Fisheries Society: Threatened

COSEWIC: Endangered 1996, 2000, 2007

SARA: Endangered, Schedule 1

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code**: B1ab(iii,v) + B2ab(iii,v)

Reasons for Designation:

The species is considered a habitat specialist dependent on stream riffles with loose, small-grained substrates. This small fish is a representative of the Chehalis fauna, and considered to be a distinct subspecies of the longnose dace. It is known in Canada from only four locations in southwestern BC where its area of occupancy is severely limited, and subject to ongoing physical destruction of riffle habitat by urban, industrial, and agricultural practices (e.g. dredging, channelization). Streams where the species is found are also impacted by lack of water in late summer due to ground and surface water extraction. Other activities have led to sediment accumulation in riffles caused by bank erosion resulting from gravel mining and/or runoff from urban storm drains, leading to further degradation of water quality and habitat.

Applicability of Criteria

Criterion A: (Declining Total Population): Not applicable – decline rates are unknown.

Criterion B: (Small Distribution, and Decline or Fluctuation): Meets Endangered B1ab(iii,v) + 2ab(iii,v). The EO is less than 1000 km^2, and the AO < 1 km^2. The species is known to exist at only 4 locations, populations are fragmented and there is continuing decline in the extent and quality of habitat and number of individuals.

Criterion C: (Small Total Population Size and Decline): Not applicable, number of mature individuals is unknown.

Criterion D: (Very Small Population or Restricted Distribution): Meets threatened D2, AO, < 20 km^2, and known from only 4 locations.

Criterion E: (Quantitative Analysis): Not applicable.

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