

FISHES FROM THE LATE MIOCENE POISON CREEK AND CHALK HILLS FORMATIONS, OWYHEE COUNTY, IDAHO

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ABSTRACT - Three new Miocene fossil fish localities from Poison Creek and Reynolds Creek Road on the Western Snake River Plain, Owyhee County, Idaho, indicate Clarendonian and Hemphillian development of lacustrine habitat. Two localities are found at Reynolds Creek Road: a lower one in the Poison Creek Formation and an upper one in the Chalk Hills Formation. The Poison Creek sediments contain eight species: four minnows (*Acrocheilus*, *Ptychocheilus*, *Mylocheilus*, and *Mylopharodon*); sucker (*Catostomus*), catfish (*Ameiurus*), char (*Salvelinus*), and sunfish (*Archoplites*). Species used to identify the Chalk Hills Formation are identical to species from numerous other localities of the Chalk Hills between Bruneau, Idaho, and Vale, Oregon. The Poison Creek Formation differs in the presence of a new species of *Mylocheilus* (which is here named for Dr. John A. White) intermediate between two Chalk Hills species, *M. inflexus* and *M. robustus copei*. The Cossel Ranch fish locality in the Poison Creek area near the Poison Creek Formation type section represents the Chalk Hills Formation because it contains *Mylocheilus robustus copei*. Both faunas include sediments and fish indicative of large-scale lake habitats.

INTRODUCTION

“Many of the animal remains found in association with the Hagerman zebras provide us with even stronger evidence to indicate a very moist climate existed at the time they were buried in what is now the dry, dusty quarry sitting far above the Snake. The presence of beaver, muskrat, two kinds of otters, together with fish, frogs, pelicans, ducks, swans, and geese certainly substantiate a wet environment” (John A. White, 1967).

Poison Creek and vicinity, Owyhee County, Idaho, is the site of more than two stages of E. D. Cope’s “Lake Idaho” on the Late Cenozoic Western Snake River Plain

(Fig. 1). The Lake Idaho depositional habitat consisted of large lakes and associated rivers (Jenks and Bonnicksen, 1989) in which the Miocene Poison Creek and Chalk Hills Formations and the Pliocene Glens Ferry Formation were deposited (Fig. 2; Malde and Powers, 1962). Shore-line continuity (Swirydczuk et al., 1979) and fish community identity (Smith et al., 1982) indicate that a large lake system was spatially continuous over much of the western Snake River Plain, but was temporally discontinuous. At its maximum extent the Glens Ferry Formation lake occupied the subsiding basin of the Western Snake River Plain from near Hagerman, Idaho, to as far west as Willow Creek, Malheur County, Oregon, in Pliocene (primarily Blancan) time (Malde and Powers, 1962; Smith et al., 1982; Middleton et al., 1985; Repenning, 1987). The

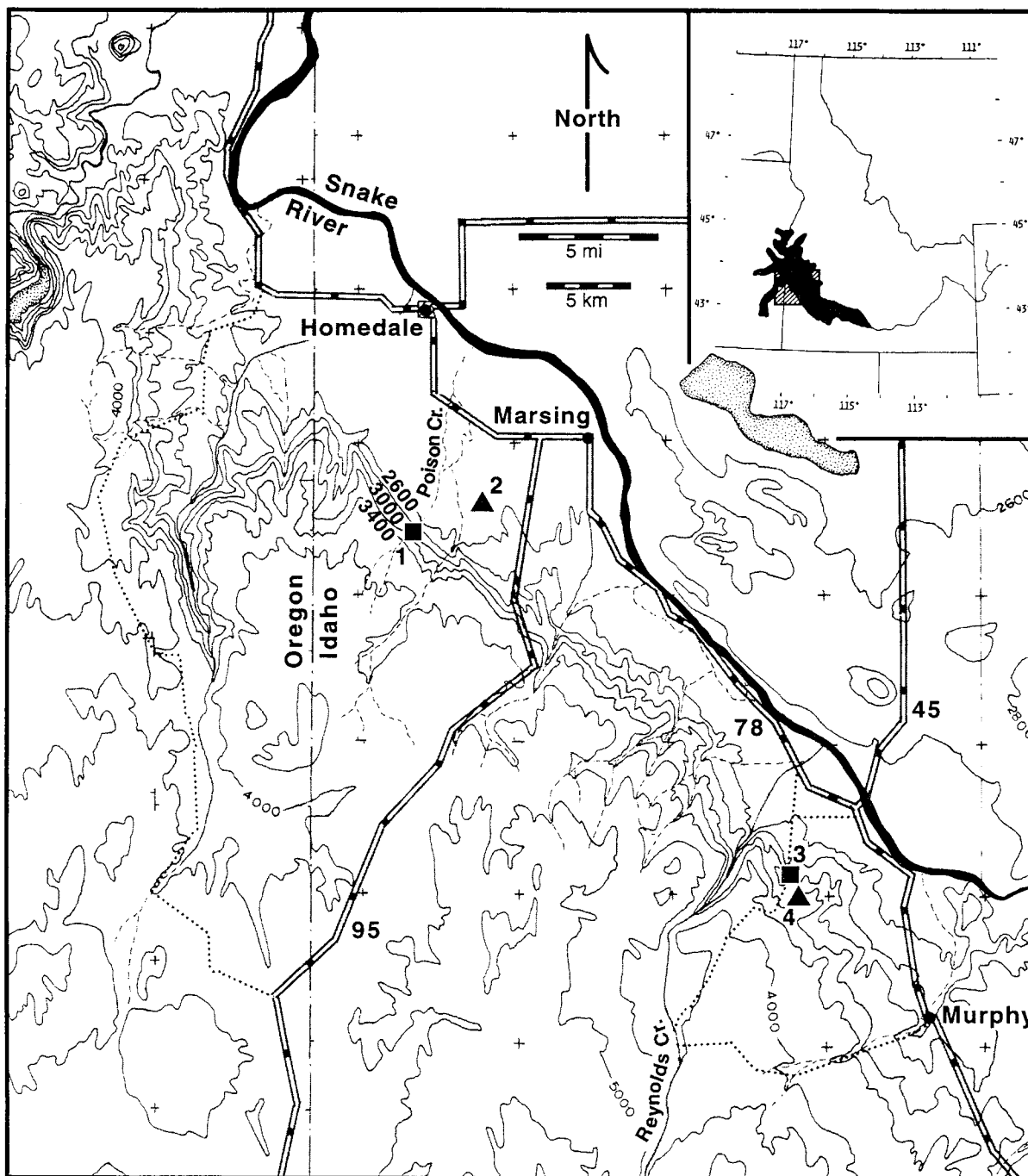


Figure 1. Map of the Western Snake River Plain showing the Reynolds Creek, Poison Creek and Cossel Ranch localities. Site 1 (square symbol), type locality, Poison Creek Formation; Site 2 (triangle symbol), fish locality in Chalk Hills Formation at Cossel Ranch; Site 3 (square symbol) fish locality in Poison Creek Formation, east of Reynolds Creek Road; Site 4 (triangle symbol) fish locality in Chalk Hills Formation, east of Reynolds Creek Road.

Late Miocene (Hemphillian) lake of the Chalk Hills Formation extended from at least as far east as Horse Hill, Owyhee County, Idaho, to the vicinity of Adrian, Malheur County, Oregon (Malde and Powers, 1962; Smith et al., 1982; Kimmel, 1982; Middleton et al., 1985). These two stages have recognizably different fish faunas,

i.e., 20 warm-water species in the Miocene Chalk Hills Formation and 27 mixed warm- and cold-water species in the Pliocene Glens Ferry Formation. While the underlying Poison Creek Formation is usually considered to be Clarendonian and is assigned to the Clarendonian in this paper, a note of caution is in order. The only

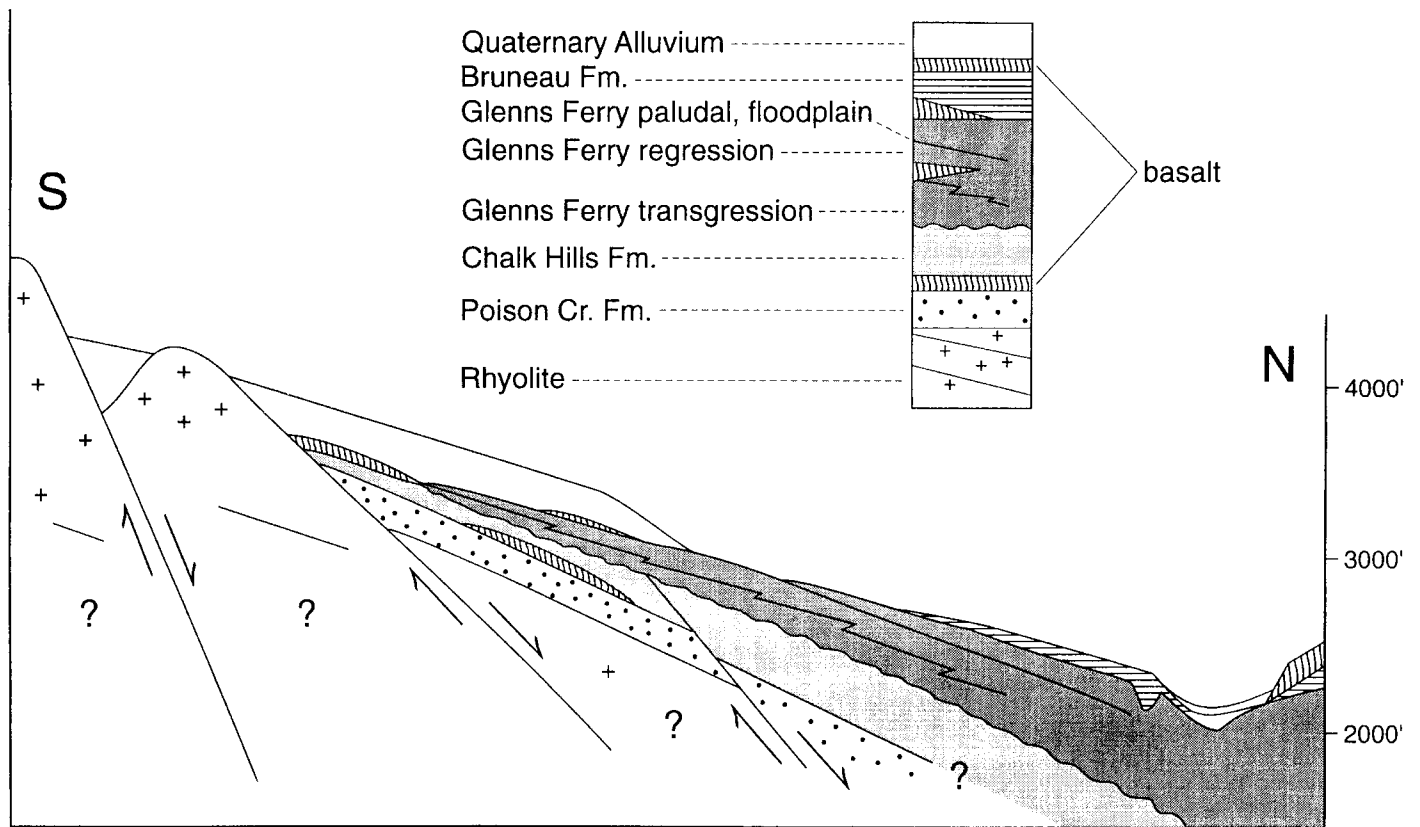


Figure 2. Cross-sectional diagram and stratigraphic column showing the vertical and north-south spatial relations of the Poison Creek, Chalk Hills and Glens Ferry Formations to other stratigraphic features of the Western Snake River Plain in the study area.

mammalian taxa reported from this unit are *Hipparion* and *Sthenictis* (Buwalda, 1924; Malde and Powers, 1962). The specimens referred to these taxa were neither described nor figured and catalog numbers were not given. This combination of genera is not chronologically definitive; it ranges from the Barstovian into the early Hemphillian (Savage and Russell, 1983; Tedford et al., 1987). Malde and Powers (1962) correlated the faulted and decomposed basalt overlying the Poison Creek Formation near Murphy, Idaho, with extensive basalt flows in the Mount Bennett Hills some 140 km to the west. A diatomite within the Mount Bennett basalt flows has yielded early Hemphillian mammals and a late Clarendonian radiometric date (see Repenning, 1987, for a brief discussion of this problem). However, Malde and Powers assigned both the basalt near Murphy and the basalt in the Mount Bennett Hills to the Banbury Basalt, dated at 4.5 to 5.0 million years old in the type section near Hagerman (Armstrong et al., 1975; Akersten et al., 1999). Thus, the correlation and age of the basalt overlying the Poison Creek Formation is very much in question. Better, but still far from conclusive, support for assignment of the Poison

Creek Formation to the Clarendonian is provided by fission track dates averaging 8.5 million years for ashes in the lower portion of the overlying Chalk Hills Formation reported by Kimmel (1982). If these dates are correct, the current placement of the Clarendonian/Hemphillian boundary at about 9.0 million years ago (Tedford et al., 1987), makes a Clarendonian age for the Poison Creek Formation reasonable but a very early Hemphillian age for at least the uppermost Poison Creek Formation cannot be ruled out at this time.

The Poison Creek Formation consists of quartz arenite, silt, clay, and siliceous volcanic ash that rest unconformably on Idavada Volcanics (Malde and Powers, 1962; Fig. 2). Near Murphy, the Poison Creek Formation is directly overlain in places by the above mentioned basalt, from which it is separated by a low angle unconformity. On upper Reynolds Creek Road, the Poison Creek Formation is directly overlain by the Chalk Hills Formation, from which it is separated by a low-angle unconformity. The Poison Creek and Reynolds Creek Road regions contain new late Miocene fishes, some of unusually large size indicative of large aquatic habitats, that have the potential to help sort out

some of the confusion regarding ages and environments of deposition. Fossil fishes from the Poison Creek Formation have not previously been documented.

In this report we document three fish localities: in the Chalk Hills Formation along lower Poison Creek, in the Chalk Hills Formation (high) along Reynolds Creek Road, and in the Poison Creek Formation (low) along Reynolds Creek Road (Fig. 1). The Poison Creek and Reynolds Creek areas are 20 miles apart along the southern margin of ancient Lake Idaho; each is 5 miles southwest of the present course of the Snake River. The Chalk Hills Formation is represented by nine species from the Cossel Ranch (Fig. 1), about 8 km southwest of Marsing, at 2430 ft (740 m) elevation, and about 4 km NE of the type section of the Poison Creek Formation (Buwalda, 1923). Both the Chalk Hills and Poison Creek Formations are represented along Reynolds Creek road near Hemmingway Butte, about 7 miles northwest of Murphy, at elevations of 3275 ft (998 m) (Chalk Hills Formation) and 3080 ft (939 m) (Poison Creek Formation). At Poison Creek the older Poison Creek Formation is higher on the southern margin of the lake; the younger Chalk Hills Formation beds to the northeast are lower in elevation out on the Snake River Plain. At Reynolds Creek Road, the vertical relation is reversed, indicating faulting in the Poison Creek area or a transgression and regression in Chalk Hills Formation time. Malde and Powers (1962), assisted by D. W. Taylor's molluscan stratigraphy (1966), investigated the age relations of the Poison Creek, Chalk Hills, Glens Ferry, and Bruneau Formations as part of their defining treatise on the sediments and volcanics of the Idaho Group (Fig. 2).

The Poison Creek Formation contains a new species of cyprinid fish in the genus *Mylocheilus*, named herein for John A. White. The Chalk Hills Formation, above the basalts and above the thick ash along Reynolds Creek Road, may be 1-2 million years younger. The Chalk Hills Formation is characterized biostratigraphically by the presence of *Mylocheilus inflexus*, *Mylocheilus robustus copei*, and *Mylopharodon doliolus*. The Chalk Hills and Poison Creek formations share the large char, *Salvelinus larsoni*, which does not persist into the Blancan Glens Ferry Formation. The Cossel Ranch locality and the upper sediments along Reynolds Creek Road are here assigned to the Chalk Hills Formation on the basis of correlating the Fish Fauna with numerous other Chalk Hills localities along the south edge of the Snake River Plain from Horse Hill, south of Bruneau, Idaho, to Vale, Oregon (Kimmel, 1984).

REYNOLDS CREEK ROAD LOCALITIES, POISON CREEK AND CHALK HILLS FORMATIONS

These two fossil localities are in the vicinity of Hemmingway Butte, east of Reynolds Creek Road, T1S, R3W, Section 35 (Fig. 1). More detailed locality information can be obtained from the University of Michigan Museum of Paleontology (UMMP).

Eight species of fossil fishes were collected from the lower Reynolds Creek Road locality, UMMP-S81-9, in orange-brown granitic sands of the Poison Creek Formation, elevation 3080 ft (939 m). The lower beds dip 10° NW and are well below the ledge-forming light gray ash conspicuously exposed along the east side of the draw.

The upper site, (UMMP-S81-8), here assigned to the Chalk Hills Formation, is at an elevation of 3275 ft (998 m). Six species of fossil fishes were collected from the upper site in granule-size granitic gravels, associated poorly-sorted sands, and 5 m of fining upward silts, above a prominent ledge of light gray ash (weathering buff color). The fossils are heavily abraded bones of large char, four minnows, sucker, catfish, and small sunfish.

Dip on beds above the ash is slightly less than that on the beds below the ash. This observation and the correlation of the species of fishes in the upper beds with the Chalk Hills Formation suggest that the upper beds represent the Chalk Hills Formation, but no unconformity has been seen. (Rhyolite cliffs form the west wall of the draw and the general area is severely faulted.) The unusually large body sizes of the fishes represented in both of these samples indicate large aquatic habitats. The granitic sands at both localities appear to be beach sands or fluvial channels; each is overlain by 10-12 m of massive, tephra-rich silts suggesting transgressive lacustrine deposition.

FOSSIL FISHES OF THE LOWER REYNOLDS CREEK ROAD LOCALITY, UMMP-S81-9, POISON CREEK FORMATION

CYPRINIDAE

Ptychocheilus arciferus (Cope) - Three dentaries and one partial pharyngeal arch (UMMP 49671) and a partial dentary (UMMP 49669), 49 mm long, are all distinctively elongated in the shape unique to *Ptychocheilus* among all North American minnows. The pharyngeals

bear thin elongate anterior limbs; the dentaries bear elongate biting edges that extend posteriorly at a right angle to the edge of the coronoid process, producing by far the largest, longest, straightest jaws of any North American cyprinid. Species of *Ptychocheilus* (North American pike minnows) are widespread in the Pacific drainages of North America from the Colorado River to southern Canada and, temporally, from the Miocene to the Recent.

Mylopharodon doliolus Smith and Kimmel - A left pharyngeal with four teeth (UMMP 49672) is diagnosed as *Mylopharodon doliolus* by the elongate, well separated teeth whose bases lie in a single plane (Fig. 3; Smith et al., 1982¹). *Mylopharodon doliolus* is also diagnosed by unique grinding surfaces normal to the axis of the teeth, indicating occlusion with opposing teeth, unlike most North American minnows (Fig. 3). The species lacks an elevated platform for the more posterior teeth (Fig. 3; Smith et al., 1982). The tooth formula appears to be 0,4-4,0. This fish is found in the Miocene of the Snake River Plain and the Esmeralda Formation of the western Great Basin in Nevada (Smith et al., 1982).

Mylocheilus whitei n. sp. Smith and Cossel - Nine pharyngeal arches represent a species similar to *Mylocheilus inflexus* (Cope) of the Hemphillian Chalk Hills Formation and western Great Basin, but with a less deflected symphyseal process of the anterior limb and a shorter ascending posterior limb of the pharyngeal bone. The tooth formula was apparently 0,5-5,0. The arches are uniformly distinguishable from *Mylocheilus robustus* (Fig. 5c) and *M. inflexus* of the Chalk Hills Formation, as well as specimens from Brady Pocket, Churchill County, Nevada, collected by Charles Dailey and from Virgin Valley, Washoe County, Nevada, collected by Tom Lugaski (Smith et al., in press^a). The Clarendonian *Mylocheilus* from the lower locality at Reynolds Creek is therefore named a new species in honor of John White, for his contributions to late Cenozoic vertebrate paleontology, and especially for his guidance and assistance to so many of us who have been fortunate enough to know him.

Type Specimens - The types are all from the lower Reynolds Creek Road locality, UMMP- S81-9, in orange-brown granitic sands 10 m above the bottom of the draw at an elevation of 3080 ft (939 m), (Fig. 1). The holotype, UMMP 49673 (Figs. 4 and 5d), is a right pharyngeal with five tooth sockets but only the second tooth present. The arch is 21 mm long, the anterior

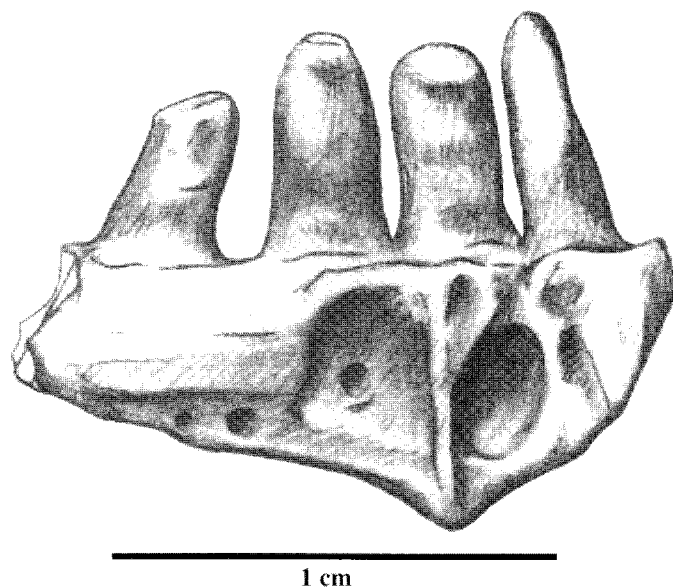


Figure 3. *Mylopharodon doliolus* pharyngeal arch (UMMP 49672) from lower Reynolds Creek Road Locality, Chalk Hills Formation.

limb is 9 mm long and little deflected, the tooth row is 13 mm long, and the posterior limb extends 15 mm above the tooth row and is 20 mm in overall height. The second tooth is elliptical in cross-section and 5 mm in greatest diameter. The paratypes (UMMP 49674) include three right and six left fragmentary pharyngeals. All are less than about 21 mm in their maximum length.

Diagnosis - A species of *Mylocheilus* known from pharyngeal arches and teeth--identifiable as a *Mylocheilus* by having a short anterior limb, massive bone with thick internal ridges and small canals and pores (Fig. 5d), and molariform teeth (Fig. 4) that occluded with their counterparts on the opposing arch. The arches differ from *Mylocheilus robustus*, *Mylocheilus caurinus*, and Virgin Valley, Nevada, specimens (Smith et al., in press^a) in lacking the minor row of teeth and having a longer, more evenly tapered, posterior ascending limb. The arches differ from *Mylocheilus inflexus* in having a less deflected anterior limb and shorter posterior limb in proportion to the anterior-posterior length. *Mylocheilus whitei* arches appear not to exceed 25 mm long and 25 mm high. The arches are therefore distinctly smaller than *M. robustus* (which are up to 55 mm long x 40 mm high) and *M. inflexus* (which are up to 25 mm long x 45 mm high), but slightly larger than *M. caurinus* (which are up to about 20 x 20 mm).

The pharyngeal arch of *Mylocheilus whitei* is proportionally (as well as in shape, texture, and tooth orientation) intermediate between *Mylocheilus inflexus*

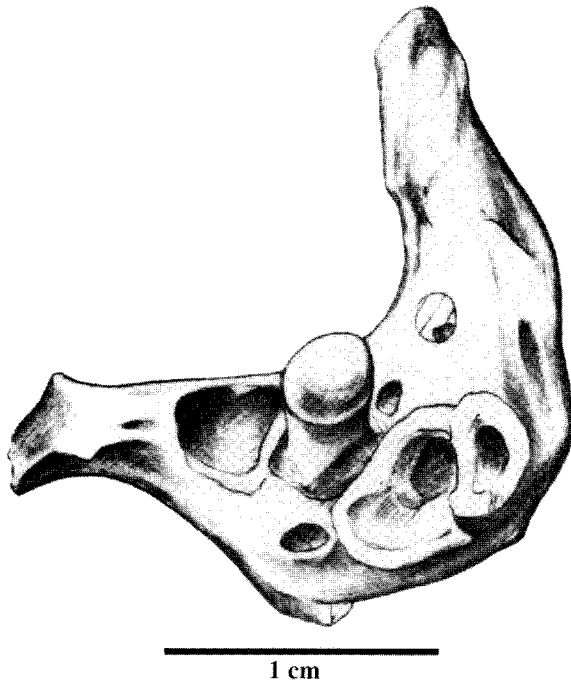


Figure 4. Holotype of *Mylocheilus whitei* Smith and Cossel (UMMP 49673), a right pharyngeal arch from the Poison Creek Formation, lower Reynolds Creek Road locality, Owyhee County, Idaho.

in one clade, and *Mylocheilus robustus*, a new species from the Ringold Formation of Washington, and Recent *M. caurinus* in its sister clade. It is possible that *M. whitei* represents a morphology and lineage more plesiomorphic than either clade and therefore, is older than the branch point leading to the other (later Miocene) forms. The pharyngeal arch of *Mylocheilus whitei* is plesiomorphic [similar to outgroup shiners such as *Richardsonius* (Smith et al., in press; T.E. Dowling, unpublished data)] in the proportions of the anterior limb. It also differs in the length of the tooth row relative to the posterior ascending limb, as well as the texture, shape of the anterior limb, and the orientation of the teeth (only partially opposite each other). The arch of *Mylocheilus inflexus* is uniquely derived in the dorsad elongation of the posterior limb and the enlarged foramen at the base of the posterior limb, as well as the extreme inflection of the symphyseal end of the anterior limb. *Mylocheilus robustus* is uniquely derived in having direct opposition of left and right teeth so that the lines of crushing force are parallel to the long axis of the teeth. The extreme molariform shape of the teeth, and the reduction of the posterior limb of the arch to a small triangle with a recurved point are also characteristic of *Mylocheilus robustus* (Fig. 5c).

Acrocheilus latus (Copa) - Four partial pharyngeals and one right post-temporal (UMMP 49675) of *Acrocheilus* are present in the lower Reynolds Creek Road fauna. The teeth are absent, but the tooth formula was 0,5-4,0. The arches are fish-hook shaped, with a slender anterior limb, round in cross-section, and a relatively straight (slightly sigmoid), robust postero-dorsal limb, like *Acrocheilus latus* of the Glens Ferry and Chalk Hills Formations.

CATOSTOMIDAE

Catostomus sp. - Rare, small, catostomid bones (UMMP 49676), such as a complete palatine, two urohyals, pterotic, dermethmoid, and two partial opercles, establish the presence of *Catostomus* in the fauna, but the material is too sparse to identify to species. The Reynolds Creek Road faunas are the only substantial samples on the Snake River Plain without abundant catostomids.

ICTALURIDAE

Ameiurus vespertinus (Miller and Smith) - Ictalurid bones (UMMP 49677) such as basioccipitals, two large Weberian vertebrae, dentary, angular-articular, premaxillary, large partial cleithrum, small partial cleithrum, seven pectoral spines and one dorsal spine represent the lineage characteristic of the Late Miocene and Pliocene of the Snake River Plain (Miller and Smith, 1967). Some of the bones are larger than those of ictalurids 50 cm in standard length, similar in size to Miocene and Pliocene specimens from the Snake River Plain and larger than modern *Ameiurus*.

SALMONIDAE

Salvelinus larsoni (Kimmel) - A large prevomer (Fig. 6), maxilla, hyomandibula, ceratohyal, pterotic, and several vertebrae (UMMP 49678) represent *Salvelinus* material typical of the Miocene on the Snake River Plain. The maxilla is similar to that of *Hucho parryi*, and the prevomer (Fig. 6) also resembles *Hucho parryi* in its anterior transverse row of teeth (Kimmel, 1975). Other characters, examined cladistically, suggest that this lineage is an early *Salvelinus* in North America (Stearley and Smith, 1993), at a time when similarity to *Parahucho* still remained. Some of the material represents very large fish, probably exceeding 1 m in standard length. The vertebrae reach 18 mm in diameter and the prevomer

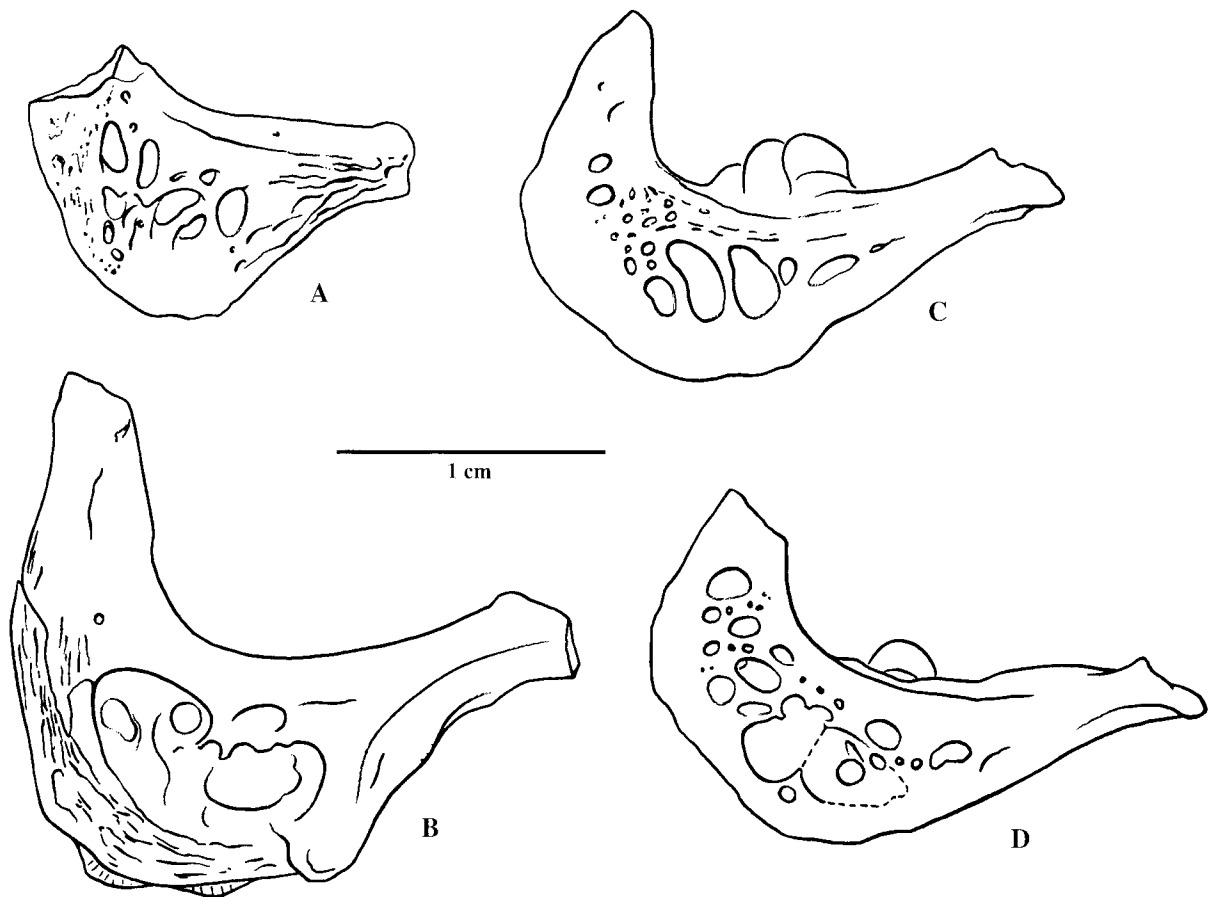


Figure 5. Right pharyngeal arches, lateral view, of (A) *Mylocheilus robustus copei* from the Chalk Hills Formation, upper Reynolds Creek locality, (UMMP 49668) showing intermediate form of ridge development between the pores beneath the teeth; (B) *Mylocheilus robustus copei* from the Cossel Ranch locality in the Chalk Hills Formation, Poison Creek, Owyhee County, Idaho (IMNH 850/41684) with intermediate pores and thin (broken) ridges under the teeth and few pores on the base of the (large) posterior limb; (C) *Mylocheilus robustus* (with small pores and thick ridges; note the reduced size of the posterior limb) from the Davis Ranch locality, Late Pliocene of the Glens Ferry Formation (UMMP 67785); and (D) *Mylocheilus whitei*, holotype, from the lower Reynolds Creek Road locality, Owyhee County, Idaho (UMMP 49673) with many large, open pores and thin, easily broken ridges, the plesiomorphic condition, as in most minnows. Lateral view.

is 40 mm long and 25 mm wide.

CENTRARCHIDAE

Archoplites taylori Miller and Smith - Large sunfish bones (UMMP 49679), including a lacrimal, nine dentaries, two premaxillae, a vomer, three maxillae, hyomandibula, two parasphenoids, and five spines are similar to those of the common *Archoplites* of the late Miocene and Pliocene on the Snake River Plain. *Archoplites* occurred in the Great Basin and adjacent drainages to the north during the Miocene and Pliocene (Smith and Miller, 1985; Smith et al., 2000) and is now native to the Great Valley of California

(Miller and Smith, 1967).

FISHES OF THE UPPER REYNOLDS CREEK ROAD LOCALITY, UMMP-S81-8, CHALK HILLS FORMATION

CYPRINIDAE

Mylocheilus robustus copei Smith and Kimmel - This sample (UMMP 49668) consists of only one small pharyngeal arch with no teeth (and unknown tooth formula). The arch shows apomorphic bone shape and texture, with thick ridges and medium-sized pores on the lateral face of the bone (Fig. 5a). These textural characteristics

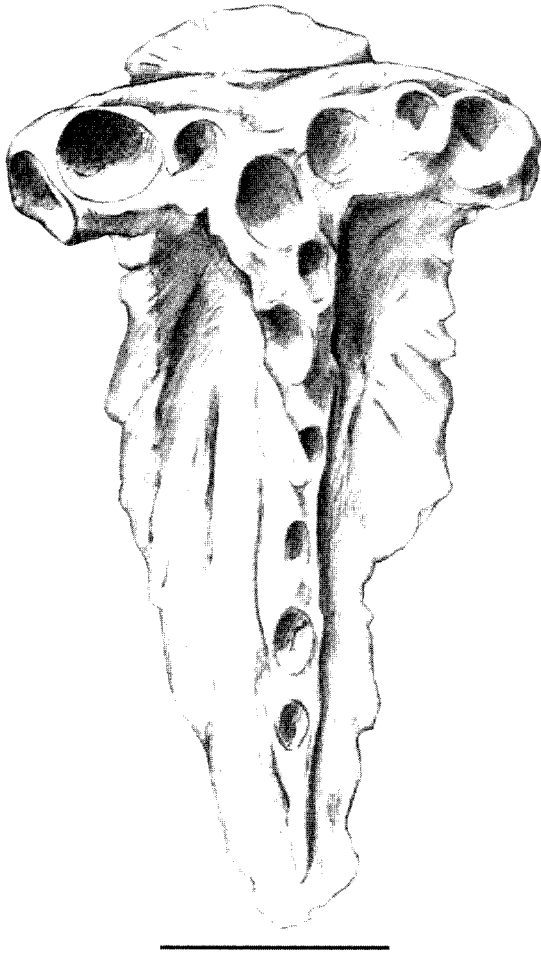


Figure 6. Prevomere of *Salvelinus larsoni* from the Poison Creek Formation, lower Reynolds Creek Road locality, Owyhee County, Idaho (UMMP 49678). Scale bar = 1 cm.

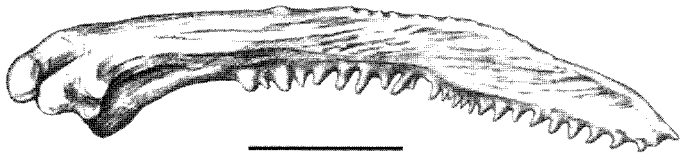


Figure 7. *Ameiurus vespertinus* pectoral spine (UMMP 49665) from the upper Reynolds Creek locality, Chalk Hills Formation. Scale bar = 1 cm.

diagnose *Mylocheilus robustus copei* from the Chalk Hills Formation (Smith et al., 1982). Examples of this species occur in the Cossel Ranch sample (below) as well as late Miocene and Pliocene beds of the Snake River Plain and the western Great Basin (Smith et al., in press). It is not represented among the numerous fossils in the lower Reynolds Creek Road sample. This specimen can be interpreted as more advanced than the Cossel Ranch sample on the basis of the smaller pore size in the lateral face of the bone, but a larger sample would be necessary to reach a firm conclusion.

Ptychocheilus arciferus (Cope) - This species is represented by (UMMP 49667) two fragments of large dentaries and one Weberian centrum, 26 mm wide (not including the parapophyses). The dentaries display the distinctive shape unique to *Ptychocheilus* and the bones are further identifiable by their large size.

CATOSTOMIDAE

Catostomus sp. - Suckers are represented in the upper Reynolds Creek Road sediments by one incomplete opercle and one articular (UMMP 49666). Suckers are unusually rare in the Reynolds Creek Road samples.

ICTALURIDAE

Ameiurus vespertinus (Miller and Smith) - Catfish are represented in upper Reynolds Creek Road sediments by a partial left cleithrum, a partial right pectoral spine, and two left pectoral spines (UMMP 49665). The pectoral spines are similar to those of *Ameiurus vespertinus* of the Chalk Hills Formation (Smith et al., 1982). The largest pectoral spine is 44 mm long (Fig. 7), indicating a catfish exceeding 30 cm in standard length. Western North American catfish are known from the late Miocene Truckee Formation of Nevada (Baumgartner, 1982), the Juntura beds of eastern Oregon (Lundberg, 1975), the Mio-Pliocene of the Snake River Plain (Smith et al., 1982), and the Pliocene Ringold Formation of south-central Washington (Smith et al., 2000).

SALMONIDAE

Salvelinus larsoni (Kimmel) - Numerous fragmentary bones (UMMP 49664, 49670) of a large char are similar to those of the char from the Chalk Hills Formation. A basioccipital with a centrum 16 mm in diameter, one partial right dentary 80 mm long, a partial left dentary

60 mm long, one partial left maxilla 49 mm long, and 18 vertebrae 5-21 mm in diameter are the size of char up to 60 cm in standard length. *Salvelinus* is also represented from middle Miocene Clarkia beds of the St. Maries drainage of Shoshone County, Idaho (Smith and Miller, 1985); Churchill County, Nevada (Cavender and Miller, in prep.); other Late Miocene Chalk Hills localities on the Snake River Plain (Smith et al., 1982); and the Poison Creek Formation (see below).

CENTRARCHIDAE

Archoplites taylori Miller and Smith - A hyomandibular, a prevomer (Fig. 8) and several fin spines of this species (UMMP 49681) were collected above the ash by K. Swirydczuk in 1979. It is notable that in this environment at this time, *Salvelinus larsoni*, a cold water fish, was more common and grew larger than *Archoplites taylori*, a warm-water fish.

FISHES OF THE COSSEL RANCH LOCALITY, CHALK HILLS FORMATION

Nine species of fossil fishes were collected from the Chalk Hills Formation at Idaho Museum of Natural History (IMNH) locality 850, Cossel Ranch, T2N, R5W, Section 14, at an elevation of 2430 ft. Detailed locality information is available to qualified researchers. The fossils come from an outcrop of brown sand with volcanic and granitic clasts: 1-3 mm-sized clasts of basalt fragments and clear quartz phenocrysts as well as quartz, feldspar, and some mica. Finer sediments consist of fine-sand-sized tephra and silt. The fossils include disarticulated mineralized and abraded resistant bones from suckers, minnows, catfish, char, and sunfish. IMNH specimen numbers consist of the institutional acronym followed by the locality number, a slash, and the catalog number for the specimen (e.g. IMNH 850/14625). The institutional acronym and locality are dropped in all but the first of a series of specimens from the same locality.

CYPRINIDAE

Ptychocheilus arciferus (Cope) - *Ptychocheilus* is represented at the Cossel Ranch locality by two large hyomandibulae (IMNH 850/14625, /14626), the central part of a large dentary (IMNH 850/41702) 20 mm long and 24 mm deep (from a bone at least 5 cm long), a large ceratohyal (IMNH 850/14627), articular (IMNH

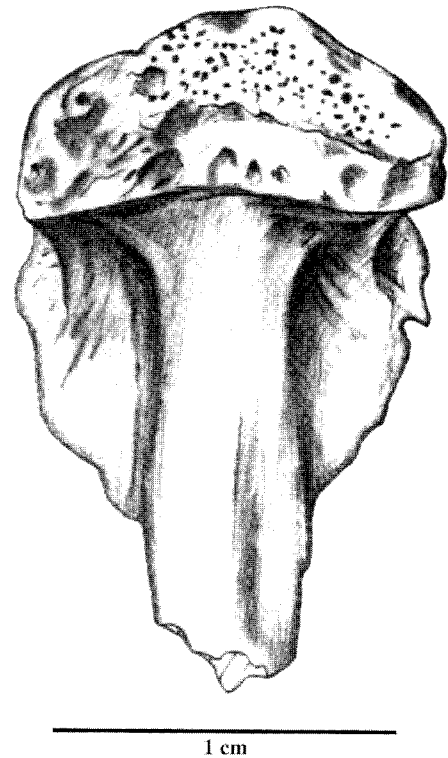


Figure 8. Prevomer of *Archoplites taylori* (IMNH 41707) from the Chalk Hills Formation, Cossel Ranch locality, Owyhee County, Idaho.

850/14627), and branchiostegal (IMNH 850/14629). *Ptychocheilus* bones are larger than corresponding bones of any other North American minnow genus. The biting edge of the jaw extends back at a right angle to the anterior edge of the coronoid process (Smith 1975, Fig. 18A).

Acrocheilus latus (Cope) - *Acrocheilus* is represented by the posterior arm of a small pharyngeal arch (IMNH 850/41707). It is elongate, slightly twisted, and of uniform width, not tapered as is characteristic of *Acrocheilus* of the Chalk Hills and Glens Ferry Formations (Smith, 1975, Fig. 22E).

Mylocheilus robustus copei (Smith and Kimmel) - Eight pharyngeal arches (IMNH 850/41683, /41684, /41686, /41687, /14630, /14631, /14632, /14633), three left and five right, with molariform teeth and robust or thick bony ridge supports under the tooth row (Fig. 5b) are identifiable as *Mylocheilus robustus copei*. Diagnostic characters include the tooth formula, 2,5-5,2, and the rather open nutrient foramina and narrow bony ridges on the lateral surface of the bone. The largest arch is 25

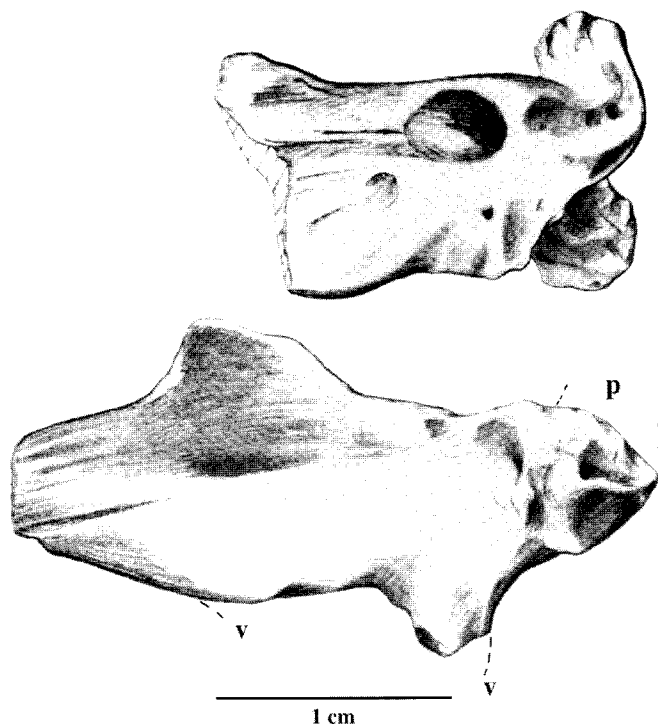


Figure 9. Right maxillae of *Deltistes owyhee* from the Chalk Hills Formation, Cossel Ranch locality, Owyhee County, Idaho (IMNH 850/41702, /41704), showing the post-dorsal position of the attachment of the ventral maxillary muscle (v) and the vertical ridge for attachment of the palatine ligament (p).

mm long. The longest tooth (separate) is over 7 mm in its longest dimension and flat across the crown as in specimens from both the Chalk Hills and Glens Ferry Formations (Smith, 1975, Fig. 17B; Smith et al., 1982, fig. 4C). Smith and Kimmel in Smith et al. (1982¹) diagnosed *M. r. copei* on the basis of the tooth formula in adults and the molariform first tooth. Specimens from the Cossel Ranch have the first tooth present and bluntly rounded or molariform in pharyngeals up to 25 mm in length, fitting the diagnosis of *M. r. copei*. These fish are probably the direct ancestors of *Mylocheilus robustus robustus*. As members of the same lineage, the two forms belong to the same species (Krishtalka and Stucky, 1985).

CATOSTOMIDAE

Deltistes owyhee (Miller and Smith) - Numerous large catostomid fragments (IMNH 850/41702, /41704, /14603, /14604, /14605, /14606, /14607, /14608) are identified as *Deltistes owyhee*. These include three maxillae, four dentaries, palatine, basioccipital, and a

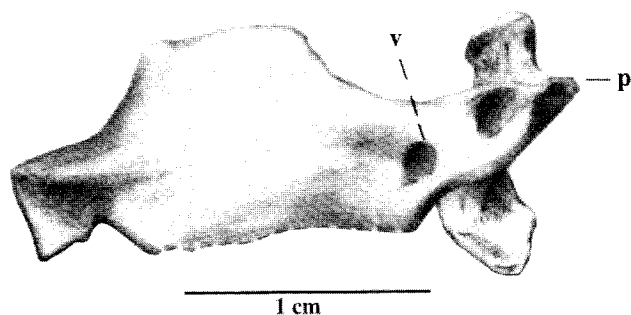


Figure 10. Maxilla of *Catostomus shoshonensis* from the Chalk Hills Formation, Cossel Ranch locality, Owyhee County, Idaho (IMNH 850/41706) showing the median position of attachment of the ventral maxillary muscle (v) and the horizontal ridge for attachment of the palatine ligament (p).

Weberian fragment, similar to bones of this species known only from the Chalk Hills and Glens Ferry Formations. The maxillae (Fig. 9) are identified by their deep ventral keels and prominent, post-dorsally positioned fossae for attachment of the ventral maxillary muscle and vertical ridge for attachment of the palatine ligament. These bones are not as apomorphic as those from the Glens Ferry Formation (Smith, 1975, Fig. 12B).

Catostomus shoshonensis Cope - Nine maxillae and two dentaries (IMNH 850/41706, /14612, /14613, /14614, /14615, /14616, /146617, /14618, /14619, /14620, /14621, /14622) representing this species are identifiable in the sample from the Cossel Ranch. The species is recognized by the presence of maxillae with the anterior-projecting, nearly horizontal ridges for the palatine ligaments and which have a general shape approaching the elliptical profile of the dorsal and ventral keels of the Glens Ferry form (Fig. 10; Smith, 1975, Fig. 12 A). The dentaries have short grooves for the gnathal cartilage (Smith, 1975, Fig. 12 D, E, J). The Cossel Ranch specimens are smaller and less apomorphic than their Glens Ferry descendants.

Catostomus cristatus Cope - Samples from Cossel Ranch include one maxilla (IMNH 850/14623) and one dentary (IMNH 850/14624) of this species. The maxilla is anteriorly elongate, as is the dentary (Smith, 1975, Figs. G, C). The maxilla lacks the extreme position of the maxillary muscle attachments and palatine ligaments seen in the other two catostomids (above); the ventral maxillary muscle attachment is lower and more posteri-

orly-located on the neck of the maxilla and the ridge for attachment of the palatine ligament is rounded in lateral view.

ICTALURIDAE

Ameiurus vespertinus (Miller and Smith) - This species is represented by one large dorsal spine pterygiophore (IMNH 850/14634), one dorsal spine (IMNH 850/14635), one vertebra (IMNH 850/41678), two pectoral spines (IMNH 850/41688, /41689), and a right dentary (IMNH 850/41699). The bones are similar to other bones of *Ameiurus* from the Chalk Hills Formation.

SALMONIDAE

Salvelinus larsoni (Kimmel) - Twenty-five vertebrae (IMNH 850/14636) and a basioccipital (IMNH 850/41705) from this locality show the coarse, longitudinal ridges and loops characteristic of *Salvelinus* (similar to *S. namaycush*, not *S. confluentus*.) The vertebrae range from 6 to 16 mm in diameter. No vertebrae of *Oncorhynchus* are evident in the sample. Large *Salvelinus* are common in samples from the Chalk Hills and the Poison Creek Formations.

CENTRARCHIDAE

Archoplites taylori Miller and Smith - Bones of a large sunfish include four premaxillae (IMNH 850/14637, /14638, /41697, /41698), 1 maxilla (IMNH 850/14639), two dentaries (IMNH 850/41700, /41701), one prevomer (IMNH 850/41707, Fig. 8) and seven median spines (IMNH 850/41675-/41682).

DISCUSSION

The earliest fossil fishes from the late Cenozoic sediments of the Western Snake River Plain, reported here, belong to five families, Cyprinidae (minnows), Catostomidae (suckers), Ictaluridae (catfishes), Salmonidae (char, salmon, trout), and Centrarchidae (sunfish), that persist from the late Miocene through the Pliocene. Three of the families (minnows, suckers, trout) persist in the area, although reduced in diversity, to the present. The large sizes of the fishes from the Poison Creek and Chalk Hills Formations indicate extensive and persistent moisture as envisioned by Cope (1883) and White (1967) and large-scale aquatic habitats. These conditions permitted the evolution

of considerable diversity, from eight known species in the late Miocene Poison Creek Formation to 20 species in the late Miocene Chalk Hills Formation, and 27 species in the Pliocene Glenns Ferry Formation. The sparse ichthyofauna of the Pleistocene Bruneau Formation indicates a biodiversity crash associated with the reduction of Lake Idaho by its late Pliocene capture and drainage through Hells Canyon (Wheeler and Cook, 1954) to produce the connection between the Snake and Columbia drainages and the mixture of fish faunas that we see today (Smith et al., 2000). Reduction in fish diversity and body size was apparently brought about in part by the onset of aridity; as the lake's moisture disappeared, basin elevations decreased, and Plio-Pleistocene uplift of the Sierras and Cascades cast a rain shadow over the region.

CONCLUSIONS

The biostratigraphic relationships of late Miocene sediments of the area between Poison Creek and Reynolds Creek, Owyhee County, Idaho, are clarified by new fossil fish discoveries in the region. Both the Poison Creek and Reynolds Creek Road areas contain exposures of the late Miocene Poison Creek Formation and the younger Chalk Hills Formation. The Poison Creek Formation is characterized by presence of *Mylocheilus whitei* n. sp. The Chalk Hills Formation is characterized by presence of *Mylocheilus inflexus*, and *Mylocheilus robustus copei*. In the Poison Creek area, the Chalk Hills Formation is lower in elevation than the older Poison Creek Formation, indicating onlapping deposition after subsidence of the offshore part of the basin or after a regression. At Reynolds Creek Road the Chalk Hills sediments lie above the Poison Creek beds, indicating deposition during a transgressive phase, though apparently after some faulting, since the upper beds show less dip than the lower beds. If the state of evolution of bone thickness in pharyngeal arches of *Mylocheilus* is any indication, the Cossel Ranch locality would appear to be older than the upper Reynolds Creek Road locality. Large sizes of the fishes indicate large-scale aquatic habitats and fine-grained silts indicate lacustrine deposition in this part of the Snake River Plain, approximately 8 million years ago.

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