

(McPhail and Lindsey 1970 in McPhail and Paragamian 2000). This interpretation is supported by recent molecular studies (Taylor and Dodson 1984; Billington and Hebert 1988; Grewe and Hebert 1988; Bernatchez and Dodson 1991; all in McPhail and Paragamian 2000). Chen (1969 in McPhail and Paragamian 2000) demonstrated that burbot from the interior of Alaska (Hubbs and Schultz's *Lota lota leptura*) consistently differ in a number of morphological traits from burbot found elsewhere in North America. These findings, coupled with past morphological studies, suggest that variation in *Lota lota* has geographic patterning and, consequently, treating all burbot as a single entity may be inappropriate (McPhail and Paragamian 2000).

In order to clarify the genetic variation of burbot throughout their wide-ranging distribution, researchers from Belgium initiated a study to test the many hypotheses related to burbot phylogeography. The mitochondrial cytochrome b from 41 populations (18 in North America and 23 in Eurasia) of burbot was sequenced (Van Houdt and Volckaert in draft 2002). Their study observed two distinct phylogroups within the genus *Lota*; a palearctic group distributed from Europe to Northern Canada, and a neararctic group in the remaining parts of North America, with both groups co-occurring in the Great Slave Lakes, Northwest Territories. The distribution pattern of the palearctic group is nearly congruent to that of the subspecies designation previously discussed as *Lota lota lota* (Van Houdt and Volckaert in draft 2002). However, the genetic analyses does not support including burbot that occur in western Europe in the subspecies *Lota lota maculosa*, as previously concluded by Pivnicka. Therefore, the neararctic group of burbot only occur in a portion of North America and are designated as *Lota lota maculosa* (Van Houdt and Volckaert in draft 2002). Within the neararctic phylogroup, three different clades (taxonomic groupings of organisms that share common ancestry) were observed, the presence of which supports the suggested glacial refugia hypothesis for burbot in North America. The three clades are referred to as the Pacific clade, the Missouri clade, and the Mississippi clade (Van Houdt and Volckaert in draft 2002).

Further, Van Houdt (pers. comm., 2002) indicated that burbot in the lower Kootenai River (the lone area sampled from the Pacific clade) are genetically distinct from burbot in the other clades in North America, as well as being

genetically distinct from the palearctic group of burbot that occur in northern Canada, Alaska, Europe, and Asia (Van Houdt and Volckaert in draft 2002). However, this distinction was based on a small sample size and is only an indication of the existence of a separate glacial race (Van Houdt, pers. comm., 2002). Furthermore, we have no evidence that the genetic profile of lower Kootenai River burbot is unique relative to other burbot in the neararctic range. It should also be noted that the results of this research do not include samples from all major drainage basins in North America, and that a detailed phylogeographic analysis that determines exact distribution of each glacial race is needed to gain insight with regard to the evolutionary relationship of burbot throughout the neararctic region.

Considering these findings and past morphological findings for burbot that suggest divergence, we determined that recognizing the two subspecies *Lota lota maculosa* and *Lota lota lota* for this finding is appropriate. We therefore evaluated lower Kootenai River burbot as they compare to other burbot in the neararctic region or to *Lota lota maculosa*.

Burbot that occur in the Kootenai River basin exhibit three life history strategies in several isolated groups. The first life history strategy is represented by the lower Kootenai River burbot population, which spends a portion of its life in the South Arm of Kootenay Lake, British Columbia, and then migrates up the Kootenai River during the winter months to spawn in the mainstem river or tributary streams in British Columbia or Idaho (adfluvial life form). The second life history strategy is represented by burbot occurring further upstream in the Kootenai River above Kootenai Falls, which have a fluvial (riverine) life history (Paragamian *et al.* 1999). That is, they migrate within the river and to tributary streams for spawning. We also considered burbot that occur in Lake Kootenai (a reservoir) to be fluvial, because they evolved with a fluvial life history prior to the construction of Libby Dam. We considered this population to be fluvial because it is currently unclear how readily burbot populations adopt a different life history strategy when faced with changing environmental conditions, and we did not believe it was appropriate to compare naturally occurring adfluvial populations of burbot to burbot that now have some adfluvial characteristics as the result of a human-created reservoir. The third life history strategy is represented by the only known lacustrine (spending entire

life cycle in the lake) population in Kootenay Lake, which occurs in the North Arm of Kootenay Lake (Spence 1999). Prior to dramatic declines of burbot in Kootenay Lake, a population was believed to have spawned at the inlet of the West Arm of Kootenay Lake, but this population has completely collapsed and is now believed to be extirpated (Spence 1999; Baxter *et al.* 2002; Colin Spence, MWLAP, pers. comm., 2001; Paragamian, pers. comm., 2000).

Lower Kootenai River burbot spawn during the winter months, and under natural conditions (pre-dam), spawning occurs under ice at temperatures near or below 1 °C (34 °F) (Paragamian *et al.* 2000; Simpson and Wallace 1982). They generally begin migrating up the Kootenai River in November and travel as far as 120 kilometers (km) (75 miles (mi)) to traditional spawning sites (Paragamian 2000). Spawning commences in late January and continues through early February and lasts for only 2 to 3 weeks, as both gamete (egg and sperm) maturation and arrival to spawning sites are highly synchronous (Paragamian 2000; Kozfkay and Paragamian 2002; Arndt and Hutchison 2000; Eveson 2000).

The lower Kootenai River once supported a significant number of burbot, which provided a very important winter fishery to the region. Declines were first documented in the burbot fishery around 1960, but numbers were still considered stable into the early 1970s. However, within only a few years, a dramatic decline in the burbot population was documented. Despite numerous fishing regulations implemented to reduce threats to burbot, their numbers continued to decline almost to extirpation, and the fishery was closed to fishing in the early 1990s. Based on data collected from the autumn of 1995 through the spring of 2000, the population is estimated to consist of roughly 540 adults (Kozfkay and Paragamian 2002).

Under the Act, we must consider for listing any species, subspecies, or, for vertebrates, any distinct vertebrate population segment (DPS) of these taxa if sufficient information exists to indicate that such action may be warranted. To implement the measures prescribed by the Act, we, along with the National Marine Fisheries Service, developed a joint policy that addresses the recognition of DPS for potential listing actions (61 FR 4722). The policy allows for a more refined application of the Act that better reflects the biological needs of the taxon being considered, and avoids the inclusion of entities that do not require its protective measures.