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Introduction

The proportion of endemic fish species found in the Columbia Basin in British Columbia sets the Columbia Basin apart from other large drainage basins in North America. At present, the Columbia Basin contains 43 fish species, of which 27 are native (9 endemic), and 16 are introduced ‘exotic’ species. The Columbia Basin presently houses over half (43 of 84 species) of British Columbia’s freshwater fish fauna, making it the parent drainage for freshwater fish diversity in British Columbia.

The breadth of fish biodiversity present in the Columbia Basin native fish fauna is easily underestimated if one merely counts the number of species present. Most diversity exists below the species level, and is represented by unique phenotypic, behavioural and life-history forms that have been selected in the isolated, mountainous terrain and glacial history characteristic of the Columbia Basin. These unique, locally adapted species of fish are part of a complex freshwater fish community that makes the ever-changing Columbia Basin a unique component of the North American Cordillera.

The successful introduction of many exotic, introduced fish species into B.C. waters during the last century appears to be correlated with the large-scale water impoundment that is now typical of the Columbia Basin. As the third longest River in North America, with a total elevation drop of nearly 1,000 metres, the Columbia River and its tributaries were obvious candidates for hydro-electric development as western North America became populated through the 20th C. The impediment that resulted as a function of impoundment and an abundance of harvesting earlier this century has left wild migratory Chinook Salmon (Oncorhynchus tshawytscha) extinct in the Canadian portion of the Columbia Basin. Anadromous Sockeye Salmon (Oncorhynchus nerka) are following suit, hovering above extinction, with only a few adults making the natal return to the Okanagan River each year. The 16 exotic species (37% of the fish fauna) found in the Columbia Basin seem to thrive in areas associated with impoundment and other anthropogenic changes that have lead to a slow-down, warming and eutrophication of waterways. Many exotic species have large reproductive capacities and several have the ability to hybridize with the native fauna. Most successful, introduced exotics are armed with spines along their fin edges that make them resistant to predation, when compared to the soft-rayed native fauna. Exotic species have proved detrimental to some native fish species through competitive mechanisms, and exotic species have been consistently difficult to eradicate once self-sustaining populations become established.
The following accounts describe some of the geographic features of Columbia Basin and the 43 native and exotic fish species currently found within or recently extirpated from the Canadian portion of the Basin. The distribution maps were drawn from data and specimens housed at the Royal British Columbia Museum Ichthyological Collections. The Collections at the Royal British Columbia Museum are some of the oldest collection records in B.C., and these records have proven to be an excellent tool for assessing changes in fish distribution, community structure and species nomenclature. Additional distribution data was obtained from the University of British Columbia Ichthyological Museum.
The Columbia River Basin in British Columbia

From the Source
Located in southeastern British Columbia, the Columbia River Basin drains over 100,000 square kilometres and ranks as B.C.’s third largest river drainage behind the MacKenzie and Fraser river systems. The source of the Columbia River, at Columbia Lake, is hemmed high inland among mountains characteristic of the western North American Cordillera. From its origin the Columbia River flows north along the Rocky Mountain trench, fed by the Spillimacheen and Kicking Horse rivers until arching around the northern tip of the Selkirk Mountains in a large bend near Mica Creek. From Mica Creek the Columbia River continues south past Revelstoke, B.C. and moves into the Arrow lakes chain. At Castlegar, B.C., the Columbia widens as it is met by the Kootenay River and continues south until crossing into Washington State near Trail, B.C.

Major Tributaries (Regions)
The Canadian portion of the Columbia Basin can be divided into eight regions based on watersheds and fish assemblages (McPhail and Carveth 1994). The regions are: the upper Columbia, lower Columbia, upper Kootenay, lower Kootenay, Similkameen, Okanagan, Kettle and the Flathead.

The upper Columbia and upper Kootenay rivers are fed from the cold, turbid, glacier fed tributaries of the Rocky Mountains. The fish fauna of these regions is largely limited to species well adapted to cold water environments such as char, trout, whitefish, and some sculpins. The upper Columbia region extends from the river’s source at Columbia Lake, past Mica Creek, through to the northern end of the Arrow lakes. The upper Kootenay River runs south through Canal Flats, B.C. and passes a mere 2 km from the headwaters of the upper Columbia River at Columbia Lake. From its highland headwaters the upper Kootenay River flows due south until crossing into the U.S.A. near Creston, B.C., where the name changes to Kootenai.

The lower Columbia and lower Kootenay regions are warmer, slower waters than the upper reaches, and they consequently support a more diverse fish fauna including: sturgeon, suckers, minnows as well as char, trout, whitefish and a variety of sculpins. The major feature associated with both the lower Columbia and lower Kootenay regions are two large lakes (Arrow lakes, Kootenay Lake). The lower Columbia River moves south through the Arrow lakes and gains speed at the lake outlet near Castlegar, B.C. From Castlegar, the lower Columbia continues south, fed by the Pend D’Oreille River at the site of Waneta Dam before crossing into the U.S.A. The lower Kootenay
Living Landscapes
Freshwater Fishes of the Columbia Basin in British Columbia
by Peter M. Troffe, Curator of Ichthyology, Royal BC Museum

region extends from the point where the Kootenay (Kootenai) River re-enters Canada near Creston, B.C., through Kootenay Lake’s west arm, to the river’s confluence with the lower Columbia River at Castlegar, B.C.

Many of the high gradient tributaries of the Columbia and Kootenay rivers contain natural escarpments and ancient volcanic terrain that act as fish-proof distribution barriers (Daly 1912). The fish fauna associated with these isolated regions commonly contain unique forms of char, trout, sturgeon and sculpins that have remained reproductively isolated from the main rivers since the Columbia Basin was repopulated with fish postglacially approximately 9,000-13,000 BP. Bonnington Falls (now the site of Bonnington Dam), escarpments along the steeper tributaries of the lower Columbia, and the Pend D’Oreille Gorge (now flooded by Waneta Dam) are some examples of geologic features that have steered the distribution of Columbia Basin fish species.

Waterfall barrier isolating fish populations on Pass Creek at Robson, B.C.

Regions west of the mainstem Columbia River, include the Similkameen, Okanagan and Kettle river systems. These systems have a native fish fauna similar to that of the lower Columbia River, but have been heavily impacted by the introduction of exotic, non-native species since the turn of the 20th C. These drainages empty the southern Interior Plateau and Monashee Mountains, and eventually meet the mainstem Columbia River south of the 49th parallel in Washington State. A natural velocity barrier on the Kettle River at Cascade, B.C., has prevented the upstream dispersal of several endemic species, and a similar distribution pattern is observed in the Okanagan River below the barrier at Okanagan Falls.

The Flathead River region is an isolated watershed located east of the Rocky Mountain trench in the extreme southeastern corner of B.C. The Flathead system is a cool headwater tributary of the Pend D’Oreille River system and contains a sparse, cold-water fish fauna -- the origins of which are complex and poorly known. Although the Flathead region is meager in terms of the number of species it contains, it does, however, contain a community of sculpins that has proven very puzzling to taxonomists. The geologic and glacial history, and the faunal assemblage of the Flathead River suggest that the Flathead Valley shared historical connections to the Missouri River drainage and Great Basin of the Mississippi River east of the Rocky Mountain Divide (Daly 1912; Dowling 1917; MacKenzie 1916; Stewart and Lindsey 1983).
The Origin and Nature of the Columbia Basin Fish Fauna

The fish fauna of the Columbia Basin is one of the most distinct in North America. In B.C., the Columbia Basin houses 43 fish species from 11 families, of which 27 are native species and 16 are introduced species (McPhail and Carveth 1992). Nine of the native species are endemic to the Columbia Basin, and it is these species that set the fish fauna of the Columbia Basin apart from those beyond the North American Cordillera.

It is widely accepted that the present distribution of freshwater fish in British Columbia is a function of historic, repeated, large-scale glacial events that successively swept B.C. clean of its fish fauna. The most recent glacial period (Wisconsin) is believed to have advanced approximately 50,000 BP, and began withdrawing from the Pacific Coast and southern extents nearly 10,000 BP. During the Wisconsin glacial period the majority of British Columbia was covered by the Cordilleran ice sheet and the biota was either destroyed or pushed into ice-free refuges that lay beyond the ice mantles. Evidence suggests that at least two areas along the B.C. coast remained ice free, but the majority of ice-free refuges lay outside B.C. borders (McPhail and Lindsey 1970; Hebda and Haggarty 1997).

The maximum extent of the Wisconsin glacial period saw the Cordilleran ice mantle reach the northern edge of the Columbia Plateau, and several ice-lobes had isolated portions of the Columbia River Basin. These ice dams impounded large portions of the Columbia River into a series of vast lakes that were formed and emptied in a number of catastrophic floods that swept across eastern Washington State (Allen et al. 1986). The recolonization of fish held in refugial areas south of the ice sheets (Columbia Refuge) began about 13,000 BP, with the retreat of the ice mantle in the lower Kootenay region (McPhail and Carveth 1992). By about 11,000 BP the remaining fronts of the Cordilleran ice-sheet began to withdraw, and British Columbia was repopulated by fish species native to the southern Columbia Basin. The Columbia Refuge fish immigrants would eventually spread through a series of ephemeral connections into the upper Fraser, Peace River and Mackenzie River drainages as the slabs of continental ice continued to retreat (McPhail and Lindsey 1970). The historic connections of the Columbia Basin with the Fraser River and Peace River drainages make the fishes of the Columbia Basin the single most important representation of B.C.’s freshwater fish diversity.
Major Tributaries and Regions of the Columbia Basin in British Columbia
Exterminated Fishes: Family Salmonidae

*Oncorhynchus tshawytscha* (Walbaum)

*Oncorhynchus*=hooked snout
*tshawytscha*=Russian vernacular

Chinook are one of the most prized and culturally renowned salmon species on the Pacific Coast of North America. At one time the Columbia River was home to the world’s largest runs of Chinook and other Pacific salmon species. The anadromous Chinook would make annual natal migrations of nearly 2,000 kilometres from the mouth of the Columbia River at Portland, OR, into the upper portions of the Columbia River in British Columbia. In 1809, explorer David Thompson recorded the presence of Chinook Salmon weighing up to 16 kg (36 lbs) at Kootenae House, the first trading post established in the Columbia River Basin, near Windermere, B.C. (Holbrook 1956). Archaeological evidence suggests that the Chinook runs in the upper reaches of the Columbia Basin were an important winter food source for Ktunaxa/Kinbasket First Nations people. By the mid 1880s some of the last major First Nations’ salmon harvests were conducted in the Upper Columbia near the river’s source at Columbia Lake, and the populations have been in steady decline ever since (Heitzmann 1999; Milne and Godfrey 1964). There have been some reports of Chinook in the Okanagan River (McPhail 1994), but it is thought that these runs were impeded from migration passage since the construction of the Grand Coulee Dam in 1941 (Myer *et al.* 1998; US Army Corps of Engineers/Bonneville Power Administration 1998).

Today, wild runs of Chinook Salmon are extinct in the Canadian portion of the Columbia River. Extensive impoundment, harvests and other anthropogenic disturbances in both Canada and the U.S.A. have prevented the passage of successive runs of spring, summer and fall migratory Chinook populations. There has been little attention or rehabilitation effort directed at the Canadian Columbia River Chinook populations. In an age where conservation programs and managers are directing their focus at within species diversity (*e.g.* salmon stocks) we find that ‘species’ as a whole are becoming extinct on a regional basis.

Chinook have been since re-introduced into the lower Columbia at Roosevelt Lake (reservoir) in Washington State, and some Chinook are occasionally found in the
lower reaches of the Columbia River below Trail, B.C. Juvenile Chinook can be distinguished from other young salmonids by the presence of a clear, unpigmented adipose fin and by the position of parr marks arranged in evenly spaced bars extending above and below the lateral line.
Introduced fishes

Earlier this century there were few stigmas associated with the stocking of ponds, lakes and rivers with non-native fish species for food, sport, commercial or aesthetic reasons. Many of the western Canadian fish introductions were welcomed as a reminder of back home, and records indicate that exotic species such as Smallmouth Bass (*Micropterus dolomieu*) were introduced into Christina Lake (Kettle system) as early as 1901 (RBCM collection records). Today, attitudes have changed and we find that 37% (16 species) of the fish fauna in the Canadian portion of the Columbia Basin are non-native species (McPhail and Carveth 1992).

The majority of these introduced species thrive in the warmer waters of the lower Columbia, Kettle and Okanagan drainages. Some exotics such as Carp (*Cyprinus carpio*) and Goldfish (*Carassius auratus*) have large reproductive capacities that enable them to quickly outnumber the less fecund, but locally adapted, native fauna. Other exotic species from families Centrarchidae (Bass and Sunfish) and Percidae (Perch) are armed with spines along their dorsal surface and fin edges, making them resistant to predation when compared to the native soft-rayed fauna. Whatever the case, exotic species seem most suited to areas that have been influenced by anthropogenic impacts associated with impoundment, agricultural use and urbanization (Dill and Cordone 1997; Nico and Fuller 1999; Gido and Propst 1999).

In addition to the introduction of non-native exotic species, many lakes, rivers and streams have been stocked with non-native, or semi-domesticated recreational species. Translocations of locally adapted species outside their original native habitat have been shown to alter the genetic integrity of wild, native faunal assemblages (Philipp *et al.* 1993; Billington and Herbert 1991). Rainbow Trout are native throughout most of British Columbia; however, the translocation of this opportunistic trout species has been detrimental to many Westslope Cutthroat Trout (*Onorhynchus clarki lewisi*) populations through mechanisms of displacement and hybridization. Most freshwater fish taxonomists agree that Char (*Salvelinus*) are notorious for their ability to hybridize and introgress among congeners (*e.g.* Baxter *et al.* 1997). Transplants of Lake Trout (*Salvelinus namaycush*) and Eastern Brook Trout (*Salvelinus fontinalis*) have occurred in a number of Columbia Basin lakes and rivers in efforts aimed at diversifying recreational angling opportunities.
Today we are noting the demise, and in some cases the eradication, of native Bull Trout (*Salvelinus confluentus*) populations as a result of such transplants (Donald 1993).

**Introduced Fishes: Family Cyprinidae (Minnows, Carp)**

*Carassius auratus* (Linnaeus)

*Carassius* = European Crucian Carp  
*auratus* = gilded

The first account of Goldfish in British Columbia was in 1935 from a large pond in Salmon Arm, B.C. (Carl *et al.* 1967). Further collections made in 1941 by G.C. Carl noted that the Salmon Arm population had increased their numbers tremendously since 1935, and had become the dominant species. In the Columbia Basin, Goldfish populations are currently established in the warm waters of the lower Columbia River and Okanagan system. Most introductions of this Eastern Asian native come from illegal releases of aquarium fish and the distribution of Goldfish in British Columbia is continually subject to change.

Goldfish are an opportunistic long-lived species that are most successful in ponds and lakes with a large littoral zone and dense vegetation (Scott and Crossman 1973). Like many cyprinid species, Goldfish are an omnivorous species that feed on aquatic invertebrates and many types of aquatic vegetation. In the wild this species often reverts to an olive-brown colour as brightly pigmented individuals are easily picked by avian predators. Mature fish of both sexes usually congregate from April to August in shallow marshy areas to spawn. Breeding males develop tubercles on their operculum and pectoral fins, while females become noticeably rotund as their ovaries develop eggs (Wydoski and Whitney 1979). Larger females may deposit as many as 12,000 eggs, but most Goldfish found in British Columbia are smaller (<25 cm) and rarely produce more than 2,000 eggs a season. Females scatter sticky eggs among aquatic vegetation and are commonly accompanied by many males during egg deposition. The eggs develop without parental care and usually hatch in 5-10 days after fertilization, depending on water temperatures (Breder and Rosen 1966).
Goldfish are identified by the presence of a well-developed spine on the leading edge of the anal, and a long dorsal fin. The dorsal fin usually has 18 rays and extends onto the caudal peduncle. Goldfish lack the distinct corner mouth barbel of Carp (*Cyprinus carpio*) and have 31 or less scales arranged along the lateral line.

![Goldfish](image)

*Cyprinus carpio* (Linnaeus)

*Cyprinus* = after island of Cyprus where Carp was first introduced in Europe  
*carpio* = Carp

Carp are native to temperate regions of Asia and are now widespread through Europe and North America. They most commonly inhabit shallow areas of lakes and streams and generally avoid swift waters. It is suspected that Carp were first noted in the Okanagan Valley in 1912 from populations planted in Washington State in 1882 as a food fish (Carl *et al.* 1967). The populations grew rapidly, and by 1934 7 Imperial Tons of Carp were removed from a trap set at the outlet of Okanagan Lake (McCrimmon 1968). In 1936, Dymond reported that Carp were not uncommon in Kalamalka, Woods and Shuswap lakes.
Carp forage for benthic crustaceans, aquatic insects, worms, algae and plant material. Males usually mature in their second year -- females mature in their third year. Spawning occurs in shallow water during the spring and summer when small groups containing one or more females and numerous males converge. Females release several batches of adhesive eggs while swimming through shallow water so that the eggs are distributed over a large area (Breder and Rosen 1966). Once females have finished depositing eggs they exit the spawning ground while males remain to spawn with other females. The eggs develop rapidly and usually hatch within four to seven days, depending on water temperature.

Carp are currently distributed in the lower Columbia (Arrow Lakes), lower Kootenay, Kettle (Christina Lake), and throughout the Okanagan system.

Carp can be identified by their long dorsal fin, heavy spines in front of the anal and dorsal fin, large immaculate scales and the presence of a conspicuous single barbel at the corner of their mouth.

Carp
Tinca tinca (Linnaeus)

*Tinca* = Latin for Tench

Tench are slow-moving Carplike fish that are commonly introduced into ornamental ponds throughout Eurasia. Tench were first noted in British Columbia by G.C. Carl in 1941 from a lakeside pond near Osoyoos Lake, and several populations are now scattered through the Columbia Basin (RBCM collection records). It is likely that populations currently established in British Columbia originated from a series of small lakes near Spokane, Washington, where Tench were first introduced around 1895 (Carl *et al.* 1967). Habitat requirements of Tench are similar to that of Carp, and the two species are superficially similar, with Tench being the smaller of the two species. Spawning usually takes place during the early summer in weedy shallows when females deposit large numbers of small, rapidly developing eggs.

Tench are currently established above and below Okanagan Falls (Okanagan system), in Christina Lake (Kettle system) and in the Pend D’Oreille system above Waneta Dam.

Tench lack the long dorsal fin of Carp, and can be identified by their blocky head, dark fins, small immaculate scales and deep caudal peduncle.
Living Landscapes
Freshwater Fishes of the Columbia Basin in British Columbia
by Peter M. Troffé, Curator of Ichthyology, Royal BC Museum

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Introducing Fishes: Family Ictaluridae (Catfish)

*Ameiurus melas* (Rafinesque)  
*Black Catfish* (left)

*Ameiurus nebulosus* (Lesueur)  
*Brown Catfish* (right)

*Ameiurus* = Nearctic cat-fish
*mela* = black
*nebulosus* = clouded

Catfish are generally a nocturnal fish native to North America east of the Continental Divide. In 1941, C.G. Carl recorded collecting several Black Catfish specimens from Oysoos Lake, B.C. It is likely that these fish originated from Washington State via the Okanagan River and thoughtless public transplants (Carl *et al.* 1967; Forbes and Flook 1985).

Catfish are rarely found in clear running water and prefer ponds, sloughs and backwaters. Ictalurid fish are a robust exotic fish family that are tolerant of high water temperatures and low, dissolved oxygen concentrations. Catfish are opportunistic bottom feeders that forage for insects, crustaceans, worms, snails, fish eggs and plant material.

Spawning takes place during late spring when water temperatures reach about 15°C. Females dig a circular depression among dense vegetation in sand or mud that serves as a nest, and both sexes circle each other in courtship before the female deposits her eggs for fertilization. The eggs develop rapidly, hatching in five to seven days, depending on water temperature, and are guarded by both parents until the young are several weeks old (Breder and Rosen 1966).

Catfish are currently distributed in the lower Columbia, lower Kootenay and Okanagan systems. Catfish can be identified by their wide head, large mouth with eight long barbels, scaleless skin and prominent adipose fin. The Black Catfish (*Ameiurus melas*) and Brown Catfish (*Ameiurus nebulosus*) are often confused for one another. The pectoral spines of the Brown Catfish are serrated along their posterior edge, unlike the Black Catfish. Also, the Brown Catfish lacks inky black membranes between its finrays, which are present on the Black Catfish.
Living Landscapes
Freshwater Fishes of the Columbia Basin in British Columbia
by Peter M. Troffe, Curator of Ichthyology, Royal BC Museum

Introduced Perch (Percidae) and Catfish (Ictaluridae) Species of the Columbia Basin

- *Perca flavescens*
- *Stizostedion vitreum*
- *Ameiurus melas / nebulosus*
Introduced Fishes: Family Percidae (Perch)

*Perca flavescens* (Mitchill)

*Perca*= ancient name meaning dusky

*flavescens*= yellowish

Yellow Perch is a widely distributed species that is native to lakes, ponds and slow-moving fresh and brackish waters east of the Continental Divide. Populations of Yellow Perch currently found in the Columbia Basin probably originated from Washington State where they were widely introduced in 1890 (Carl et al. 1967).

The Yellow Perch is currently established in the lower Columbia (including the Pend D’Oreille), upper Kootenay, lower Kootenay, Similkameen rivers and Okanagan system.

Yellow Perch are a laterally compressed, spiny fish with two completely divided dorsal fins, the first of which is heavily spined. The lateral surfaces are patterned with banded markings.

![Yellow Perch](image-url)
**Stizostedion vitreum** (Mitchill)

*Stizostedion* = pungent throat  
*vitreum* = glassy, referring to the large eye

The native distribution of Walleye includes most of Canada east of the Continental Divide. Walleye are one of the most important sport fish in Ontario and the Prairie provinces, where they are commonly known as Pickerel. Adult Walleye are currently established in the lower Columbia, below Castlegar, B.C., and it is likely that their distribution will expand up river in time. Walleye are common in Roosevelt Lake (reservoir) in Washington State, and it is likely that this species moved upstream into the Canadian portion of the lower Columbia River. There has been a single juvenile specimen collected in the Kettle River and it is likely that a reproducing population resides further down river. It is estimated that in the Columbia Basin this exotic piscivorus species preys heavily on salmon smolts (McMahon and Bennett 1996).

Walleye have a long, cylindrical body with two well-developed dorsal fins, the first of which is stoutly spined. The leading edge of the anal fin is preceded by two, sharp spines.
Introduced Perch (Percidae) and Catfish (Ictaluridae) Species of the Columbia Basin

- Perca flavescens
- Stizostedion vitreum
- Ameiurus melas / nebulosus
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Introduced Fishes: Family Salmonidae (Trout, Salmon, Whitefish, Char and Grayling)

*Salmo trutta* (Linnaeus)

*Salmo* = Latin for the Salmon of the Atlantic; "to leap"

*trutta* = trout

Original introductions of Brown Trout in Canada came to Newfoundland in 1884 from Loch Leven, Scotland. The European Brown Trout inhabits lakes streams and coastal rivers and has a reputation as a wily game fish with experienced anglers. The Brown Trout was originally introduced to British Columbia from eggs purchased from Wisconsin and Montana in 1932 (Clemens and Wilby 1946). These eggs were hatched in a hatchery, and the fry were deposited in several rivers on Vancouver Island. Many sea-run populations of Brown Trout are currently established and promoted as exotic angling opportunities.

Brown Trout were introduced into the Columbia Basin via the Kettle River system in 1957, and they are occasionally taken by anglers in the West Kettle and Similkameen rivers.

Brown Trout can be identified by the presence of large, dark brown or black spots along the lateral surfaces, surrounded by pigmented halos of blue and red colouration. Unlike other members of the genus *Salmo*, Brown Trout spawn in the fall and early winter. The gape of the maxillary extends past the margin of the eye and the caudal fin is almost square or slightly forked.
**Salvelinus fontinalis** (Mitchell)

*Salvelinus* = an old name for Char  
*fontinalis* = living in springs

Brook Trout are native to northeastern North America where they are a common game fish inhabiting both lakes and streams. Most Brook Trout populations presently found in British Columbia originated from numerous transplants from eastern Canada early in the 20th C. Brook Trout are one of the most commonly transplanted salmonid species in Canada; they do not require running water to spawn, and transplants are equally successful in lakes and in rivers. Members of the genus *Salvelinus* are prone to hybridization within and outside their genus (*e.g.* Baxter et al. 1997; Crossman and Buss 1966). There is some concern that the introduction of the non-native Brook Trout has had deleterious effects on native fluvial and lacustrine Bull Trout (*Salvelinus confluentus*) as well as Kokanee (*Oncorhynchus nerka*) populations throughout B.C.

G.C. Carl reported seeing Brook Trout in 1944 in a small stream north of Keremeos, and populations are currently established throughout the Columbia system except the Flathead River. Brook Trout can be identified by the presence of distinct, black streaks on their dorsal fin, truncate caudal fin, vermiculations (wormlike patterns) on their dorsal surface, and green and red spots on the lateral surfaces surrounded by blue halos.

**Brook Trout**
Salvelinus namaycush (Walbaum)

Salvelinus = an old name for Char
namaycush = a First Nations' name meaning deep dweller

Lake Trout are a large cold-water char that frequent deep lakes. They are one of the larger members of the genus Salvelinus, and grow up to 45 kg. The native distribution of Lake Trout includes most of northern North America including British Columbia north of Shuswap Lake (Lindsey 1964). Although not native to the Columbia Basin, Lake Trout were successfully introduced into the lower Columbia, lower Kootenay and Okanagan systems for purposes of large game angling. The introduction of these large piscivorus fish has had a deleterious effect on some Bull Trout (Salvelinus confluentus) populations to the point that some populations are now extinct (Donald 1993).

Lake Trout are fall spawners and -- unlike most salmonids -- do not require running water for the development of their eggs. Most spawning occurs along shallow gravel margins of lakes, although some stream spawning has been reported.

Lake Trout can be identified by their large mouth that extends past the margin of the eye, the presence of creamy irregular spots and vermiculations (wormy markings) covering the fins and dark body and a deeply forked caudal fin.
Thymallus arcticus (Pallas)

Thymallus = ancient name referring to the odour of thyme
arcticus = of northern distribution

Arctic Grayling are common in lakes and fast-flowing streams in the Mackenzie drainage of northern B.C., and less common in the extreme southeastern portion of the province in the Flathead River system. Naturally occurring pockets of Arctic Grayling survived Pleistocene Glaciation in Montana and Michigan, but these natural populations have become extinct since the 1930s (Carl et al. 1967). Arctic Grayling have since been re-introduced into western Montana, and it is thought that the Flathead River populations originated from this introduction.

Arctic Grayling typically follow a contagious distribution and are seldom found alone. They inhabit pools in larger rivers, and make seasonal foraging and reproductive migrations in and out of lakes and small tributaries.

Arctic Grayling are easily identified by their brilliant iridescent lateral surface colouration and prominent sail-like dorsal fin. Juvenile Arctic Grayling are easily confused with juvenile whitefish of the genus Prosopium, but Prosopium's jaws have poorly developed teeth in comparison to the young Arctic Grayling.
Coregonus clupeaformis (Mitchill)

Coregonus = angle-eyed
clupeaformis = herring-shaped

Lake Whitefish are widely distributed throughout Canada where they are recognized as a valuable commercial species (Scott and Crossman 1973). Lake Whitefish are generally restricted to the cool bottom regions of larger lakes where they feed primarily on benthic insects and crustaceans. This species is of particular scientific interest as, like many Coregonids, Lake Whitefish are highly polymorphic, and many lakes contain two forms. The 'dwarf' and 'normal' forms differ in growth rate, size of maturity, gill raker number and exhibit distinct genetic differences (Bodaly 1979; Bernatchez and Dodson 1991). Although Lake Whitefish are native to northern British Columbia, populations from eastern Canada were introduced to the larger lakes of the Columbia Basin in hopes that they would become a commercially viable species. The introduced populations have become neither abundant nor sizable, and the species is caught only occasionally by anglers today. An attempt to develop a commercial fishery in Okanagan Lake in 1929 was considered unsuccessful. Transplanted Lake Whitefish are currently distributed in the Arrow and Kootenay lakes as well as the Okanagan system.

Lake Whitefish are a large-scaled species with a silvery, flat-sided, deep body. The snout overhangs the lower jaw and the brow is commonly concave.
Introduced Trout and Char (Salmonid) Species of the Columbia Basin

- Salvelinus fontinalis
- Salmo trutta
Introduced Fishes: Family Centrachidae (Bass and Sunfish)

*Lepomis gibbosus* (Linnaeus)

*Lepomis* = scaled gill cover  
*gibbosus* = formed like the full moon

The Pumpkinseed Sunfish is native to southeastern Canada where it prefers weedy lakeshore waters. The origin of the Pumpkinseed Sunfish in British Columbia is unknown, but its distribution seems to follow that of the Smallmouth Bass; it seems likely that these two centrachid species were introduced to British Columbia together early in the 20th C. Sunfish are considered a specious group of fish in their native range, and recent evidence suggests that this species can exhibit a variety of different phenotypic and behavioural forms (Robinson and Wilson 1996).

Pumpkinseed Sunfish are currently established in the lower Columbia, lower Kootenay, Kettle and Okanagan systems below Cascade and Okanagan falls.

Pumpkinseed Sunfish are marked by a distinct black spot on the posterior edge of their gill flap, which ends in a flat spine. The anal fin is preceded by three to four rigid spines, and it is less than half as long as the dorsal fin.
Micropterus dolomieu (Lacpde)

Micropterus = small or short fin; the dorsal fin of the type specimen was damaged, which led Lacpde to mistake it for a second small fin.
dolomieu = after M. Dolomieu (after whom dolomite was named); a French mineralogist and friend of Lacpde

The native distribution of Smallmouth Bass was restricted to eastern-central North America. Smallmouth Bass is a popular recreational species, and the species has been widely introduced across Africa, Canada, Europe, Russia and the United States of America. In British Columbia, Smallmouth Bass fry were first introduced in the fall of 1901 to the Kettle River system at Christina Lake to provide angling opportunities in waters deemed too warm for native trout species (RBCM collection records). Smallmouth Bass are currently established in the upper and lower Columbia River, Kettle River below Cascade Falls, and throughout the Okanagan system.

Smallmouth Bass can be identified by: an upper jaw that does not extend past the posterior margin of the eye, a banding pattern across the operculum, short spines on the leading edge of the anal fin, and the presence of a notch separating the spined and soft rayed portion of the dorsal fin.
**Micropterus salmoides** (Lacpde)

*Micropterus*= small or short fin; the dorsal fin of the type specimen was damaged, which led Lacpde to mistake it for a second small fin.

*salmoides*= troutlike

The native distribution of the Largemouth Bass is similar to that of the Smallmouth Bass, and it too has been widely introduced throughout North America and globally. It has been suggested that populations of Largemouth Bass in British Columbia stem from fish that escaped from a private pond near the Kootenai River, Idaho in 1916 (Carl *et al.* 1967). Populations of Largemouth Bass are established in the upper and lower Kootenay, the lower Columbia and the Kettle rivers, and the waters of the Okanagan system.

Largemouth Bass can be identified by: an upper jaw extending past the posterior margin of the eye, a banding pattern across the operculum, short spines on the leading edge of the anal fin, and the presence of a notch separating the spinus and soft-rayed portion of the dorsal fin.
**Pomoxis nigromaculatus** (LeSueur)

*Pomoxis* = sharp gill cover  
*nigromaculatus* = dark-spotted

The Black Crappie is a common fish, native to eastern and central North America. It was commonly introduced into Washington and Oregon states early in the 20th C, and it is likely that these populations were the source for B.C.’s introductions. The Black Crappie is currently established in the Okanagan River below Okanagan Falls. The lateral profile of the Black Crappie is similar to that of the Pumpkinseed Sunfish; however, the Black Crappie’s long anal fin and dorsal fin are approximately equal in length and five to seven fine, sharp spines precede the anal fin.
Native Fishes

With 27 native species, 9 of which are endemic to the Columbia system, the fish native to the Columbia Basin form one of the most distinct freshwater fish faunas in North America (McPhail and Carveth 1994). The endemic fish assemblage housed in the Columbia Basin sets apart the entire freshwater fish fauna of British Columbia from that of the rest of Canada east of the Rocky Mountain Divide.

The amount of biodiversity housed within the unique faunal assemblage of the Columbia Basin is easily underestimated if one merely counts the number of fish species present. A great wealth of selected variability exists below the species level that is often underappreciated by species list-makers. The Columbia system contains unique types of Kokanee, whitefish, sculpins, dace, suckers, sturgeon, Rainbow Trout and Cutthroat Trout. Many of these ecotypes are locally adapted varieties that have become isolated from other reproductive groups by the mountainous terrain and glacial history that is characteristic of the Columbia Basin. Much of the diversity below the species level is represented by phenotypic differences like those of Longnose Suckers (*Catostomus catostomus*), Umatilla Dace (*Rhinichthys umatilla*) and Torrent Sculpins (*Cottus rhotheus*) isolated by waterfalls and other fish-proof barriers. Ecological variation is more pronounced in species like Longnose Dace (*Rhinichthys cataractae*), Mountain Whitefish (*Prosopium williamsoni*) and Kokanee (*Onchorhynchus nerka*).

These and other native, locally adapted fish species display a wide variety of reproductive and foraging behaviours that are dependent on seasonal variations in photoperiod and water flow regimes for continued maintenance over time.

Although large-scale water impoundment is nothing new, the anthropogenic change associated with it, including the introduction of non-native species, has impacted the native fish fauna of the Columbia Basin. Many native riverine fish assemblages in North America have been adversely affected by habitat modifications that are a direct and an indirect result of large-scale water impoundment during the 20th C.

The Columbia River and its tributaries were obvious candidates for flood control and hydro-electric development as western North America became populated through the 20th C. Impoundment of the Columbia River and its tributaries began in 1933 with the construction of the Rock Island dam south of Wenatchee, Washington and a flurry of impoundment construction continued in both the United States and Canada until 1985 when the Revelstoke dam was completed.
The direct effects of anthropogenically induced impoundment on native fish populations are obvious -- fish require water to survive and fare best in natural environments to which they have become locally adapted -- dams impede migration passage, disrupt natural flow regimes, alter water quality and convert complex riverine habitats into slow moving reservoirs (Brett 1957). Currently we find that migratory wild Chinook Salmon (*Oncorhynchus tshawytscha*) -- a species that historically migrated over 1900 km to spawn in the upper Columbia -- are extirpated from the Canadian portion of the Columbia Basin. Migratory Sockeye Salmon (*Oncorhynchus nerka*) populations are following the same fate as Columbia Chinook Salmon with populations so dangerously low that only a few individuals survive the long natal return migrations to the Okanagan River below Vaseau Lake.

The indirect effects of impoundment and non-native fish introductions to native fish populations can be complex. The introduction of exotic species (both fish and macroinvertebrates) into impounded waters has visibly altered the native fish communities in the Columbia Basin, and there are some drainages where the numbers of exotic species currently exceed the native fauna.

**Native Fishes: Family Acipenceridae (Sturgeon)**

*Acipencer transmontanus* (Richardson)

*Acipencer* = sturgeon  
*transmontanus* = beyond the mountains

White Sturgeon is the largest freshwater fish in North America, with the largest individuals reaching lengths of up to 6 m and weighing over 800 kg. In the Columbia Basin, White Sturgeon is most commonly found in large, cool, fluvial environments, but some populations have become isolated in the larger lakes. Columbia River and Kootenay River sturgeon were originally isolated by natural barriers at Bonnington Falls since the Pleistocene glaciation, and these populations have become isolated further by a series of impoundment dams along the lower reaches of the Kootenay River. White Sturgeon are currently considered a rare, threatened species in western North America, after populations were reduced to very low numbers by overfishing early this century. As a consequence, harvesting sturgeon in British Columbia has been illegal since 1994. The absence of juvenile fish in life history studies conducted on the Kootenay River suggest that these sturgeon populations have not reproduced since 1974; furthermore, numbers of adult individuals in breeding condition are dangerously low (Cannings and Ptolemy 1998).
Spawning is thought to take place in fast water during June-July during peak freshet flows, and some spawning has been observed in the race tails at the confluence of the Pend D’Orielle and lower Columbia River at the site of Waneta Dam. Some Kootenay River sturgeon make seasonal migrations into Kootenay Lake where they spend the winter at depths of up to 100 m (Cannings and Ptolemy 1998). It seems that females inhabit deeper water than males do during this winter period.

There have been occasional reports of sturgeon in Slocan, upper Arrow and Okanagan lakes, but most Canadian Columbia Basin sturgeon are known from the lower Columbia River, Kootenay River above Bonnington Dam, in Kootenay lake and in the upper Kootenay River.

White Sturgeon
Native Fishes: Family Cyprinidae (Chub, Minnows, Dace)

*Acrocheilus alutaceus* (Agassiz and Pickering)

*Acrocheilus* = sharp lip  
*alutaceus* = leathery

Chiselmouth are endemic to the rivers and lakes of British Columbia and the northwestern United States. It was unknown in British Columbia waters until 1950 when a population was discovered in Skaha Lake (Scott and Crossman 1973). This species has a spotty distribution pattern in British Columbia that suggests it requires warmer waters than many other cyprinid species. There has been sporadic historical reports of Chiselmouth in Windermere Lake, in the upper Columbia region, and a single adult specimen was collected in 1957 by H.V. Hopkins near Windermere Lake outlet (RBCM collection records). Recent surveys of Windermere Lake suggest that Chiselmouth are now extirpated from the Upper Columbia. The feeding behaviour of Chiselmouth is unique and, as their common name implies, they posses a sharp chisel-like lower jaw that is used to scrape algae from smooth rocks and submerged logs (Moodie and Lindsey 1972). After the Chiselmouth eats the algae, the algae remains relatively undigested in the fish’s long gut, but the nutritive portions of diatoms contained within the algae are absorbed. Chiselmouths are rare in British Columbia, and little is known about the life-history and habitat requirements of this unique species.

The distribution of Chiselmouth in the Columbia Basin is restricted to below barriers in the Similkameen, Okanagan, Kettle and lower Columbia systems.

Chiselmouth have a long, slender caudal peduncle and a deeply forked caudal fin. The lower jaw is covered with a rigid cartilaginous plate that appears honed to an edge, like that of a chisel.
**Couesius plumbeus** (Agassiz)

*Couesius*= after ornithologist Elliot Coues  
*plumbeus*= lead-coloured

Lake Chub have a wide native distribution that includes streams, rivers and lakes throughout Canada. This species is capable of tolerating a wide variety of habitats, and some populations even inhabit hot springs in portions of the Mackenzie Drainage. Lake Chub are a small, schooling, cyprinid fish that mature in their third or fourth year, and are an important diet item for larger piscivorous fish. Females have shorter paired fins, generally grow faster and live longer than the males. Lake Chub come into reproductive condition in early spring, and deposit small, yellow eggs along the rocky margins of streams and lakes. The eggs hatch about two weeks after they are laid, depending on water temperature (Breder and Rosen 1966). The males develop tubercles on their head, pectoral and pelvic fins as they come into breeding condition. It has been suggested that Lake Chub west of the Rocky Mountain Divide are a subspecies that has been isolated from the rest of North America since the Pleistocene Glaciation (McPhail and Lindsey 1970). Like many cyprinid species, Lake Chub are prone to hybridization; and Nelson (1966) and Butcher (1980) provided evidence that Lake Chub and Longnose Dace were hybridizing in the Kananaskis Reservoirs, Alberta.

Lake Chub have a small terminal barbel near the corner of their mouth, and the insertion of their dorsal fin is slightly anterior to the insertion of their pelvic fins when viewed latterly.

In the Columbia Basin, Lake Chub are confined to small lakes in the warm waters of the Kettle, Okanagan and Similkameen systems.
Mylocheilus caurinus (Richardson)

Mylocheilus = grinder lip
caurinus = wind from the northwest

This species is endemic to western North America, and is the sole member of the genus Mylocheilus (Bailey et al. 1970). Peamouth Chub are commonly found in the weedy shallows of rivers and lakes, and grow to a maximum of about 35 cm. Peamouth Chub are one of the most abundant cyprinid species in the Columbia Basin, and are easily angled on a variety of baits including dry flies. Near the turn of the last century Peamouth Chub were erroneously advertised as freshwater herring or white-fish, and served up in hotels throughout the Columbia Basin.

Spawning takes place in the inlets, outlets and gravel shallows of lakes during May and June once waters reach about 12ºC (Wydoski and Whitney 1979). During spawning, Peamouth Chub aggregate in schools, then females broadcast release large numbers of sticky, greenish eggs that hatch in seven to eight days depending on water temperatures. Male and female Peamouth Chub are dimorphic during the breeding season, with the ripe males developing tubercles on the head, pectoral and pelvic fins. Breeding males also develop a dark lateral stripe flanked with tinges of red, and exhibit a dark green dorsal surface. Ripe females are less colourful than males, and lack well-developed lateral stripes.

Like many cyprinids, Peamouth Chub hybridize easily with other family members, and in 1856 a specimen was described from the lower Columbia as a new species, Cheonda cooperi (Carl et al. 1967). Nearly a hundred years later a similar specimen was found in Flathead Lake, Montana that was correctly identified as a hybrid between the Redside Shiner and Peamouth Chub (Weisel 1954). A similar case of hybridization has been noted for Northern Squawfish (Ptychocheilus oregonesis) and Peamouth Chub (Scott and Crossman 1973).

Peamouth Chub are currently found throughout the Columbia Basin except the Flathead system. Peamouth Chub can be identified by their deeply forked tail, small mouth that ends in a small terminal barbel and well-developed pelvic auxiliary process (finlette) above the pelvic fin.
**Richardsonius balteatus** (Richardson)

*Richardsonius*=after Sir John Richardson  
*balteatus*=girdled

Redside Shiners are native to the pacific slope of North America, where they are abundant and widespread in lakes, ponds and slow rivers. The biology of this abundant species has received a lot of attention compared with other cyprinid species because of their close relationship to Rainbow Trout sports fisheries. Redside Shiners were widely introduced into the lakes of the interior of B.C. to provide forage for trout species, but it was later discovered that they out compete and forage on small salmonids (Johannes and Larkin 1961). Great efforts have been mounted to remove Redside Shiners from lakes where they were introduced, but eradication attempts have been unsuccessful and many transplanted populations remain.

Lake-dwelling Redside Shiners make seasonal migratory and daily movement patterns. They inhabit shallow water by day and deeper waters during the night and winter months (Lindsey and Northcote 1963). Tributary stream inhabitants migrate into the stable lower reaches, as water temperatures and photoperiod decreases with approaching winter.

Redside Shiners are seldom found alone, often congregating in schools by the thousands. Redside Shiners spawn in groups of 30-40 during May to early August when males become brilliantly coloured in crimson and gold. Sexual maturity is reached in their third year, and females deposit small, adhesive eggs in multiple lots throughout the breeding season over an unprepared substrate (Scott and Crossman 1973). Redside Shiners are known to hybridize with Northern Squawfish (*Ptychocheilus oregonensis*), Longnose Dace (*Rhinichthys cataractae*) and Peamouth Chub (*Mylocheilus caurinus*) (Carl *et al.* 1967; Scott and Crossman 1973).

Redside Shiners are common throughout the Columbia Basin, but absent from the Flathead River system.

Redside Shiners are laterally compressed, have a long anal fin base length and the posteriorly mounted dorsal fin has its insertion above the anal fin origin.

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**Redside Shiner**
**Ptychocheilus oregonesis** (Richardson)

Ptychocheilus=folded lip  
oregonesis=of Oregon

The native distribution of the Northern pikeminnow is typical of species that have survived glaciation in the Columbia Refuge (McPhail 1967). In British Columbia, these endemic minnows are found only in drainages between the Pacific and Rocky Mountain divides. They are common in weedy lakes, slow-moving streams and edge waters of larger rivers in all regions of the Columbia Basin except the Flathead system. Northern pikeminnow, like Peamouth Chub, are one of the most numerous species in B.C., and are commonly caught by anglers on a wide variety of baits including fruit and berries.

Juveniles inhabit the shallow back channels and lake edges, while larger fish dwell along drop-off zones in the summer months (Scott and Crossman 1973). Northern pikeminnow feed on a variety of organisms, but larger individuals are primarily piscivorus. Sexual maturity is achieved at around six years, once the fish reaches about 30 cm in length. Spawning occurs during late May to July when congregations form along lake shores or near tributary streams. Females may spawn many times in a season, and are usually accompanied by many males during breeding.

The head of Northern pikeminnow is somewhat flattened between the eyes, the mouth is large and the maxillary extend to the hind margin of the eye. While most juvenile cyprinids are notoriously difficult to identify, juvenile Northern pikeminnow have a distinct black spot on their caudal peduncle.
Minnow and Chub (Cyprinidae) Species of the Columbia Basin

- **Acrocheilus alutaceus**
- **Coushis plumbeus**
- **Mylocheilus caurinus**
- **Ptychocheilus oregonesis**
- **Ritchardsonius balteatus**
Comment on Dace (*Rhinichthys*)

The representatives of the this cyprinid genus are comprised of four related species that have been confusing to taxonomists. The Longnose Dace (*Rhinichthys cataractae*) is widespread throughout North America and is the most common dace in the Columbia Basin. Hybrids between Longnose Dace and Redside Shiner (*Richardsonius balteatus*), and Longnose Dace and Lake Chub (*Couesius plumbeus*), are relatively common.

The three remaining species of dace in the Columbia Basin are endemic to the Columbia Basin and thought to be closely related. At one time Umatilla Dace (*Rhinichthys umatilla*) was thought to be a stable hybrid species between Leopard Dace (*Rhinichthys falcatus*) and Speckled Dace (*Rhinichthys osculus*). It has since been discovered that Umatilla Dace were present in areas where at least one of the presumed parent species was absent (Peden and Hughes 1980). The origins of Umatilla Dace is still in debate, but the species may have multiple origins and appears variable in the Columbia Basin.

*Rhinichthys cataractae* (Valenciennes)

*Rhinichthys* = snout-fish; the snout being prominent  
*cataractae* = of the cataract, the original species description was from Niagara Falls

Longnose Dace is a small, wedge-shaped bottom-oriented fish that inhabits the rocky interstices of swift streams and edge zones of some larger lakes throughout north central North America. Unlike many cyprinid species it is not a schooling species and is generally found alone, even while coming into condition during the reproductive season. Spawning time is variable but generally occurs during late summer (Breder and Rosen 1966). There is some evidence to suggest that two or more cohorts may be produced per spawning year. Males defend a territory and guard over the adhesive, nearly invisible eggs deposited by a single female. Like many cyprinid species with overlapping reproductive periods, hybrids occur between Longnose Dace with Lake Chub (*Couesius plumbeus*) and with Redside Shiners (*Richardsonius balteatus*) (Nelson 1966; Butcher 1980; Scott and Crossman 1973).
Longnose Dace are easily identified by their wedgelike shape, small eyes, thick caudal peduncle, non-protractile ventral mouth and yellow-olive green colouration.

Longnose Dace are distributed throughout the Columbia Basin, except for portions of the Kettle River above the barrier at Cascade, B.C. and the Flathead system.
**Rhinichthys falcatus** (Eigenmann & Eigenmann)

*Rhinichthys* = snout-fish; prominent snout  
*falcatus* = sickle-shaped

Leopard Dace are a small cyprinid fish that have a distribution restricted to the Fraser and Columbia River systems east of the Cascade Mountains. Leopard Dace inhabit streams, larger rivers and occasionally lake margins near outlets. This species prefers slower waters than its congener, the Longnose Dace (*Rhinichthys cataractae*) (Gee and Northcote 1963).

Leopard Dace develop tubercles about their head during reproductive periods, and usually spawn during July and August. Breeding females are accompanied by many males and deposit adhesive eggs over unprepared gravel (Scott and Crossman 1973). The males exhibit a scarlet spawning dress on the lips and points near the insertion of their pelvic and pectoral fins.

Leopard Dace have a long, slender body with mottled leopard spots along their lateral and dorsal surfaces. Fleshy stays connect the rays of the pelvic fin to the lateral surface of the body wall. Leopard Dace is the only member of the genus *Rhinichthys* that has pelvic stays.

In the Columbia Basin Leopard Dace have a restricted distribution and are absent from the Upper Columbia, Upper Kootenay and above barriers in the Similkameen, Kettle and Lower Columbia systems.
**Rhinichthys osculus** (Girard)

*Rhinichthys* = snout-fish; prominent snout  
*osculus* = small mouth

The northern limit of the Speckled Dace distribution is found in the Canadian portions of the Columbia Basin. The only occurrence of this species in British Columbia is from the Kettle and Granby rivers, where it is found above and below the barrier at Cascade. This distribution suggests that Speckled Dace was one of the first fish to disperse into the upper Columbia post-glacially.

In British Columbia, adult Speckled Dace are found in shallow waters with slow to moderately strong current over a cobble substrate (Peden and Hughes 1981). Spawning usually occurs once a year from June through August in animals older than two years (Cannings and Ptolemy 1998). During reproductive periods males develop a red spawning dress similar to Leopard Dace (*Rhinichthys falcatus*). Breeding occurs in riffles with a clean gravel substrate and males clean and prepare the gravel with their mouths prior to spawning. During breeding, many males accompany a single female which deposits adhesive eggs into prepared substrate.

Speckled Dace have a moderately robust body with a short caudal peduncle. The mouth is located sub-terminal, and does not overhang the lower jaw like that of the Longnose Dace (*Rhinichthys cataractae*). The young have strong lateral bands that are absent in the mottled adults.
Rhinichthys umatilla (Gilbert and Evermann)

*Rhinichthys* = snout fish; prominent snout
*umatilla* = first described from Umatilla, Oregon

Umatilla Dace have a restricted distribution in Western North America, occurring only in the Columbia Basin (Hughes and Peden 1989). This species has been thought to be of hybrid or introgressed origin, with Leopard Dace (*Rhinichthys falcatus*) and Speckled Dace (*Rhinichthys osculus*) being the proposed parent species (Peden and Hughes 1988a). Recent evidence suggests that Umatilla Dace are of a variable hybrid origin, but the populations are stable and separate from their parent species. The occurrence of Umatilla Dace in drainages that do not support one of the proposed parent species further suggests that Umatilla Dace is a viable, but variable, species that may have a polyphyletic hybrid past (Cannings and Ptolemy 1998). The Umatilla Dace prefers faster waters than does Leopard Dace when the two species are found together, and like other members of the genus *Rhinichthys*, Umatilla Dace probably breed in the late spring and summer (Peden and Hughes 1988b).

In the British Columbia portion of the Columbia Basin Umatilla Dace prefer larger riverine habitat with large cobbles, and are found in the Similkameen, Kettle River below Cascade, lower Kootenay and lower Columbia rivers.

Umatilla Dace exhibit inconspicuous barbels, which are often very difficult to see, at the corner of the mouth, and have poorly developed pelvic fin stays compared to Leopard Dace. The dorsal fin insertion is above the pectoral fin and is commonly falcate along the posterior edge.
Native Fishes: Family Catostomidae (Suckers)

*Catostomus catostomus* (Forster)

*Catostomus* = inferior mouth

Longnose Suckers are one of the most common sucker species and they are distributed throughout Canada and eastern Siberia and have been sold commercially in frozen fillets as mullet (Scott and Crossman 1973). Several regional longnose subspecies designations have been suggested throughout Canada, and hybrids between catostomid species are common (Nelson 1973; Nelson and Paetz 1992). Longnose Suckers can grow up to a maximum length about 60 cm, and a weight of more than 3 kg.

The species matures between five to seven years, and come into reproductive condition during the early spring shortly after cover ice melts and temperatures rise to 5°C (Scott and Crossman 1973). At breeding time, male Longnose Suckers become coloured with a lateral band with a red stripe, and develop large nuptial tubercles on their head, anal and caudal fins. Females shed large numbers of small white adhesive eggs over unprepared gravel while accompanied by multiple males. Experimentally raised eggs hatch in 11 days at 10°C and the hatchlings remain in the gravel for one or two weeks before leaving the nest site (Wydoski and Whitney 1979).

Longnose Suckers are distributed throughout the Columbia Basin, except in the waters above barriers in the Similkameen system.

Longnose Suckers have a ventrally located mouth that suits its benthic diet. The lower lip is completely cleft and both lips are covered by coarse, fleshy papillae. The snout is long and extends well beyond the upper lip. The body is covered with small scales and is elongate and cylindrical in shape.

*Longnose Sucker*
**Catostomus columbianus** (Eigenmann and Eigenmann)

*Catostomus* = inferior mouth  
*columbianus* = of the Columbia

The distribution of the Bridgelip Sucker is restricted to the waters of northwestern North America. This species inhabits lakes and rivers in backwaters and edges of the main current with sandy or muddy substrates. The body is cylindrical in shape that reaches an average length of 30 cm.

Bridgelip Suckers mature at as little as 13 cm in length, and spawn during late spring after ice breakup. Breeding males develop an orange lateral band and tubercles on their anal, lower caudal fin, and scales on posterior portions of the body as breeding season approaches. It is thought that females broadcast spawn their small yellow eggs like other catostomid species (Wydoski and Whitney 1979).

The diet of the Bridgelip Sucker includes aquatic insect larvae and crustaceans, although the flat mouth, edged frenum and long intestinal tract suggests that this sucker supplements its diet by scraping algae off bottom rocks.

The Bridgelip Sucker can be distinguished from other suckers -- except the Mountain Sucker (*Catostomus platyrhynchus*) -- by the incomplete cleft in the lower lip. Bridgelip Suckers lack the distinct notches at the corner of the mouth separating the upper and lower lips as seen in the Mountain Sucker.

In the Columbia Basin Bridgelip Suckers are present below barriers on the lower Columbia, lower Kootenay, Okanagan and Similkameen rivers.
**Catostomus macrocheilus** (Girard)

*Catostomus*=inferior mouth  
*macrocheilus*=larger lip

The distribution of the Largescale Sucker is restricted to western North America where it inhabits weedy portions of lakes and backwaters of larger rivers. The species can reach a maximum length of 60 cm, can weigh up to 3 kg and can live as long as 11 years. Males first breed at an age of five years, and females usually mature a year later (Carl *et al.* 1967). This species is not sexually dimorphic except during reproductive periods when males develop horny tubercles on their anal and lower caudal fin, and accentuate the distinct dark band extending below the lateral line along the lateral surface.

Spawning occurs from late April into June once water temperatures reach 7-9° C. Females release up to 20,000 yellow, adhesive eggs along river margins and lake outlets during breeding, and are commonly accompanied by many males. The eggs hatch in about two weeks, at which time the fry are pelagic and feed on zooplankton with their terminal mouths. The positions of the mouths of the fry gradually turn subterminal as they move into deeper water and feed on larger benthic prey. Largescale Suckers commonly spawn in similar habitats and during similar periods as the Longnose Sucker (*Catostomus catostomus*) and Bridgelip Sucker (*Catostomus columbianus*), and hybrids have been reported (Wydoski and Whitney 1979; Scott and Crossman 1973).

Largescale Sucker has a thick body covered with large scales that are easily seen with the naked eye. The ventrally placed mouth has a deep cleft in its lower lip, but the snout does not overhang its mouth like that of Longnose Sucker (*Catostomus catostomus*).

The Largescale Sucker is abundant in all regions of the Columbia system except the Flathead system.

**Largescale Sucker**
**Catostomus platyrhynchus** (Cope)

*Catostomus*=inferior mouth  
*platyrhynchus*=flat snout

Mountain Sucker is a small species restricted to mountainous regions of western North America. This rare endemic species has a very restricted distribution in south central British Columbia. Mountain Suckers inhabit cool, clear mountain streams of moderate current with sand, gravel and cobble substrates. The Mountain Sucker was unknown in British Columbia until 1955 and the species was known previously under the name of *Pantosteus jordani*. The genus *Pantosteus* was later considered a subgenus of *Catostomus*, and the groups were later merged (Carl *et al.* 1967). Mountain Suckers reach sexual maturity between three to five years of age, and males often mature a year earlier than females. Spawning occurs in riffles of streams adjacent to pools during late spring and early summer when waters are between 10.5-18.8°C (Wydoski and Whitney 1979).

The horny edges of the lower jaw of the Mountain Sucker incorporate a chisel-like sheath. Diet studies have found large quantities of diatoms and filamentous algae in the gut, suggesting that the Mountain Sucker scrapes its mouth over rocky substrate to supplement its diet.

Mountain Sucker’s body is thick anteriorly, but becomes compressed towards at the narrow caudal peduncle. Mountain Sucker can be distinguished from other suckers by its incompletely cleft lower lip that is flanked by two notches separating the upper and lower lips.

Mountain Suckers are known only in the Similkameen system in the Columbia Basin, and these populations may be hybridizing with Bridgelip Suckers (*Catostomus columbianus*).
Suckers (Catostomids) of the Columbia Basin

- Catostomus catostomus
- Catostomus columbianus
- Catostomus macrocheilus
- Catostomus platyrynchus
Native Fishes: Family Salmonidae
(TROUT, SALMON, CHAR, WHITEFISH)

Oncorhynchus clarki lewisi (Girard)

Oncorhynchus = hooked snout

The common name ‘Cutthroat’ comes from the distinct red or orange slash mark under the lower jaw of this species, which makes it appear as though it has a sliced throat. The presence of slashmarks under the chin and the extension of the upper jaw beyond the margin of the eye separate Westslope Cutthroat Trout from the closely related Rainbow Trout.

Two forms of Cutthroat Trout are recognized in Canada. The Pacific variety, Coastal Cutthroat Trout (Oncorhynchus clarki clarki) ranges from Alaska to northern California in fresh, brackish and salt water with many populations having anadromous reproductive migrations. The Westslope Cutthroat Trout (Oncorhynchus clarki lewisi) occurs in southeastern British Columbia, southwestern Alberta and Montana (Scott and Crossman 1973). The Westslope Cutthroat Trout differs from its coastal relatives by having spots restricted to the posterior portion of its body and lacks the distinct red lateral band typical of many Coastal Cutthroat Trout populations. The Westslope Cutthroat subspecies designation refers to the western slopes of the Rocky Mountain Divide although this variety occurs east of the Rocky Mountains. In British Columbia Coastal Cutthroat Trout and Westslope Cutthroat Trout are separated by a narrow band through the Interior Plateau where the closely related Rainbow Trout (Oncorhynchus mykiss) outcompete Cutthroat Trout for foraging and spawning habitat (McPhail 1998). Occasionally in overlapping ranges, Cutthroat Trout and Rainbow Trout hybridize. There has been some concern that translocated (purposefully transplanted) Rainbow Trout populations have had a deleterious effect on native Westslope Cutthroat Trout populations (Nelson 1965).

Cutthroat Trout frequent lakes and streams with stepping pools and back-eddies. Spawning occurs in small gravel-laden streams during the late spring and early summer, once water temperatures reach about 10° C (Scott and Crossman 1973). Females prepare a redd (salmonid nest) by thrashing their tails while laying on their side to
displace gravel until the pocket is about 15 cm deep. Males are aggressive towards other males that appear too close to courted females or her redd. After the spawning ritual is performed, females bury the fertilized eggs in the nest by dislodging gravel on the upstream edge of the redd.

Cutthroat are native and thrive in all cool water drainages of the upper Columbia, upper Kootenay and Flathead systems. The species is less abundant in the lower Columbia and lower Kootenay, and native populations are absent from the Kettle, Okanagan and Similkameen rivers.
**Oncorhynchus mykiss** (Walbaum)

*Oncorhynchus* = hooked snout

*mykiss* = vernacular name in Kamchatka

The native distribution of Rainbow Trout in North America includes coastal and interior areas west of the Continental Divide, extending south from Alaska to northern Mexico. The popularity of Rainbow Trout as a sport fish has made it a globally translocated species, with successful introductions in New Zealand, Australia, Japan, Europe, Africa and South America (McCrimmon 1971).

Many Rainbow Trout populations have been translocated (the introduction of native species into waters they did not originally inhabit) through efforts aimed at improving angling opportunities, and it is presently difficult to differentiate the native, wild varieties from domesticated strains.

Rainbow Trout are highly variable in life history characteristics and appearance, with up to 16 different historic subspecies being designated throughout the species range. Modern taxonomists loosely agree that there are three potential subspecies of Rainbow Trout in British Columbia. These are: Columbia River Redband Trout (*Oncorhynchus mykiss gairdneri*), coastal resident Rainbow Trout, including the anadromous Steelhead Trout (*Oncorhynchus mykiss irideus*), and the Athabascan Rainbow Trout (*Oncorhynchus mykiss* subsp.) of the Mackenzie drainage (Taylor and Haas 1996).

Rainbow Trout are a common species throughout the Columbia Basin, and this species displays a bewildering array of life history and phenotypic variability within the region. The large Gerrard Rainbow Trout (up to 15 kg) from Kootenay Lake and the "yellow fin" Rainbow Trout of the Arrow lakes are unique in terms of their large trophy size and distinct colouration. The steep headwater drainages of the Selkirk Mountains contain mature, dwarf varieties of Rainbow Trout that maintain juvenile characteristics throughout life.

Inland representatives of Rainbow Trout are characteristically a stream and lake fish. Spawning occurs in both inlets and outlets of lakes and small streams with fine, clean gravel during early spring when the water reaches 10-15.5° C (Scott and Crossman 1973). Females dig a redd in riffles above a pool by turning on their sides and thrashing their tails to create a depression of about body length. During the construction of the redd the female may be accompanied by many aggressive males -- usually the
largest of the males is dominant and most active in courtship. After the eggs are fertilized, the female covers the nest with gravel and the eggs hatch four to seven weeks later.

Rainbow Trout are often difficult to differentiate from the closely related Cutthroat Trout, and the species often hybridize in areas where their distributions overlap. The upper jaw length of Rainbow Trout never extends past the hind margin of the eye, nor do they exhibit the diagnostic red or orange slash under the chin that is typical of Cut-
**Oncorhynchus nerka** (Walbaum)

*Oncorhynchus* = hooked snout  
*nerka* = Russian name for anadromous form

The deep-red oily flesh of Sockeye Salmon makes it one of the most prized and valuable of the Pacific Salmon. Sockeye are distributed along the Pacific Rim from the Klamath River in California, north along the coast of British Columbia to Alaska, and westward to the Kamchatka Peninsula through to Japan. Sockeye exhibit a variety of life history patterns, with mature fish characteristically making long seasonal, homing migrations of hundreds of kilometres from the ocean to their natal waters, which are usually associated with large lake systems. One of the most striking features of migrating Sockeye is their "toothy" hooked kype and spawning dress. Both sexes develop brilliant crimson dorsal surfaces and green heads, although females are usually less colourful than males.

Juveniles rear in lakes, feeding on zooplankton for two to three years before emigrating to the ocean. Return migrations are made after three to four summers at sea, although some precocious males (jacks) return after a single summer of ocean growth. Most Sockeye populations are anadromous, there are, however, distinct non-migratory populations known as Kokanee.

Kokanee reside permanently in freshwater, and evidence suggests that they have diverged repeatedly from Sockeye populations since the retreat of the last glacial period. Because Kokanee are derived from migratory stocks of Sockeye Salmon, many populations differ in life history, behaviour and phenotype between and within some lakes. In Okanagan Lake there are at least two unique forms of Kokanee: one is a beach shore spawner and the other -- larger crimson variety -- is a stream spawner (Taylor et al. 1997). The Kokanee of Kootenay Lake can be divided into at least three homing races, each returning to their parent streams to spawn (Vernon 1957). Although there have been no known Kokanee extinctions, decreasing lake productivity (nutrient flow) and the introduction of exotic invertebrate shrimp (*mysids*) have been factors contributing to declining Kokanee numbers in Kootenay, Okanagan and Arrow lakes. Most of the larger lakes in the Columbia Basin have rehabilitation programs in place to help boost Kokanee numbers.
In the Canadian portion of the Columbia Basin, the only remaining anadromous Sockeye Salmon runs return to spawn in the Okanagan River between Osoyoos and Vaseau lakes. Kokanee are widely distributed in large lakes and associated tributaries, except for isolated regions not historically visited by Sockeye runs in the upper Columbia, upper Kootenay and Flathead drainages.

Sockeye Salmon (Kokanee)
**Salvelinus confluentus** (Suckly)

*Salvelinus* = an old name for char  
*confluentus* = flowing together

Bull Trout are endemic to both sides of the Continental Divide in northwestern North America from southern Alaska to California. This variable cold-water species is not a true trout as its common name implies, but rather a char of the genus *Salvelinus*. Bull Trout are a robust species well suited to the mountainous terrain typical of British Columbia and the remainder of the North American Cordilleran.

The nomenclature and distribution of the Bull Trout has been a recent point of debate for salmonid taxonomists (Haas and McPhail 1991). Bull Trout are often difficult to distinguish from Dolly Varden Char (*Salvelinus malma*), and, until recently, they were considered the same species, the difference being distribution -- Dolly Varden is a coastal species and Bull Trout is an interior species. Recent studies provide evidence that they are, in fact, distinct species: Dolly Varden is more closely related to Arctic Char (*Salvelinus alpinus*), while Bull Trout is more closely related to an Asiatic species, the White-spotted Char (*Salvelinus leucomaenis*) (Cannings and Ptolemy 1998). Many Bull Trout and Dolly Varden populations overlap, and intermediate hybrids have been identified (Baxter *et al.* 1997). Generally, Bull Trout adults are large (up to 103 cm, 14.5 kg), piscivorous interior species that make seasonal migrations from large lakes into tributaries to spawn; although up to four life-history patterns have been identified, including a dwarf headwater stream variety (Cannings and Ptolemy 1998). Dolly Varden is a small coastal species with sea-run and non-migratory populations.

Spawning occurs during the fall when water temperature reaches about 9° C. A redd is prepared in large, clean gravel by the female. Aggressive males court a female by quivering alongside her as she rests over the nest. Occasionally, precocious satellite males take advantage of their small size to sneak into the redd and deposit milt while the dominant pair are engaged in the spawning act.

Bull Trout are highly susceptible to habitat degradation and displacement by introduced salmonid species, especially Lake Trout (*Salvelinus nammycush*) and Brook Trout (*Salvelinus fontinalis*). Bull Trout are presently the only fish species currently recognized by the British Columbia Forest Practices code.
In the Columbia system, Bull Trout inhabit lakes and streams that are less than 15° C throughout the upper and lower Columbia, upper and lower Kootenay and Flathead systems. Bull Trout have a block-shaped head with a large mouth, the upper jaw extends past the hind margin of the eye in adults. The dorsal fin is dusky without clearly pigmented or black markings. The anal and pelvic fins have a cream-coloured leading edge.
**Comment on Whitefish (Prosopium)**

This understudied genus is distributed throughout Siberia and western North America. *Prosopium* houses six distinct species worldwide, and two are native to the Columbia Basin. The fossil record suggests that Mountain Whitefish (*P. williamsoni*) is the least derived and ancient member of the genus *prosopium*, and probably has its evolutionary roots in western North America rather than in Siberia (Norden 1970). As a group, the whitefish are a notoriously phenotypically variable family that successfully inhabit cooler lakes, rivers and streams. They are generally fall spawners and perform complex seasonal reproductive and foraging migrations (Northcote and Ennis 1994).

*Prosopium coulteri* (Eigenmann and Eigenmann)

*Prosopium* = a mask, from the large bones in the front of the eyes

*coulteri* = after Dr J.M. Coulter, a distinguished botanist

Pygmy Whitefish are abundant in lakes, rivers and streams of near mountainous areas. The species was first described in 1892 from the Kickinghorse River near Field, B.C. (McPhail and Lindsey 1970). The current western North American distribution ranges along the Continental Divide from southern Alaska to Montana. In 1952, Pygmy Whitefish were shown to have a disjunct distribution in North America when they were discovered in a trawl catch in Lake Superior (Scott and Crossman 1973). This discontinuous distribution suggests that Pygmy Whitefish took advantage of a series of large pro-glacial lakes that were formed through central Canada after the last glacial retreat approximately 10,000 BP (Johnston 1946; Stewart and Lindsey 1983). It is likely that there will be further discoveries of Pygmy Whitefish across the Central Plains as more surveys are conducted. In addition to having a discontinuous distribution, some Pygmy Whitefish populations in lakes contain two forms -- one form resembles the default form and is typically small -- the other is several times larger and is commonly known as Giant Pygmy Whitefish.

In the Columbia Basin Pygmy Whitefish is restricted to the cool lakes and rivers of the upper and lower Columbia and Kootenay systems, as well as to the major lakes of the Okanagan system.
Pygmy Whitefish can be identified by its blunt snout, rounded cigar-shaped body, large scales and adipose fin. Although there have been reports of Pygmy Whitefish of up to 27 cm in length, it generally averages 10-13 cm long.
Prosopium williamsoni (Girard)

Prosopium = a mask; from the large bones in the front of the eyes
williamsoni = after Lt R.S. Williamson of the U.S. Pacific Railroad exploration

The Mountain Whitefish is indigenous to interior lakes, rivers and streams of western North America, including all regions of British Columbia. Although the Mountain Whitefish is not an esteemed sportfish, it is often pursued by anglers for its troutlike behaviours and sweet-tasting flesh.

Recent evidence suggests that there are at least two forms of Mountain Whitefish in the rivers of British Columbia -- a long-snout and a short-snout variety. The long-snout morph is characteristically found in riverine habitats, and has an elongate, upturned snout used to overturn rocks and dig into crevices along the river bottom. The blunt short-snout form picks drift suspended in the water column and avoids foraging along the bottom (Troffe 1999a). The two fluvial forms of Mountain Whitefish are known from the Fraser, Peace and Columbia systems, and there is evidence suggesting that the forms are genetically distinct. The long-snout ‘Pinocchio’ form of fluvial Mountain Whitefish resembles the Chisel Mouth Jack (Prosopium oregonium) originally described from Oregon State in 1909 (Jordan and Snyder 1909).

Mountain Whitefish usually mature when they are three to four years old. Little is published about the reproductive behaviour of Mountain Whitefish; however, spawning takes place during the fall over unprepared gravel when water temperatures reach 5-7°C (Hagen 970; Troffe pers. obs.). Breeding fish aggregate in step-off riffles in rivers or along gravelly margins in lakes. Early reports have suggested that spawning is a nocturnal activity (Brown 1952). Eggs hatch in the early spring, and juveniles can be found along the edge and backwaters for several weeks after hatching before moving into deeper water.

Mountain Whitefish are common and distributed throughout the Columbia Basin except above barriers in the Similkameen system.
Mountain Whitefish are troutlike in their appearance, have a small mouth without teeth, large scales and a prominent adipose fin. Juveniles have 8-10 neatly arranged parr marks along the lateral line.
Native Whitefish and Char (Salmonidae) Species of the Columbia Basin

- **Prosopium williamsoni**
- **Salvelinus confluentus**
Native Fishes: Family Gadidae (Codfish)

*Lota lota* (Linnaeus)

*Lota*= an ancient name used by Rondelet

Burbot is the only member of the cod family that has adapted to a purely freshwater existence. Burbot follows a northern circumpolar distribution and is common in the colder parts of lakes, rivers and streams. Little is known about the behaviour and ecology of Burbot, and many regional subspecies designations have been proposed (McPhail and Lindsey 1970; Scott and Crossman 1973). Burbot’s diet consists chiefly of fish and aquatic insect larvae, and it is thought to prey heavily on whitefish eggs during certain parts of the year. Burbot conducts most of its foraging during the night. Mature Burbot obtain lengths of up to 122 cm, weigh as much as 34 kg and are one of the few fish that are known to grow faster in the winter than in the summer (McPhail and Lindsey 1970). Its large size and high-quality flesh has made Burbot a favourite sport fish, especially during winter months. The rich oily cod liver of Burbot has been used as lamp oil and for medicinal purposes due to its high vitamin A and D contents.

Burbot usually mature in their third year, and spawning occurs from January to April. Many adults aggregate to form a large spawning ball over a sand substrate, and one large female can release as many as 1,000,000 small eggs in a spawning event (McPhail and Lindsey 1970). Spent females cover the nest with sand using their tail, and the eggs hatch after four to five weeks of incubation (Breder and Rosen 1966).

Burbot are distributed throughout the cold rivers and lakes of the Columbia Basin, with the exception of the Kettle and Flatheat rivers, and above the barriers on the Similkameen.

Burbot is a long, snakelike fish with a single chin barbel. The caudal fin is rounded and the pelvic fins are placed ahead of the pectoral fins.
Living Landscapes
Freshwater Fishes of the Columbia Basin in British Columbia
by Peter M. Troffe, Curator of Ichthyology, Royal BC Museum

Codfish (Gadidae) of the Columbia Basin

Lota lota
Native Fishes: Family Cottidae (Sculpins)

Comment on Sculpins (Cottidae)
Cottidae is one of the most taxonomically complex and widespread families of freshwater fish in B.C. It can be found in lakes, streams and rivers. Cottidae is a highly adapted family of fish, with complex reproductive behaviours that include nest building and strict, male parental care. Cottids display a bewildering amount of meristic and colour variation between and within populations. To complicate things further, many sympatric species overlap in their meristic and morphometric traits and hybridize with each other. The Columbia Basin is a hotbed of sculpin diversity, both at and below the species level.

Sculpin Xray
**Cottus asper** (Richardson)

*Cottus*= an old European name  
*asper*= rough

Prickly Sculpins are a euryhaline species distributed on the pacific slope of North America. It is a slow-water sculpin preferring lake shores, pools and quiet waters in rivers (Northcote 1954). Adults are usually solitary, and do most of their foraging for benthic invertebrates, fish eggs and small fish at night. This species is one of the largest of the freshwater sculpins -- it can grow to a maximum length of 150 mm, although some estuarine inhabitants have been reported as large as 300 mm (Scott and Crossman 1973).

Spawning occurs in streams during the early spring. Males become melanistic and defend a prepared nest among boulders before females move into the breeding sites. Eggs are <1 mm, orange and usually found in clutches of 7,00-4,000 adhered to the roof of the nest (Scott and Crossman 1973). The males guard and fan the eggs as the eggs develop, and seldom leave the nest once the eggs are present. Many egg clutches in different developmental stages may be found in the nest of single male suggesting that males spawn with more than one female. A large female may lay as many as 10,000 eggs in a season (Patten 1971).

There is considerable geographic variation in reproductive behaviour (pre-spawning migration) and prickling patterns in *Cottus asper*, but most sculpin taxonomists recognize two forms of Prickly Sculpin; a saline-tolerant coastal variety and an interior variety (McPhail and Lindsey 1970). The geographic range of *Cottus asper* suggests that this species survived glaciation in more than one location in the Pacific Refuge (McAllister and Lindsey 1961). The interior form moved north postglacially through the Columbia Basin and it is currently found below barriers in the lower Columbia, lower Kootenay, Kettle and Similkameen rivers; it is, interestingly enough, ubiquitous in the Okanagan system.

The Prickly Sculpin has a high anal fin ray count (15-19) with the anal fin being distinctly longer than the head length. There is a single medial chin pore on the under surface of the lower jaw, rough prickles on the back and lateral surfaces, and a distinct black spot on the hind portion of the first dorsal fin.
Prickly Sculpin
**Cottus bairdi** (Girard)

*bairdi*=an ancient name used by Rondelet, presumably after Baird

The Mottled Sculpin (**Cottus bairdi**) is a wide-ranging freshwater fish species that has a discontinuous distribution in North America. The species is present through much of eastern North America, absent through the Great Plains region, and is present in western North America in southern British Columbia, southwestern Alberta, Missouri, Utah, Montana, Idaho and Washington State.

Mottled Sculpins live in clear, cool rivers and lakes over gravel and rocky bottoms. Sexual maturity is reached in their second year and spawning usually occurs April through June (Patten 1971). Females adhere eggs to the underside of rocks in nests prepared and guarded by males.

The status of Mottled Sculpins in western Canada is poorly understood. The species is often difficult to identify because of its close relationships to other sculpin species. To complicate things further, Mottled Sculpins have been known to hybridize with the Slimy Sculpin (**Cottus cognatus**) (Strauss 1986; Smith 1992). Mottled Sculpins in western Canada can be divided into two groups: the western Columbia form that adheres to the description of the Columbia Sculpin (**Cottus hubbsi**) (Bailey and Dimik 1949), and a Rocky Mountain form following the description **Cottus bairdi punctulatus** (Gill). The Rocky Mountain form straddles the Continental Divide and has a limited distribution in southeastern British Columbia and southwestern Alberta (Bajkov 1927; Schultz 1941; McPhail 1994).

Populations of Mottled Sculpin in the Flathead system have been consistently tagged as unique, and many accounts have suggested that these fish resemble Shorthead Sculpins (**Cottus confusus**) (McAllister and Lindsey 1961; Peden *et al.* 1989). Evidence that is more recent suggests that the isolated Flathead populations are in fact Mottled Sculpins (**Cottus bairdi punctulatus**) that share characters with the Slimy Sculpin (**Cottus cognatus**) (Troffe 1999b).

Mottled Sculpins are present in the Kettle, lower Kootenay below Bonnington Dam and the Lower Columbia rivers, below barriers in the Similkameen, and present in a unique form in the Flathead system.
Mottled Sculpins are a variable species that generally have papillae on the top of the head, well-developed palatine teeth, and an anal fin that is pigmented with fine, black spots. Columbia Basin specimens exhibit prickleless behind the pectoral fin and have a complete lateral line. Flathead River and western Alberta populations lack the prickles behind the pectoral fin and have an incomplete lateral line.
Cottus cognatus (Richardson)

Cottus = an old European name
cognatus = related to the European species, C. gobio

The Slimy Sculpin is widespread in North America and eastern Siberia, and this polymorphic species is thought to be represented by at least two forms in British Columbia -- a northern and a southern form (McPhail and Lindsey 1970). The Slimy Sculpins of the Columbia and upper Fraser basins appear intermediate between the two forms. The Columbia Basin may have been a mixing zone for this species post-glacially, or some Slimy Sculpin populations survived glaciation west of the Continental Divide in Washington or Idaho State (McAllister and Lindsey 1961).

The Slimy Sculpin rarely exceeds 100 mm in length. It is typically found in cool running water with rocky or sandy bottoms along the edges of rivers, but may be present near lake inlets. Spawning occurs during the spring when ripe males select a nesting site under rocks and large cobble. Courted females lay adhesive eggs on the roof of the nest, and males guards the eggs and hatching larvae until the larvae begin feeding. Nests often contain egg clutches in different developmental stages suggesting that multiple females may spawn with a single male. A large female can lay as many as 1,400 eggs (Scott and Crossman 1973).

Insect larvae and nymphs, including mayflies, caddisflies and dragonflies, make up the majority of the Slimy Sculpin’s diet; although larger fish have been known to have fish larvae and salmonid eggs in their guts. Slimy Sculpins are a common prey item of Burbot and of trout species, and have been used as angling bait (McPhail and Lindsey 1970).

Slimy Sculpins are common above and below barriers throughout the Okanagan, upper Columbia and Kootenay systems. They are absent above waterfalls in the Similkameen and are rarely found in the tributaries of the lower Columbia. This cottid species is most abundant in cooler headwater reaches, especially in the Flathead Valley (Hughes and Peden 1984).
The Slimy Sculpin is, as the common name suggests, slimy to the touch. Palatine teeth are absent and so are head papillae. The lateral line is incomplete and usually terminates near under the middle of the second dorsal fin. The anal fin usually has 10-13 rays. The pelvic fins have three rays, but, when a fourth is present it is usually only three-quarters the length of the longest rays (Hughes and Peden 1984). There is some evidence that Mottled Sculpins (*Cottus bairdi*) and Slimy Sculpins share characters in areas where they overlap in the Flathead system.
Cottus rhotheus (Smith)

Cottus = an old European name
rhotheus = rushing of the torrent

The Torrent Sculpin is a unique western North American species endemic to British Columbia, Washington, Oregon, Idaho and portions of northwestern Montana (Scott and Crossman 1973). Torrent Sculpins are most common in swift streams, although they may be found in lakes along beach margins. Stream dwellers live in fast waters with a gravel and cobble substrate and are often one of the larger cottid species present. This species is phenotypically and behaviourly variable throughout its range, and is often observed in sympatry with the Mottled Sculpin (Cottus bairdi). Many populations isolated above waterfalls along the tributaries of the lower Columbia River exhibit differences in prickle patterns and spawning activities (McPhail and Carveth 1994; Troffe pers. obs.).

Young Torrent Sculpins forage for planktonic crustaceans and move to an aquatic insect larvae diet as they grow. Adults 70 mm or longer forage almost exclusively for juvenile cyprinids and other fish (Northcote 1954). Torrent Sculpins are one of the longer-lived cottid species, and can live up to seven years and reach a maximum size of about 155 mm.

Spawning occurs from May to July in animals two years and older. The fecundity of females is quite low, with large females usually producing less than 500 eggs a season (Patten 1971). As the spawning season approaches, territorial males turn melanistic and the tip of the first dorsal fin becomes bright orange.

Torrent Sculpins are heavily prickled especially on the wide head, dorsal and lateral surfaces. The lateral surface is usually marked with two distinct forward-sloping stripes that originate under the second dorsal fin and the chin is heavily mottled.

Torrent Sculpins are absent from the Flathead system, but found throughout the Columbia Basin except areas above barriers in the Kettle, Okanagan and Similkameen systems.

Torrent Sculpin
**Cottus confusus** (Bailey and Bond)

*Cottus*=an old European name  
*confusus*=clouded, referring to the irregular body pigment

The Shorthead Sculpin is the most confusing and elusive freshwater sculpin species in British Columbia. The taxonomy and distribution of this species has been debated since the species was first proposed by Bailey and Bond in 1963. Since its inception, this species has been used as a catch-all for sculpins from the Columbia Basin that exhibit intermediate characteristics between the Slimy Sculpin (*Cottus cognatus*) and the Mottled Sculpin (*Cottus bairdi*) (Peden et al. 1989). This Columbia Basin endemic species is often found together with other cottid species, and it is thought to be restricted to northeastern Oregon, Idaho, eastern Washington and southeastern B.C.

The Shorthead Sculpin is usually found in fast riffles in colder streams with gravel and cobble substrates, but may be found along the edge waters of larger rivers. This species seems to prefer cooler upstream habitats, although populations in British Columbia have been found in many stream reaches of the lower Columbia (Peden et al. 1989).

Shorthead Sculpins mature at two to three years of age, and spawn during the early spring in rocks and cobble of larger streams. The males become melanistic and emaciated during the breeding season and defend the nest. This species rarely exceeds 100 mm in length, and mature females have a mean fecundity of 326 orange-yellow eggs -- making them one of the least fecund freshwater sculpin species (Cannings and Ptolemy 1998; Patten 1971).

The Shorthead Sculpin is very difficult to identify, and it generally resembles the Mottled Sculpin (*Cottus bairdi*) and the Slimy Sculpin (*Cottus confusus*). The lateral line is generally complete and ends in an axial scar near the caudal peduncle. The presence (although they may be weak) of palatine teeth and two post-maxillary pores, and two to three preopercular spines can separate *C. confusus* from *C. cognatus*. Head papillae are generally absent, and the pigmentation of the anal fin is dusky and lacks clearly defined spots.
In Canada the Shorthead Sculpin is restricted to the Kettle river below Cascade Falls, the tributaries of the lower Columbia and portions of the Slocan River. Earlier reports of nominal Shorthead Sculpins in the Flathead River drainage should be treated as suspect, as they appear more closely allied with the Mottled Sculpin (*Cottus bairdi*) (Troffe 1999b).

Shorthead Sculpin
Sculpins (Cottus) of the Columbia Basin

- Cottus cognatus
- Cottus rhotheus
- Cottus bairdi
- Cottus confusus
- Cottus asper
# Select List of Freshwater Fish Species of the Columbia Basin, B.C.

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<td>White Sucker</td>
<td>Native</td>
</tr>
<tr>
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<td><em>Ameiurus melas</em></td>
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</tr>
<tr>
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<td><em>Ameiurus nebulosus</em></td>
<td>Brown Catfish</td>
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<tr>
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<td><em>Oncorhynchus clarki lewisi</em></td>
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<td>Native</td>
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<td>Salmonidae</td>
<td><em>Oncorhynchus nerka</em></td>
<td>Sockeye (Kokanee)</td>
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<tr>
<td>Salmonidae</td>
<td><em>Oncorhynchus mykiss</em></td>
<td>Rainbow Trout</td>
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<td><em>Oncorhynchus tshawytscha</em></td>
<td>Chinook</td>
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<td><em>Salmo trutta</em></td>
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<td><em>Salvelinus confluentus</em></td>
<td>Bull Trout</td>
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<td>Salmonidae</td>
<td><em>Salvelinus fontinalis</em></td>
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<td>Introduced</td>
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<td>Lake Trout</td>
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<td>Arctic Grayling</td>
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<td>Thymalinae</td>
<td><em>Coregonus clupeaformis</em></td>
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<td>Coregoninae</td>
<td><em>Prosopium williamsoni</em></td>
<td>Mountain Whitefish</td>
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<td><em>Prosopium coulteri</em></td>
<td>Pygmy Whitefish</td>
<td>Native</td>
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<td>Gadidae</td>
<td><em>Lota lota</em></td>
<td>Burbot</td>
<td>Native</td>
</tr>
<tr>
<td>Cottidae</td>
<td><em>Cottus asper</em></td>
<td>Prickly Sculpin</td>
<td>Native</td>
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Living Landscapes
Freshwater Fishes of the Columbia Basin in British Columbia
by Peter M. Troffe, Curator of Ichthyology, Royal BC Museum

Select List of Freshwater Fish Species of the Columbia Basin, B.C. (cont’d)

<table>
<thead>
<tr>
<th>Family</th>
<th>Latin Name</th>
<th>English Name</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>Cottidae</td>
<td>Cottus bairdi</td>
<td>Mottled Sculpin</td>
<td>Native</td>
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<tr>
<td>Cottidae</td>
<td>Cottus cognatus</td>
<td>Slimy Sculpin</td>
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<tr>
<td>Cottidae</td>
<td>Cottus confusus</td>
<td>Shorthead Sculpin</td>
<td>Native</td>
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<tr>
<td>Cottidae</td>
<td>Cottus rhotheus</td>
<td>Torrent Sculpin</td>
<td>Native</td>
</tr>
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<td>Centrarchidae</td>
<td>Lepomis gibbosus</td>
<td>Pumpkinseed</td>
<td>Introduced</td>
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<tr>
<td>Centrarchidae</td>
<td>Micropterus dolomieui</td>
<td>Smallmouth Bass</td>
<td>Introduced</td>
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<tr>
<td>Centrarchidae</td>
<td>Micropterus salmoides</td>
<td>Largemouth Bass</td>
<td>Introduced</td>
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<tr>
<td>Centrarchidae</td>
<td>Promoxis nigromaculatus</td>
<td>Black Crappie</td>
<td>Introduced</td>
</tr>
<tr>
<td>Percidae</td>
<td>Perca flavescens</td>
<td>Yellow Perch</td>
<td>Introduced</td>
</tr>
<tr>
<td>Percidae</td>
<td>Stizostedion vitreum</td>
<td>Walleye</td>
<td>Introduced</td>
</tr>
</tbody>
</table>

43 species  27 Native species
1 Extinct species
16 introduced species
8 species rare or endangered
### Key to the Freshwater Fish Families of the Columbia Basin

**Fish Families of the Columbia Basin**

<table>
<thead>
<tr>
<th>Family</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmonidae:</td>
<td>Trout, Salmon, and Char</td>
</tr>
<tr>
<td>*Subfamily Coregonida</td>
<td>Whitefish</td>
</tr>
<tr>
<td>*Subfamily Thymallinae</td>
<td>Graylings</td>
</tr>
<tr>
<td>Acipenseridae</td>
<td>Sturgeon</td>
</tr>
<tr>
<td>Cottidae</td>
<td>Sculpins</td>
</tr>
<tr>
<td>Cyprinidae</td>
<td>Minnows, Carp, Dace, Chub</td>
</tr>
<tr>
<td>Catostomidae</td>
<td>Suckers</td>
</tr>
<tr>
<td>Gadidae</td>
<td>Cod</td>
</tr>
<tr>
<td>Centrachidae</td>
<td>Bass and Sunfish</td>
</tr>
<tr>
<td>Percidae</td>
<td>Perch</td>
</tr>
<tr>
<td>Ictaluridae</td>
<td>Catfish</td>
</tr>
</tbody>
</table>

1 (2) Tail Heterocercal (top lobe of tail much larger than bottom)

Bony scales arranged in rows along lateral and dorsal surfaces

**Acipenseridae: Sturgeon**

2 (3) Tail not Heterocercal.

Scales not bony or absent from body.
Key to the Freshwater Fish Families of the Columbia Basin

Fish Families of the Columbia Basin

3 (10) Adipose fin present.

4 (5) Body without scales.

Four barbels arranged around mouth.

**Ictaluridae: Catfish**

5 (6) Body with scales.

No barbels arranged around mouth.

6 (7) Dorsal fin long and sail-like. Dorsal fin base length = or >head length.

Dorsal fin rays more than 17.

Scales large, <110 along lateral line.

**Salmonidae, Subfamily Thymallinae: Graylings**

7 (8) Dorsal fin not long and sail-like. Dorsal fin base length = or <head length.

Dorsal fin rays less than 17.

8 (9) Teeth on jaws.

Scales small, >110 along lateral line.

**Salmonidae, Subfamily Salmoninidae: Trout, Salmon, and Char**
9 (1) No teeth on jaws.
Scales large, <110 along lateral line.

**Salmonidae, Subfamily Coregonidae: Whitefish**

10 (14) Adipose fin absent.
gill flap (operculum, preoperculum) ends in spine(s).

11 (12) Two completely divided dorsal fins, one with stout spines, other rayed.
Two or more sharp spines on leading edge of anal fin.

**Percidae: Perch**

12 (13) Two Dorsal fins, first approximately twice as long as second.
Body without scales (sandpaper, like prickles, may be present).
Globiform shape (large head with tapering body).
Eyes mounted on dorsal surface of head.

**Cottidae: Sculpins**

13 (14) Single Dorsal fin (spinous and soft rayed portions separated by a notch).
Two or more spines on the leading edge of the Anal fin.
Scales immaculate.

**Centrachidae: Bass and Sunfish**
14 (15) Mouth ventral.

Lips thick and fleshy, covered with papillae.

Distance from snout to vent >2.5 times distance of vent to caudal origin.

**Catostomidae: Suckers**

15 (16) Mouth terminal or subterminal.

Distance from snout to vent <2.5 times distance of vent to caudal fin origin.

Most with barbel at corner of mouth.

**Cyprinidae: Minnows, Carp, Dace, Chub**

16 (10) Two Dorsal fins, second Dorsal and Anal fins long.

Caudal fin rounded.

Single chin barbel.

Pelvic fins placed jugular and reduced.

**Gadidae: Cod**
Provincial Ranking (B.C. Conservation Data Centre)

The status of a species is ranked (S-ranks) on a scale of one to five, and based on the number of extant occurrences of the species. Factors such as abundance, trends, range, protection and threats are also considered if the information is available. Species assigned as S1 or S2 are considered rare and endangered (Red-listed), while those assigned S3 are considered rare or uncommon (Blue-listed) (Cannings and Ptolemy 1998).

1. Critically imperiled because of extreme rarity (five or fewer extant occurrences, or very few remaining individuals) or because of some factors making it especially vulnerable to extirpation or extinction.

2. Imperiled because of rarity (typically 6-20 extant occurrences, or few remaining individuals) or because of some factors making it vulnerable to extirpation or extinction.

3. Rare or uncommon (typically 21-100 occurrences); may be susceptible to large-scale disturbances; e.g., may have lost extensive peripheral populations.

4. Frequent to common (more than 100 occurrences); apparently secure, but may have a restricted distribution; or there may be perceived threats.

5. Common to very common; demonstrably secure and essentially ineradicable under present conditions.

X. Apparently extinct or extirpated, without the expectation that it will be rediscovered.

E. Exotic or introduced species.
<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
<th>Provincial Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acipenser transmontanus</td>
<td>White Sturgeon</td>
<td>S2</td>
</tr>
<tr>
<td>Acipenser transmontanus</td>
<td>White Sturgeon (Kootenay River Population)</td>
<td>S1</td>
</tr>
<tr>
<td>Acipenser transmontanus</td>
<td>White Sturgeon (Columbia River Population)</td>
<td>S1</td>
</tr>
<tr>
<td>Ameiurus melas</td>
<td>Black Bullhead</td>
<td>SE</td>
</tr>
<tr>
<td>Ameiurus nebulosus</td>
<td>Brown Bullhead</td>
<td>SE</td>
</tr>
<tr>
<td>Carassius auratus</td>
<td>Goldfish</td>
<td>SE</td>
</tr>
<tr>
<td>Catostomus catostomus</td>
<td>Longnose Sucker</td>
<td>S5</td>
</tr>
<tr>
<td>Catostomus columbianus</td>
<td>Bridgelip Sucker</td>
<td>S5</td>
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<tr>
<td>Catostomus macrocheilus</td>
<td>Largescale Sucker</td>
<td>S5</td>
</tr>
<tr>
<td>Catostomus platyrynchus</td>
<td>Mountain Sucker</td>
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<td>Coregonus clupeaformis</td>
<td>Lake Whitefish</td>
<td>S5</td>
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<tr>
<td>Cottus asper</td>
<td>Prickly Sculpin</td>
<td>S5</td>
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<tr>
<td>Cottus Bairdi</td>
<td>Mottled Sculpin</td>
<td>S3</td>
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<td>Cottus bairdii &quot;hubbsi&quot;</td>
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<td>&quot;Rocky Mountain Sculpin&quot;</td>
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<td>Cottus cognatus</td>
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<td>Cottus confusus</td>
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</tr>
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<td>Cottus rhiethus</td>
<td>Torrent Sculpin</td>
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<td>Conesus plumbeus</td>
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<td>S5</td>
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<td>Cyprinus carpio</td>
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<tr>
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<td>Burbot</td>
<td>S5</td>
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<tr>
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<td>Burbot, lower Kootenay River population</td>
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<tr>
<td>Lota lota</td>
<td>Burbot, lower Columbia River population</td>
<td>Unassigned</td>
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<td>Mylocheilus caurinus</td>
<td>Peamouth</td>
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<td>Cutthroat Trout</td>
<td>S4</td>
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<tr>
<td>Oncorhynchus mykiss</td>
<td>Rainbow Trout</td>
<td>S5</td>
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<tr>
<td>Oncorhynchus nerka</td>
<td>Sockeye Salmon</td>
<td>S5</td>
</tr>
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<td>Oncorhynchus tshawytscha</td>
<td>Chinook Salmon</td>
<td>S4</td>
</tr>
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<td>Perca flavescens</td>
<td>Yellow Perch</td>
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<td>Pomoxis nigromaculatus</td>
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<td>Prospium coulteri</td>
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<td>S5</td>
</tr>
<tr>
<td>Prospium williamsoni</td>
<td>Mountain Whitefish</td>
<td>S5</td>
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<tr>
<td>Ptychocheilus oregonensis</td>
<td>Northern pikeminnow</td>
<td>S5</td>
</tr>
<tr>
<td>Rhinichthys cataractae</td>
<td>Longnose Dace</td>
<td>S5</td>
</tr>
</tbody>
</table>
### Freshwater Fishes of the Columbia Basin in British Columbia

**by Peter M. Troffe, Curator of Ichthyology, Royal BC Museum**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
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<tr>
<td><em>Rhinichthys falcatus</em></td>
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<tr>
<td><em>Rhinichthys osculus</em></td>
<td>Speckled Dace</td>
<td>S1S2</td>
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<tr>
<td><em>Rhinichthys umatilla</em></td>
<td>Umatilla Dace</td>
<td>S2</td>
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<td><em>Richardsonius balteatus</em></td>
<td>Redside Shiner</td>
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<td><em>Salmo trutta</em></td>
<td>Brown Trout</td>
<td>SE</td>
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<td><em>Salvelinus confluentus</em></td>
<td>Bull Trout</td>
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<td>Brook Trout</td>
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<td><em>Salvelinus namaycush</em></td>
<td>Lake Trout</td>
<td>S5</td>
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<td><em>Stizostedion vitreum</em></td>
<td>Walleye</td>
<td>S5</td>
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<td><em>Thymallus arcticus</em></td>
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<tr>
<td><em>Tinca tinca</em></td>
<td>Tench</td>
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Acknowledgments

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References


References (cont’d)


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References (cont’d)


--------- 1988a. Sympatry in four species of *Rhinichthys* (Pisces), including the first documented occurrences of *R. umatilla* in the Canadian drainages of the Columbia River. 66(8):1846-1856.


References (cont’d)


References (cont’d)


Glossary

Adipose fin: A tapered, fleshy lobe located on the dorsal surface above the base of the pelvic fin.

Anadromous: Ascending rivers from the sea to spawn.

Anal fin: Unpaired fin located on the ventral surface posterior to the anus.

Anthroprogenic: Human induced.

Barbel: A slender tactile or taste process usually located about the mouth and head.

Caudal peduncle: Tapered region of the body between the edge of the anal fin and the caudal fin.

Caudal: Near the tail (caudal fin = tail fin).

Chironomids: Flies belonging to the midge family.

Compressed: Flattened from side to side.

Congeneric: Belonging to the same genus; refers to species.

Continental Divide: The watershed boundary that follows the Rocky Mountains and separates Pacific coastal drainages form other major North American drainages.

Crustaceans: Invertebrates with gills, shell, appendages and two pairs of antennae.

Cyprinid: Of the Cyprinid Family (Cyprinidae).

Dimorphism: Existing in two forms.

Dorsal: Pertaining to the back, or situated near the back.

Endemic: Confined to a given or defined geographic area.
**Euryhaline:** A fish that can move between saltwater and freshwater environments.

**Eutrophication:** To add nutrients to.

**Extirpated:** Extinct in a certain area or region, but surviving elsewhere.

**Falcate:** Sickle-shaped or curved.

**Family:** A group used to classify organisms consisting of a number of genera; animal family names end in the suffix -idae.

**Fauna:** The animals inhabiting a region.

**Fecundity:** The number of eggs in the ovaries that are mature or will mature. A common measure of reproductive potential.

**Genus/Genera:** A category for a taxon that includes one or more species.

**Gill cover:** The operculum; the flat thin bones that cover each side of the head.

**Gill rakers:** The series of comblike projections along the edge of the gill arch.

**Globiform:** Body shape where the majority of the body is located anteriorly and the posterior portion of the body is reduced.

**Heterocercal:** Pertaining to when the upper lobe of the caudal fin is larger than the lower lobe.

**Holarctic:** A zoogeographic region that includes North America, Europe, northern Africa, most of Asia. Fish that are Holarctic in distribution may be expected to occur in most of these regions but not necessarily throughout it.

**Homocercal:** A tail fin shape where the upper and lower lobes are the same size or rounded.
Illinoian glaciation: The second-last and most extensive continental ice sheet, which partially covered North America 300,000 years ago.

Indigenous: Native to a geographic area.

Inferior mouth: Mouth is located on and opens to the ventral surface.

Insertion (fin): The area where a fin is attached to the body.

Interorbital: The space between the eyes.

Introduced: Brought to an area by means other than its own dispersal ability.

Jugular pelvic: When pelvic fins are located on the anterior portion of the body ahead of, or at, the pectoral fins origin.

Kype: The hook at the anterior portion of the snout in many breeding male salmonid species.

Lacustrine: In or about lakes.

Lateral line: A series of pores or canals arranged along the lateral surface in a line.

Limnetic: The open water of a lake that is above the bottom; usually shallow enough for light to penetrate.

Littoral: The in-shore shallows of a lake that usually contain aquatic vegetation.

Maxillae: The upper jaw bones.

Melanistic: Black or darkly coloured.

Meristic: Any body part occurring in repetition (scales, fin rays, vertebrae).
Operculum: See Gill cover.

Palatine: A paired set of toothed bones on the roof of the mouth.

Papilla: A small fleshy projection.

Papillose: Covered with papillae.

Parr marks: Vertical dark bars arranged on the lateral surface of young salmonids.

Pectoral fin: The most anterior of the paired fins, usually connected to the pectoral girdle.

Pelagic: Living in open water.

Pelvic fins: The most posteriorly located of the paired fins.

Pharyngeal teeth: Teeth situated on the bones behind the gills at the beginning of the esophagus.

Piscivorus: Fish-eating.

Pleistocene period: The last one million years.

Preopercle: The bone lying in front and parallel to the operculum.

Proglacial lake: A lake with part of its margin at an ice sheet.

Ray (fin): A supporting structure in the fin membrane, includes soft-rays and spines.

Redd: The gravel nest of many salmonid species.

Snout: The part of the head anterior to the eyes.

Spine: A ray that is not branched and usually stiff and sharp.
Sympatric: Living in the same place, or a least overlapping in ranges.

Terminal mouth: A mouth where the upper and lower jaws form the extreme anterior end of the head.

Tubercles: Lumpy projections on the surface of scales or fin rays, especially in sexually ripe fish.

Vermiculations: Irregular lines or patterns that are wormlike in shape.

Vertebrae: The individual bones of the vertebral column.

Vomer: The most anterior medial bone in the roof of the mouth; may have teeth.

Wisconsin glaciation: The most recent continental ice sheet that partially covered North America from 50,000 to 10,000 years ago.
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Included bibliographic references.
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