Annotated Checklist of the

Indigenous Species of Freshwater Fish of British Columbia (2007)

by Don McPhail

Lampetra ayresii – The relationship between this species (river lamprey) and the western brook lamprey is unclear. They may be anadromous and non-migratory forms of the same species (not unlike the anadromous and freshwater-resident forms of threespine sticklebacks). If the river lamprey is a separate species, its spawning sites are unknown.

Lampetra macrostoma – This species occurs only in Cowichan and Mesachie lakes. Its validity is questionable. It is clearly a non-migratory form derived from the anadromous Pacific lamprey. The major distinctions between this species and the Pacific lamprey are freshwater residence and freshwater feeding. Other Pacific lamprey populations are known to feed in fresh water but have not been studied.

Lampetra richardsoni – This species may be a non-migratory form of the river lamprey (*L. ayresii*). If they are the same species, the brook lamprey has taxonomic priority.

Lampetra tridentata – The relationships of non-migratory, freshwater populations of this species need clarification. Additionally, the upper Fraser population(s) needs to be examined. Also, there is strong evidence (Docker et al. 1999, Gill et al. 2003) that the Pacific lamprey does not belong in the genus *Lampetra*.

Acipenser medirostris – The green sturgeon is an occasional visitor to B.C. marine and estuarine waters. There is no evidence that this species breeds in either the Columbia or Fraser river systems even though it is seasonally common in the Columbia estuary. The source of both the Columbia and our green sturgeons appears to be the Klamath River.

Acipenser transmontanus – The white sturgeon is in serious decline in the Nechako, upper Columbia, and Kootenay rivers. The Kootenay population is genetically distinctive. The apparent head shape differences between the Fraser populations above and below the Fraser Canyon need to be quantified and clarified.

Hiodon alosoides – The status of this species in B.C. needs to be clarified. Only small numbers of goldeye are taken in B.C. and they may be occasional wanderers from downstream populations in Alberta. Juveniles are present in the Ft. Nelson River, however, and there may be a breeding population in the B.C. portion of the Liard system.

Acrocheilus aleutaceus – The fragmented distribution of chiselmouth in B.C. suggests that the species was more widely distributed in the past. Ecologically it is unique in B.C. The Kettle River population is isolated above Cascade Falls and may be slightly divergent. The hybrids (including backcrosses) between chiselmouth and pikeminnows in Missezula Lake provide a potentially interesting problem in trophic ecology ― how do hybrids between a periphyton-scraper and a predator make a living?

Couesius plumbeus – This is the most cold adapted minnow in North America. In northern B.C. there are hints that its reproductive cycle and thermal physiology are worth a closer look, especially in the outlets of hotsprings. The southern edge of the species' range closely corresponds to the southern margin of glaciation. Most of the B.C. populations in the south are now extinct. It is not clear why they disappeared, although many of the small lakes in this area were "rehabilitated" in the 1950s and 60s. This species is now under study.

Hybognathus hankinsoni – The biology of this little fish is a mystery. It is especially abundant in the lower Fraser Valley and headwater ponds and small lakes in the Prince George area. In between it is exceedingly rare. In the lower Fraser Valley it appears to migrate to and from the main river; however, its movements are largely uncharted. All we know is that, seasonally, it

turns up in large numbers at some sites and then disappears. The populations in the Esker Provincial Park appear to be extinct. Probably victims of an exotic species (brook trout) introduced to create a recreational fishery.

Margariscus margarita – The northern pearl dace only occurs in the northeastern portion of the province. Here, its distribution is spotty. It is widespread in boggy habitats in eastern North America and across the northern Great Plains. Curiously, all of the largest known specimens of this species are from the extreme northwestern margin of its range (B.C.). In some B.C. lakes pearl dace are involved in a three-way hybrid swarm with finescale and northern redbelly dace. Given the propensity of hybrids between the latter two species to give rise to all female, diploid and triploid clones, the three-way cross might produce some interesting offspring. There is evidence (Bailey et al. 2004) that the northern pearl dace is species distinct from the southern pearl dace. If so, the name of our species should be *Margariscus nachtriebi*.

Mylocheilus caurinus – The peamouth is the only primary freshwater fish on Vancouver Island and the Sechelt Peninsula. Its presence on both the west and east coasts of Vancouver Island is a minor biogeographic puzzle that probably could be solved with a microsatellite study. On the mainland, peamouth normally occur with a suite of minnows and suckers with which it has co-evolved. These fish are absent on Vancouver Island. Consequently, the peamouth on Vancouver Island or the Sechelt Peninsula might make an interesting study in ecological release.

Notropis atherinoides – The emerald shiner was collected once in B.C. (in a small tributary to the Ft. Nelson River). It is not clear if this species breeds in B.C. or even if there is a B.C. population; however, in other provinces it is characterized as a large river fish, and the large rivers of northern B.C. are probably the most neglected — in terms of research — aquatic environments in the province.

Notropis hudsonius – There is one indigenous population of this species in B.C. (Maxhamish Lake) but it has been introduced (from Alberta) as a forage fish into Charlie Lake. From Charlie Lake, the spottail minnow has spread into other Peace River tributaries. From a biodiversity standpoint it is important to remember that the Maxhamish population is native and the other populations are not.

Phoxinus eos – Pure populations of the northern redbelly dace are rare in B.C. In the few places where this species is known to occur, it usually hybridizes with the finescale dace. These hybrids are of considerable scientific interest. Elsewhere (including adjacent lakes in Alberta), this hybrid combination produces diploid and triploid all-female “species”. The B.C. populations of these hybrid complexes are now under study.

Phoxinus neogaeus – The finescale dace is widely distributed in the northeastern part of the province. Its biology is not well known and the products of its hybridization with the northern redbelly dace are of considerable scientific interest.

Platygobio gracilis – The flathead chub is probably the least studied — but abundant — species of freshwater fish in North America. Again, it is a fish of our large, turbid, northern rivers. Its reproductive biology, life history, and habitat use are largely unknown.

Ptychocheilus oregonensis – The northern pike minnow is a much-maligned fish. Biologically it is something of an anomaly — a large, predaceous minnow. Its biology has been reasonably well studied but always with the aim of “controlling” its numbers. The “dwarf” pikeminnows in some lakes on the Bonaparte Plateau may be unique to B.C., but are probably stunted introduced populations.

Rhinichthys cataractae – This widespread species is remarkably uniform across North America, except in British Columbia. In B.C., there are three forms of longnose dace — the typical Great

Plains form in northeastern B.C., the typical Columbia-Fraser form in the rest of the province, and the Nooksack dace in the extreme southwestern region. The first two forms differ substantially in their reproductive biology and, genetically, they are quite (>4%) divergent. They may be different species. Similarly, the mitochondrial DNA of the Nooksack dace is >2% divergent from that of the Columbia-Fraser longnose dace. Although the Nooksack dace is abundant in western Washington State, it is seriously threatened by urban development in B.C.

Rhinichthys falcatus – The leopard dace is a Columbia endemic. It is abundant in gravel deposition reaches along the Fraser River. Curiously, with the exception of the lower Similkameen River, it is not common in the Columbia system. Its rarity in most of the Columbia system may be natural or may be a result of human intervention (dams). Although its general ecology is modestly well known, its reproductive biology is unknown. It is one of the species involved in the evolution, through an ancient hybridization event, of the Umatilla dace. The genetic relationships between leopard and Umatilla dace need more study — based on mitochondrial analyses, some populations group with Umatilla dace rather than with their own species. This may reflect past hybridization.

Rhinichthys osculus – The Kettle River is the only place in Canada where the speckled dace occurs; however, it is widespread in the western U.S. Within the Kettle River system, it is widely distributed and abundant. Nonetheless, its biology in B.C. is poorly understood. Since it is on the COSEWIC list, an effort should be made to document its life history and quantify its habitat use. To determine if the B.C. population is actually unique, a molecular study of its relationships with other middle Columbia drainage populations is needed.

Rhinichthys umatilla – The Umatilla dace has only recently been recognized as a separate species. It is endemic to the Columbia River system and is thought to be the product of an early Pleistocene hybridization involving leopard and speckled dace. Very little is known about its habitat requirements. There are two forms of Umatilla dace in B.C. — one in the Columbia and Slocan rivers and the other in the Similkameen River. There are subtle differences in their morphology and some evidence of molecular differentiation. The relationship between the two forms and their habitat requirements needs study.

Richardsonius balteatus – The redside shiner is the most common minnow in B.C. Although its biology is relatively well known there are some things about the species that warrant further study. For example, there are consistent differences in body shape between riverine and lacustrine populations. How these differences affect habitat use is unknown.

Catostomus catostomus – This is the most widely distributed sucker in British Columbia. There are “dwarf” populations scattered around the province. The ecological factors associated with these populations of small suckers are unknown but in at least one lake (now rehabilitated) small-bodied and large-bodied longnose suckers once coexisted. In B.C., one small-bodied form — the Salish sucker — is restricted to the lower Fraser Valley. Genetically and morphologically, it is slightly, but consistently, different from other northwestern longnose suckers.

Catostomus columbianus – The bridgelip sucker is another Columbia endemic. Ecologically, it bridges the trophic gap between the largescale sucker and the mountain sucker — it is less dependent on periphyton than the mountain sucker but is not as clearly a general benthivore as the largescale sucker. Interestingly, much of its anatomy is also intermediate between these species. Little is known about its reproductive biology or the details of its habitat use.

Catostomus commersonii – The white sucker is an eastern North American species that postglacially colonized the upper Fraser and Skeena drainage systems. Where the largescale and white sucker co-exist, they often hybridize. In eastern North America, the biology of this species

is well studied and, presumably, its biology is similar in B.C.

Catostomus macrocheilus – The largescale sucker probably is the most common sucker in the southern half of our province. It grows to a large size and appears to be morphologically and ecologically uniform over most of its B.C. range. In the summer, the population in Eagle Lake (Chilcotin) is reported to forage at the surface on emerging chironomids.

Catostomus platyrhynchus – The mountain sucker is the most specialized sucker in B.C. It is a periphyton scraper and has a chisel-like lower jaw. Like the chiselmouth, its B.C. distribution is scattered — it occurs in the Fraser River between Hope and Chilliwack, the North Thompson near Heffley, the Similkameen River near Keremeos and, perhaps, the Salmo River near its junction with the Pend d'Oreille River. Nothing is known about its biology in B.C., and B.C. mountain suckers are about 5% divergent (mtDNA) from those on the Great Plains (Alberta and Saskatchewan). The two published accounts of mountain sucker life history are both from east of the Continental Divide and probably refer to a different species.

Esox lucius – Pike are abundant in suitable habitats in the northeastern part of the province (Mackenzie River system) and in the upper Yukon system. Their geographic distribution in the province suggests our populations were derived from two sources: the Beringian and Great Plains refugia. Genetically, they probably are slightly divergent.

Hypomesus pretiosus - The surf smelt is a marine or estuarine species; however, in the lower Fraser River it commonly occurs upstream as far as Queen's Reach, and it has been collected as far upstream as the upper end of Pitt Lake. Also, young surf smelts were taken in a tow-net sets in Queen's Reach. Probably, these young were entrained in tidal water moving upstream. Nonetheless, there is a remote possibility that this species spawns in the tidal portions of the Fraser River. McAllister (1963) mentions surf smelt spawning in a lower Columbia tributary (the Sandy River, Oregon).

Osmerus dentex – There are unconfirmed reports of Arctic smelt in some north-coast estuaries and there is a marine record from Barclay Sound (based on a desiccated juvenile specimen). In Alaska, it has not been recorded south of the Alaska Peninsula (Morrow 1980). Consequently, it is unlikely that this species occurs in the fresh waters of B.C.

Spirinchus thaleichthys – There are records of longfin smelt from the central and north coasts but the only known B.C. spawning run is in the lower Fraser River. It is not clear how far upstream they migrate but young-of-the-year longfin smelts have been taken near Chilliwack (Island 22). Apparently, there are two spawning runs into the river — one in late August and September, and one in November. The little data available suggest the runs are discrete and the fish differ in body size and spawning area. Additionally, there are pygmy, neotenic smelts in both Pitt and Harrison lakes. The relationships between these freshwater resident smelts and the anadromous populations is unknown; however, in Pitt Lake they are seasonally sympatric. The relationships between neotenic and anadromous longfin smelts are currently under study. There are rumours of small "smelts" in Chilliwack Lake. They should be checked out.

Thaleichthys pacificus – Spawning runs of eulachon are known from most major rivers along the B.C. coast. This fish is especially significant to the coastal first nations and appears to be in serious decline in the Fraser River.

Coregonus artedi – Although the cisco is widespread across the northern Great Plains, only one population is known from B.C. (Maxhamish Lake). This lake, and its fishes, has been studied and the cisco population appears to be healthy. There is some debate about the relationship of this, and the following, species.

Coregonus autumnalis – Normally, the Arctic cisco is an anadromous species. About 30 years

ago a spawning run was intercepted in the lower Liard River and, apparently, spawned below the Liard Canyon. It is not known if this is an annual event. There is little work done in this area and nothing is known about their biology, or status, in B.C.

Coregonus clupeaformis – The lake whitefish is native to central and northern B.C. The taxonomy of this complex of species is still confused. We may have one or, perhaps, two species in B.C. In addition, there is a genetically divergent form that apparently survived the last glaciation in the Nahanni glacial refuge (Foote et al. 1992). This complex needs work.

Coregonus nasus – The only known population of broad whitefish in B.C. is in Teslin Lake. Nothing is known about its biology or interactions with the lake whitefish. The only published reports on this species in North America are from Alaska and the Northwest Territories. Most of the reports refer to anadromous populations and the Teslin fish represent an isolated freshwater-resident population. Two whitefish species (broad whitefish and inconnu) in Teslin Lake harbours are isolated lacustrine populations that warrant more study.

Coregonus sardinella – The least cisco occurs in the B.C. portion of the Yukon drainage system. Elsewhere in its range, this species sometimes occurs as two sympatric trophic forms. There is a hint of such a situation in one unnamed lake in northern B.C. The lake is remote and there were too few fish in the original samples to be certain of their population structure. Nothing is published on the ecology or behaviour of B.C. populations of least ciscoes.

Prosopium coulterii – The pygmy whitefish is usually characterized as a glacial relict. Typically it occurs in deep oligitrophic lakes and most B.C. populations fit this description; however, two B.C. populations occur in eutrophic lakes and grow to a giant size (for pygmies). A third B.C. population occurs in a shallow (max. depth 25 m) mesotrophic lake with a depauperate fauna (originally only three fish species). In this lake, pygmy whitefish are very abundant and show some unusual behaviour (e.g., schooling, nocturnal use of the littoral zone). It is an enigmatic species and we should learn more about its biology.

Prosopium cylindraceum – This species survived glaciation in the Mississippi and Bering refugia. All the published information on the biology of round whitefish is on the eastern North America form. Our populations are confined to the upper Yukon, Taku, and upper Liard systems. They are derived from Beringia and undoubtedly are genetically distinct from the eastern form. We know little about their biology but Dease Lake is the only place in the world where all three of the widespread species of *Prosopium* co-exist.

Prosopium williamsoni – The biology of riverine mountain whitefish is reasonably well known. They have a complex life cycle and make major spawning, over-wintering, and summer feeding migrations. In contrast, the biology of lacustrine populations is poorly known. We do know that there are major differences in body form between riverine and lacustrine populations and, that in Kootenay Lake there are spatially and temporally separate spawning runs. This suggests that in large lakes there may be multiple demes. Additionally, in many interior rivers there are two riverine forms — a normal form and a longnose “pinocchio” form. The two forms differ in foraging behaviour, morphology and there is some evidence of genetic differences. This should be checked out.

Stenodus leucichthys – The distribution of inconnu in B.C. is disjunct — there is a freshwater-resident population in Teslin Lake and a migratory population in the Liard River system. The Liard population is biologically complex: some individuals appear to be part of the general upper Mackenzie River population and probably isn’t anadromous but other individuals are known to migrate to the Mackenzie Delta, and others tagged individuals have been taken in the Beaufort Sea. There is some evidence that some of the Liard population breeds in B.C.; however, no fry

have been collected in B.C. although one juvenile was collected in the Ft. Nelson River. In contrast, the Teslin Lake population is thought to breed in the lake and appears to be isolated from the migratory Yukon populations. As far as is known, the Teslin population is the only lacustrine population in the Yukon system. In itself, this makes it unusual. Additionally, all the Yukon populations appear to be separated from the Mackenzie populations by a substantial distributional gap along the north coast of Alaska. This suggests that the two B.C. groups of *Stenodus* may be genetically different. The Teslin Lake population really needs study.

Oncorhynchus clarkii clarkii – In B.C., the coastal cutthroat occurs as three major life history forms — sea-run populations, freshwater-resident populations (lacustrine and fluvial) and headwater stream populations. Within each of these groups there are complex arrays of subtle, and not so subtle, life history variants. For example, although sea-run cutthroats typically return to freshwater to overwinter, in the Bella Coola system there was once a run of exceptionally large cutthroat that may have spent a year or more in the sea. This run now appears to be extinct. The complexity, and inter-and intra-population variation in coastal cutthroat life histories, presents a challenge to conservation managers. It will be difficult to maintain biodiversity in this subspecies. The "cutbows" in the upper Dean River should be studied. Unlike most of the hybridization between rainbows and cutthroats this population may be a natural hybrid swarm that has existed since before European colonization. If true, it could be genetically interesting.

Oncorhynchus clarkii lewisi – The native range of the westslope cutthroat is the southeast part of the province (especially the Kootenay drainage system). Generally, its life history is not as complex as the coastal subspecies. There are, however, "dwarf" headwater populations and also some in high mountain lakes. At one time, some of these small-bodied populations were recognized as separate subspecies but there is no good evidence that they warrant taxonomic recognition. The biggest threat to the westslope cutthroat is the introduction of rainbow trout into areas where westslope cutthroat are native. Such introductions inevitably lead to massive hybridization and the loss of the "pure" westslope genome. The process has gone so far in the northwestern U.S. that pure westslope cutthroats are almost gone. In B.C., there are enough isolated populations above barriers that "pure" populations probably will survive; however, further introductions of rainbows into areas that are occupied by westslope cutthroat would be ecological vandalism. The few headwater populations in some Eagle River tributaries are the only native populations of westslope cutthroat in the Fraser River system. They should be protected.

Oncorhynchus gorbuscha – There are still unsolved problems involving the relationships and distribution of the odd and even year broodlines in this species. Because virtually all pink salmon mature at two years, the generations spawning on odd and even years are genetically isolated from one another and often differ in life history and genetic characteristics. Usually one broodline is dominant (i.e., there is a strong run one year followed by a much smaller run the next year). At the southern end of their North American distribution (including southern British Columbia) odd year runs are dominant but, in B.C., north of the Fraser River system, many rivers support relatively strong runs on both odd and even years. From the Queen Charlotte Islands north into Alaska, even year runs are dominant. Presumably, odd and even year runs have evolved independently in different areas but the reasons for the broad geographic pattern in run-dominance is still a mystery. The pattern of mitochondrial variation in northern pink salmon indicates multiple Pleistocene divergences followed by a relatively recent (postglacial) expansion from different sources and, perhaps, different colonization routes for the odd and even year broodlines.

Oncorhynchus keta – The chum salmon is still abundant along the B.C. coast. There are some interesting life history variants in this species — temporally separated runs to the same small streams are common and some populations spawn intertidally. Of special interest are two northern runs. Most chum runs spawn within 100 km of the sea but there is a run of chum salmon in the Yukon system that reaches Teslin Lake (>2,000 km from the sea). Unlike southern chums, these Yukon fish are bright when they enter freshwater and in good condition when they reach their spawning grounds. The other northern run of potential interest is in the Liard River (Mackenzie system). Chum salmon have reached the lower Liard River in B.C.; however, it is not clear that there is a self-sustaining run in the Liard. Interestingly, this chum run was reported the same year as the Arctic cisco run into B.C. Perhaps it was only an anomalous year but, if there is a self-sustaining run, it is of considerable interest.

Oncorhynchus kisutch – The coho salmon is genetically heterogeneous and locally adapted populations are common in this species. Much of this local adaptation is associated with small populations in small streams. This biodiversity is threatened by hatchery operations (genetic swamping) and the practice of basing management decisions on a few, large populations.

Oncorhynchus mykiss – The rainbow trout is the most common and popular trout in B.C. In the past, biodiversity in this species has been compromised by fish culture operations but in recent years the emphasis has shifted to protecting the remaining wild stocks. In B.C., rainbow trout occur both as freshwater-resident and anadromous (steelhead) populations. Some authors recognize two subspecies of *O. mykiss* and both appear to occur in British Columbia — the coastal rainbow trout, *O. mykiss irideus* and, in the interior, the Columbia redband trout, *O. mykiss gairdneri*. However, subspecies should represent monophyletic clusters of populations. Consequently, although the coastal and interior forms of rainbow trout generally are treated as two distinct lineages, subspecific names are rarely used. In B.C., recent molecular studies support the notion of two rainbow trout clades. Although the geography of these lineages roughly supports a coastal-interior dichotomy, there is extensive overlap in their distributions. Thus, while many B.C. sites include both lineages, the coastal clade is dominant on the coast and the interior clade is dominant in southern Interior populations. Since the molecular markers characteristic of the two clades occur in both coastal and interior populations, the boundaries between the purported subspecies are fuzzy and confound attempts to assign formal subspecific names to the two clades. Typically, the considerable life history variation in this species (e.g., differences in run-timing, body size, and foraging behaviour) is present in both clades. Nonetheless, some life history types are relatively rare (e.g., large, piscivorous forms) and special efforts should be made to preserve them. Many of the anadromous (steelhead) populations on the south coast are in serious trouble but managers are well aware of the problems.

Oncorhynchus nerka – The sockeye salmon is also a genetically heterogeneous species and locally adapted populations are common. In the past, kokanee were often referred to as a subspecies, *Oncorhynchus nerka kenneryli*. We now know that most natural kokanee populations evolved from different populations of anadromous sockeye. Since shared common ancestors is a crucial component in defining any taxon, and the kokanee life-history form is clearly polyphyletic, it is inappropriate to assign the same subspecific name to all kokanee populations. This does not mean that kokanee are simply small sockeye. Some kokanee populations spawn sympatrically (i.e., in the same stream and at the same time) as anadromous sockeye but still retain a suite of inherited morphological, physiological, and behavioural differences from sockeye. Populations where kokanee and sockeye are sympatric for part of their life history are

scientifically important and some should be protected. Also, there are lakes (e.g., Okanagan Lake) where two, or more populations, spawn in different habitats (i.e., beach and stream spawners). These situations are of scientific interest. There is also a mysterious population of deep-bodied kokanee in Seton Lake. Apparently, they spawn late in the year and at great depth. We know nothing about this unusual population.

Oncorhynchus tshawytscha – This is another genetically heterogeneous species and locally adapted populations are common. Apparently, much of the variation within the species is derived from the presence of two behavioural forms of Chinooks — a "stream type" and an "ocean type". Stream type Chinooks have a relatively long period of freshwater residence (one or more years), at sea they make major offshore migrations, and they return to their natal rivers in the spring or summer. In contrast, ocean type Chinook usually migrate to sea within about three months of emergence, they spend most of their ocean life in inshore waters, and they return to their natal streams in the fall. From a biodiversity perspective, any management plans for this species should attempt to preserve a wide range of these life history variants.

Salvelinus confluentus – The relationship between bull trout and Dolly Varden has a long and tangled history. In B.C., the bull trout is primarily an interior species; however, it reaches the coast wherever large rivers cut through the Coast Mountains. Again, there are a number of life history types — stream-residents, large bodied fluvial and adfluvial populations, and even a few anadromous (or perhaps, more properly, amphidromous) populations. These populations that migrate to estuaries appear to be unique to southern British Columbia but probably at one time also occurred in the Puget Sound region of Washington State. Special care should be taken to protect these migratory populations. Where they come together, bull trout and Dolly Varden commonly hybridize; however, even in the face of persistent hybridization (and back-crossing) they maintain themselves as distinct ecological and genetic entities. At the southern margins of their range bull trout are in serious decline.

Salvelinus malma – The relationship between Dolly Varden and bull trout has a long and tangled history. In B.C., the Dolly Varden is a coastal species. It occurs in most rivers and streams along the length of the coast but is more common on the north coast than on the south coast. There are at least three life history forms — stream-resident, adfluvial and lacustrine, and sea-run populations. On Vancouver Island, sea-run Dolly Varden appear to stop at about Campbell River. Dolly Varden have crossed the Coast Mountains in at least three areas — the middle Fraser, upper Peace, and upper Liard systems. There are no bull trout on Vancouver Island and the Dolly Varden in some of the island's large lakes have adopted a bull trout-like life history as deep-water piscivores. Where they come together, Dolly Varden and bull trout commonly hybridize; however, even in the face of persistent hybridization (and back-crossing) they maintain themselves as distinct ecological and genetic entities.

Salvelinus namaycush – There is evidence that, during the Pleistocene, lake trout survived (and diverged) in at least five separate refugia. The B.C., populations are derived from two refugia: those in the Yukon, Chilkat, Taku, and Stikine systems, and, perhaps, in the upper Liard are derived from the Bering Refugium; while, those in the Skeena, Fraser, Peace and lower Liard systems are derived from eastern sources. In addition, lake trout from eastern North America have been introduced into B.C. Again, from a biodiversity perspective, it is important to distinguish between indigenous and introduced populations. Basically, any populations south of Shuswap Lake are probably introduced. Although, the biology of lake trout is well known, we need more information on our native populations.

Thymallus arcticus –Arctic grayling occur in both North America and Siberia. As the name

implies, in North America this coldwater species ranges in a broad band from the west coast of Hudson Bay to Alaska. They are absent from the Arctic Archipelago but, historically, isolated populations occurred in upper Michigan and in the upper Missouri system in Montana. Arctic grayling appear to be especially vulnerable to over-fishing and habitat changes. At one time they were the most abundant recreational fish in the upper Peace system; however, since the formation of the Williston Reservoir they have dramatically declined in this region. After the fact, we have learned more about their life history and, especially, about the importance of large, valley-bottom rivers as over-wintering sites. Elsewhere in northern B.C., wherever road access allows anglers into grayling waters, grayling appear to be in decline. Current management practices are designed to stop these declines but it is too early to know whether they are working.

Percopsis omiscomaycus – The trout-perch is an archaic little fish. In B.C., it only occurs east of the Continental Divide. Although it has not been studied in our province, it appears to be doing well.

Lota lota – In North America, burbot survived glaciation in multiple refugia and different morphological forms of this species now occur in different regions. At least two subspecies have been recognized — one in Siberia, Alaska, parts of the Yukon, and in northern B.C., and the other on the Great Plains and eastern North America. Regardless of whether or not forms derived from different refugia warrant subspecific recognition, B.C. probably was colonized from both refugia. Consequently, genetically, our northern and southern burbot populations probably are different. Whether these differences translate into life history or habitat differences is unknown. The northern populations appear to be healthy but some of our southern populations are in trouble. For example, the once thriving burbot population in Kootenay Lake is almost gone and other Columbia system populations are also be in decline.

Culaea inconstans – In B.C., the brook stickleback is found in the northeastern part of the province. It is extremely abundant in muskeg areas and occupies a number of major drainages (although they are all part of the Mackenzie River system). Elsewhere there are populations of this species that lack pelvic girdles and, eventually, this condition may turn up in B.C.

Gasterosteus aculeatus – The threespine stickleback is notorious for the complexity of its morphological, ecological, and behavioural forms. These forms often are sympatric or parapatric and, in many cases, they act like good biological species (i.e., they are reproductively isolated and use different trophic and spatial resources). To further confuse matters, these forms tend to evolve repeatedly. They are of great scientific interest and a headache for biodiversity managers. A rule of thumb for prioritizing the different forms of *Gasterosteus* for protection is to examine their geographic distributions. For example, the anadromous stream-resident dichotomy is widespread in Europe, Asia, and both coasts of North America. This suggests that the conditions that produce this dichotomy are widespread. Consequently, although local examples may be lost, the dichotomy is unlikely to go extinct. In contrast, the benthic-limnetic dichotomy only occurs in B.C. (although it has been searched for elsewhere). This suggests that the conditions that lead to this dichotomy are rare, local, and unique. Thus, this dichotomy has a higher biodiversity value than the anadromous stream-resident dichotomy and warrants more rigorous protection than the other dichotomy.

Pungitius pungitius – The ninespine stickleback may not breed in B.C. Only four specimens are known. Three came from the Petitot River just west of the Alberta border and one came from the Ft. Nelson River just downstream from old Ft. Nelson. The Petitot River specimens probably drifted downstream from Bistcho Lake in Alberta. Although no breeding fish were taken in the Petitot, the region close to the Alberta border has only been collected once. The Ft. Nelson fish is

more puzzling. It was taken hundreds of kilometers from any known self-sustaining population. If it was a stray from the nearest known source (Bistcho Lake) it had to swim down the Petitot River to the Liard River and then upstream against the current to the Ft. Nelson area. A formidable journey against a strong current! The simplest explanation is that there is some unknown, but nearby, source. If so, there maybe a self-sustaining B.C. population.

Cottus aleuticus – As its name implies, the coastrange sculpin is a coastal species. In southern B.C., it rarely penetrates more than 150 km inland. Reproductive adults in minor coastal drainages migrate downstream and spawn just above estuaries. The larvae over-winter in brackish water before moving upstream. On Vancouver Island and, presumably on the mainland, the larvae of populations associated with large lakes are swept down into the lakes and live limnetically for an unknown length of time before migrating back into streams. The "dwarf" limnetic (?) adults in Cultus Lake are probably derived from this life history. It is not known if the lake and stream populations in Cultus Lake represent separate gene pools or if some limnetic larvae stay behind in the lake. Morphology, however, suggests that the lake form is neotenic. Although, this species does not occur above the Fraser Canyon, there is a disjunct population associated with Anderson and Seton Lakes. On the central coast (e.g., Skeena system), coastrange sculpins penetrate over 500 km inland (Morrison Lake).

Cottus asper – There are two morphological forms of the prickly sculpin in B.C., and a number of life history types. There is a coastal and an interior form that, morphologically, are slightly different. Additionally, preliminary mtDNA data suggest a modest divergence between the two forms. Presumably the coastal form dispersed into B.C. through the sea — many coastal populations are catadromous — while the interior entered from the unglaciated portions of the Columbia system (a pattern common to other species; e.g., chinook salmon, rainbow trout). In catadromous populations, adults migrate downstream and spawn in estuaries. The larvae spend at least a year in the estuary before migrating upstream. Obviously, the interior form doesn't migrate to the sea. The biology of the interior form has never been studied and there may be significant life history difference between the two forms.

Cottus cognatus – The slimy sculpin is the most widely distributed sculpin in B.C. Distributional and morphological evidence suggest that the province was postglacially colonized from three sources — the Columbia River, the northern Great Plains, and Beringia. Except in the southern part of the province, the populations are generally healthy. With one exception (a geographically isolated population in central Idaho), the southern populations of this species closely coincide with the maximum extent of glaciation. This raises the possibility that they did not survive glaciation in the Columbia system but postglacially entered Columbia drainages from the north. The slimy sculpin is a coldwater species and most populations in southern B.C. are found in glacial streams or cool headwaters. Nonetheless, there are populations above barriers (where they are the only sculpin) that occupy relatively warm streams (e.g., the Kettle River). Indeed, it is common to find slimy sculpins, by themselves, above barriers in the B.C. portion of the Columbia system. They tolerate warmer conditions if they are the only sculpin but appear to be excluded where warm-water sculpins (e.g., Columbia, torrent, and Rocky Mountain sculpins) occur. The Flathead River would be an excellent site to look at water temperature and interactions between the slimy and Rocky Mountain sculpins. In this system the pattern of slimy sculpins in cool water and eastslope sculpins downstream is repeated in several tributary streams.

Cottus confusus – In B.C., the shorthead sculpin occurs in Columbia River tributaries below Bonnington Falls and in the three km of the Kettle River below Cascade Falls. Their life history has never been studied in B.C. (early B.C. reports refer to the Rocky Mountain sculpin in the

Flathead River as the shorthead sculpin). Most of the existing B.C. populations appear to be strong and in no immediate danger; however, Blueberry Creek near Castlegar is being encroached on by development and should be monitored. Additionally, Brilliant Dam divides the Slocan populations from those below the dam.

Cottus hubbsi – The Columbia sculpin is endemic to the Columbia River system. In B.C., it occurs in the Columbia River and tributaries (e.g., the Slocan, Kootenay (below Bonnington Falls), Kettle (below Cascade Falls), and Similkameen rivers. In the Castlegar-Trail area it is rare in small tributaries but common in the mainstem Columbia. The tributary streams in this area are dominated by shorthead sculpins (at least in their lower reaches). In contrast, Columbia sculpins are abundant in small tributaries to the Similkameen (below Similkameen Falls) and Tulameen rivers. These habitat shifts may reflect interspecific interactions (there are no shorthead sculpins in the Similkameen system). The only known lacustrine populations of this species occurred in a series of small lakes in the Allison Creek drainage (Similkameen system). Unfortunately, the lakes were rehabilitated before any data was collected on these fish. Some sculpins appear to have modified life histories in lakes (see comments under torrent sculpin). There are lakes in the Otter Creek drainage (also Similkameen system) where Columbia sculpins are abundant in streams above and below the lakes. Perhaps these lakes should be checked for Columbia sculpins. There is another sculpin in the upper Otter Creek area that may be the Columbia sculpin but, morphologically, some individuals fit the description of the Malheur mottled sculpin, *Cottus bendirei*. These upper Otter Creek individuals also differ in their mitochondrial sequence from the Columbia sculpin.

Cottus rhotheus – The torrent sculpin occurs throughout the Columbia River system and in the North Thompson River. Normally, this species is heavily prickled but there are two populations in B.C. that lack prickles — one in Pass (Norns) Creek and one in Beaver Creek. In both cases these populations are isolated above barriers. There are no other sculpins at these sites. As their name implies torrent sculpins are usually associated with fast water; however, it is not clear if this is by choice or a result of interactions with other sculpins. In areas where they coexist with shorthead sculpins (e.g., the Little Slocan River), they appear to shift into quiet water. There are also lacustrine populations of torrent sculpin. There is a bit of data on Columbia Lake that suggests some early life history modifications in this lacustrine population. In Columbia Lake they spawn in the littoral zone (under rocks). Usually, the larvae of this species remain in the gravel until they metamorphose into tiny sculpins. In Columbia Lake, the larvae (<10 mm) are found in open water off the bottom. They are transparent and remain in the plankton until they reach about 15 mm (newly emerged stream dwellers are typically 10-12 mm). Presumably, this lacustrine population metamorphoses at about 15-20 mm and settles to the bottom. In late August or early September they suddenly appear inshore on gravel beaches. These observations suggest that there is an offshore benthic phase in the life history of the Columbia Lake population.

Cottus ricei – In B.C., the spoonhead sculpin only occurs in the northeastern part of the province. In eastern North America it is described as a lacustrine species that often occurs in deep water. In B.C., it is another species associated with large, turbid, northern rivers. Nothing is known about its biology in these habitats.

Cottus sp. – This is the sculpin in the lower Flathead River. It has been variously called the shorthead sculpin (*C. confusus*), the mottled sculpin (*C. bairdi*), and another sculpin (*C. punctulatus*). It is none of the above. Recent molecular studies show that it is an undescribed species. The same species occurs in southwestern Alberta and the upper Missouri system in

Montana. Dr. Dave Neely is describing it. Its common name is the Rocky Mountain sculpin. This COSEWIC listed species is threatened by extensive coalmine development in southeastern B.C.

Perca flavescens – The yellow perch. Most B.C. populations of this species are introduced; however, it is possible that the Swan Lake population near Tupper in the Peace Region is native. It is indigenous to Peace River drainages in adjacent Alberta and was first recorded from Swan Lake in B.C. in the 1950s.

Sander vitreus – This is the walleye. The generic name has been changed. The walleye is indigenous to the northeast corner of B.C. but has been introduced into the Columbia River system.