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NEW FOSSIL FISHES FROM PLIO-PLEISTOCENE LAKE IDAHO

BY ROBERT RUSH MILLER AND GERALD R. SMITH[1]

LAKE IDAHO (Fig. 1) was a large body of water in western United States that supported a rich fauna during the last (Blancan) part of the Pliocene epoch and into the first of the Pleistocene. E. D. Cope supplied the name and was one of the earliest to study the lake beds and describe the associated fossil fishes (Cope, 1870, 1871, 1883*a*,*b*). As used here, Lake Idaho is a restriction of previous usage since for decades "Idaho Lake Beds" and "Idaho Formation" have represented a composite of the Glenns Ferry and Bruneau formations not distinguished until publication of the work of Malde and Powers (1962). All of our fishes come from the Glenns Ferry formation, as probably did Cope's specimens. The larger lake, which may appropriately be named Lake Bruneau, was mapped by Wheeler and Cook (1954) and by Feth (1961); it overflowed at approximately the 3200-foot (980-meter) contour at the Oxbow. The discussion of stream capture of Lake Bruneau by a branch of the Columbia River (Wheeler and Cook, 1954; Miller, 1965) refers to this larger lake rather than to Lake Idaho.

The fishes of Lake Idaho are now known to number about 20 species in 12 genera and 6 families. Additions to the known fish fauna have been made by Leidy (1870), Hussakof (1908), Uyeno (1961), Uyeno and Miller (1963), and Miller (1959, 1965). The following study provides descriptions of 7 of the 20 species, all new.

Present knowledge of the geology and stratigraphy is summarized by Malde and Powers (1962) and Malde (1965). An up-to-date faunal list, brief summary, bibliography, and correlations with other Blancan

[1] Museum of Natural History, University of Kansas, Lawrence, Kansas.

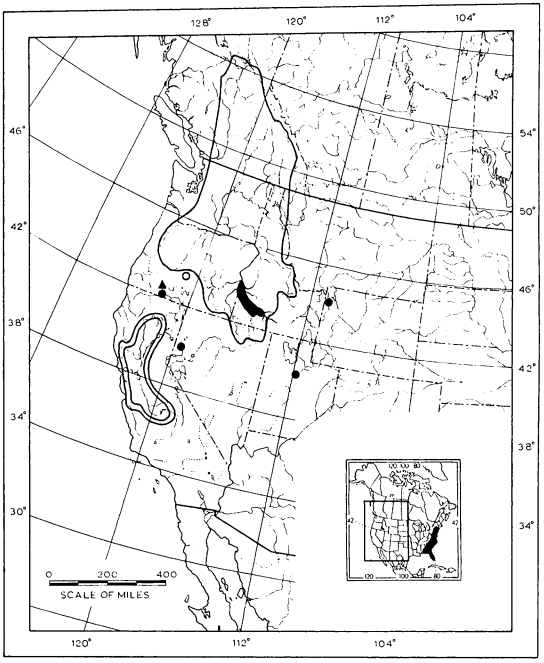


FIG. 1. Lake Idaho (solid area, southwestern Idaho) and the distribution of the nearest relatives of the fossil species described here from that lake. Triangle, *Deltistes luxatus;* solid circles, *Chasmistes,* living species; open circle, *Chasmistes* cf. *C. batrachops;* solid outline, *Acrocheilus alutaceus* and *Catostomus columbianus* (latter does not inhabit Willamette basin of western Oregon); double outline, *Archoplites interruptus;* solid range in insert, *Ictalurus catus.*

faunas are given by Taylor (1966). The age of the fauna is probably near 3.0 to 3.5 million years according to a K:A radiogenic date of $3.48 \pm 0.27 \times 10^6$ based on whole-rock analysis of a widespread basalt flow that is associated or correlated with the strata bearing the fossils reported here (Evernden *et al.,* 1964; Taylor, 1966:71).

The lake sediments and associated stream deposits outcrop in an area covering several thousand square miles in southwestern Idaho and southeastern Oregon (Feth, 1961; Malde, 1965). The deposits include a lacustrine facies containing most of the distinctive species of mollusks of the lake and a floodplain and fluviatile facies with a sharply different molluscan fauna (Taylor, 1966:70–71).

Two species of fishes described here appear to be characteristic of the lacustrine facies, although they are found in other sediments. They are suckers of the genus *Deltistes,* among the most distinctive fishes of

the lake. A sucker of the genus *Chasmistes* was found associated with the fluviatile facies, but it probably lived in the lake except, perhaps, during spawning runs. Catfish remains (*Ictalurus*), presently identified as a single species, are found in all facies.

The floodplain and fluviatile facies were deposited in tributary streams and at the margin of the eastern (upstream) end of the basin (Taylor, 1966:72). The new species from this habitat are related to river fishes and include a chisel-mouthed chub with jaws adapted to herbivorous feeding (*Acrocheilus*); a mountain sucker, similarly adapted (*Catostomus* [*Pantosteus*]); a sunfish (*Archoplites*); and a catfish (*Ictalurus*).

The fossils described and reported here are deposited in the Museum of Vertebrate Paleontology of the University of Michigan (UMMP) and the United States National Museum (USNM). Recent specimens figured for comparison are in the Division of Fishes of the Museum of Zoology, University of Michigan (UMMZ).

DESCRIPTION AND DISCUSSION OF THE FOSSILS

CYPRINIDAE

Acrocheilus Agassiz

Acrocheilus xestes, new species

SYNONYMY.—*Acrocheilus* sp., Miller, 1965:574, 576; Taylor, 1966:74.

HOLOTYPE.—UMMP V55546: a nearly complete right dentary (Fig. 2), collected by Robert R. Miller. U.S.G.S. Cenozoic locality 19128, Idaho, Owyhee Co.: south of Hammett, SW ¼ Sec. 1, T. 6S, R. 8E, 1550 feet E, 650–1050 feet N of SW corner; 2600 feet elevation (Hammett quadrangle, 1948, 1:24000). Late Pliocene–Early Pleistocene Glenns Ferry formation, fluviatile facies.

The dentary is that of a small individual, presumably immature. The leading or cutting edge of the gnathic ramus is rounded to form an anterior ridge. The ascending process is directed slightly anteriorly. The sensory pores probably number 5 or 6. The greatest length of the dentary is 5.7 mm; its depth at the ascending process is 3.1 mm; the greatest depth of the gnathic ramus is 1.7 mm; and the width of the gnathic ramus is 2.9 mm.

DIAGNOSIS.—A chisel-mouthed chub of the genus *Acrocheilus* resembling *A. alutaceus* Agassiz and Pickering, but with (1) a much heavier (thicker) dentary; (2) the gnathic ramus forms a less acute angle

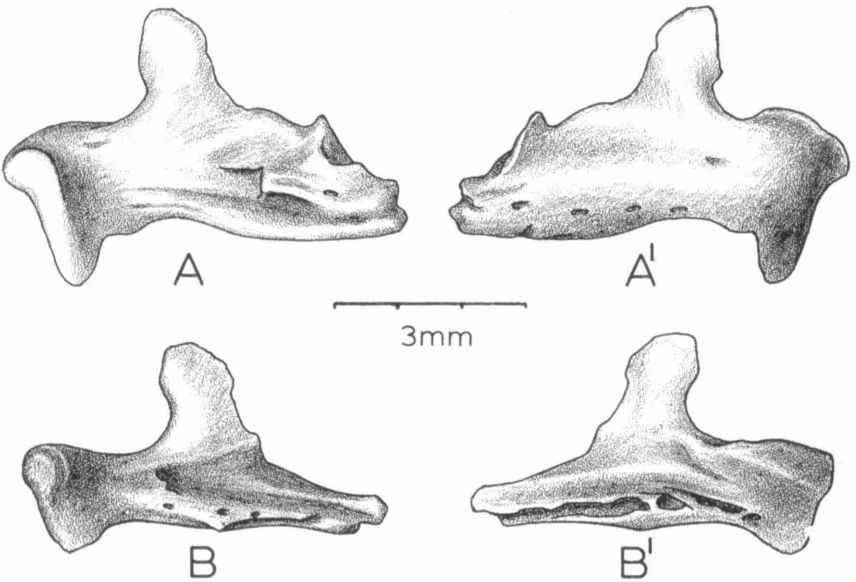


FIG. 2. A, mesial view of the right dentary of a female (?), 195 mm in standard length, of *Acrocheilus alutaceus,* UMMZ 179596, from the Bruneau River, Owyhee County, Idaho. A', lateral view of the same. B, mesial view of the holotype, UMMP V55546, of *Acrocheilus xestes,* n. sp. B', lateral view of the same.

with the main axis of the dentary (greater than 100° in *A. xestes* whereas the two parts of the bone are virtually at right angles as viewed ventrally in *A. alutaceus*); and (3) the gnathic ramus slenderer as viewed anteriorly with its depth about one-half to two-thirds its width (depth subequal to width in *A. alutaceus*).

REFERRED MATERIAL.—UMMP V55547: four incomplete dentaries (3 left, 1 right) from the same locality as the holotype; UMMP V55548: one nearly complete right dentary taken with the holotype.

DISCUSSION.—*Acrocheilus alutaceus* is a highly specialized fluviatile minnow with jaws adapted to scraping attached algae from a solid substrate (Fig. 2). The primary oromandibular adaptation is the abrupt angle of the gnathic ramus, providing a base for the scraper-like cartilaginous edge of the jaw. *A. xestes* is specialized in a similar manner, but represents a more generalized stage through which *A. alutaceus* probably passed in its evolution. Other herbivorous cyprinids have been described from this fauna on the basis of pharyngeal teeth. *Sigmopharyngodon idahoensis* Uyeno (1961) has pharyngeal bones with

recurved posterior ends and teeth of the single row with sharp grinding surfaces. The pharyngeal bones and teeth of *A. alutaceus* are not as specialized as in *S. idahoensis,* lacking the recurved posterior tip of the bone, the high tooth platform, and the extremely sharp cutting or grinding surfaces. However, several species of *Diastichus,* named by Cope, are based on pharyngeal arches that are similar to those of *A. alutaceus* in morphology and in number and arrangement of teeth. It is possible that *Acrocheilus xestes* and one or more of the species of *Diastichus* are the same, but we prefer to keep the names separate until better evidence of association of the jaws and pharyngeals is obtained in the field, and until *Diastichus* is better understood.

The name, *xestes,* is a masculine Greek noun meaning scraper or polisher and is given in the nominative singular in apposition to the generic name.

CATOSTOMIDAE

Deltistes Seale

The genus *Deltistes* was erected for the sole reception of *Chasmistes luxatus* Cope, on the basis of the deltoid form of the gill rakers. The species, an endemic of the Klamath basin in Oregon and California, was recognized as a member of the genus *Catostomus* by Miller (1959) when it was found that the deltoid gill rakers were not diagnostic.

The following features are offered as diagnostic of *Deltistes* as here recognized to include one living and two fossil species. The characteristics are restricted to the maxilla (Fig. 4 A–C) since the two fossil species are known principally from this bone. The maxilla is foreshortened, robust, and deep, the greatest depth being more than one-half the greatest length. The anteromedian process projects medially and slightly ventrally from a base on the neck of the bone, just posterior to the anterodorsal process. The dorsal and ventral keels of the body of the bone are high and the ventral keel is anteriorly positioned. The anterodorsal process is dorsally perpendicular to the axis of the body of the bone.

Deltistes owyhee, new species

SYNONYMY.—*Deltistes,* Miller, 1965:574, 576; Taylor, 1966:74.

HOLOTYPE.—UMMP V55549: a complete right maxilla (Fig. 4A), collected by R. R. Miller and party. University of Michigan locality UM-IDA-9-62, Idaho, Owyhee Co.: road cuts on state highway 45,

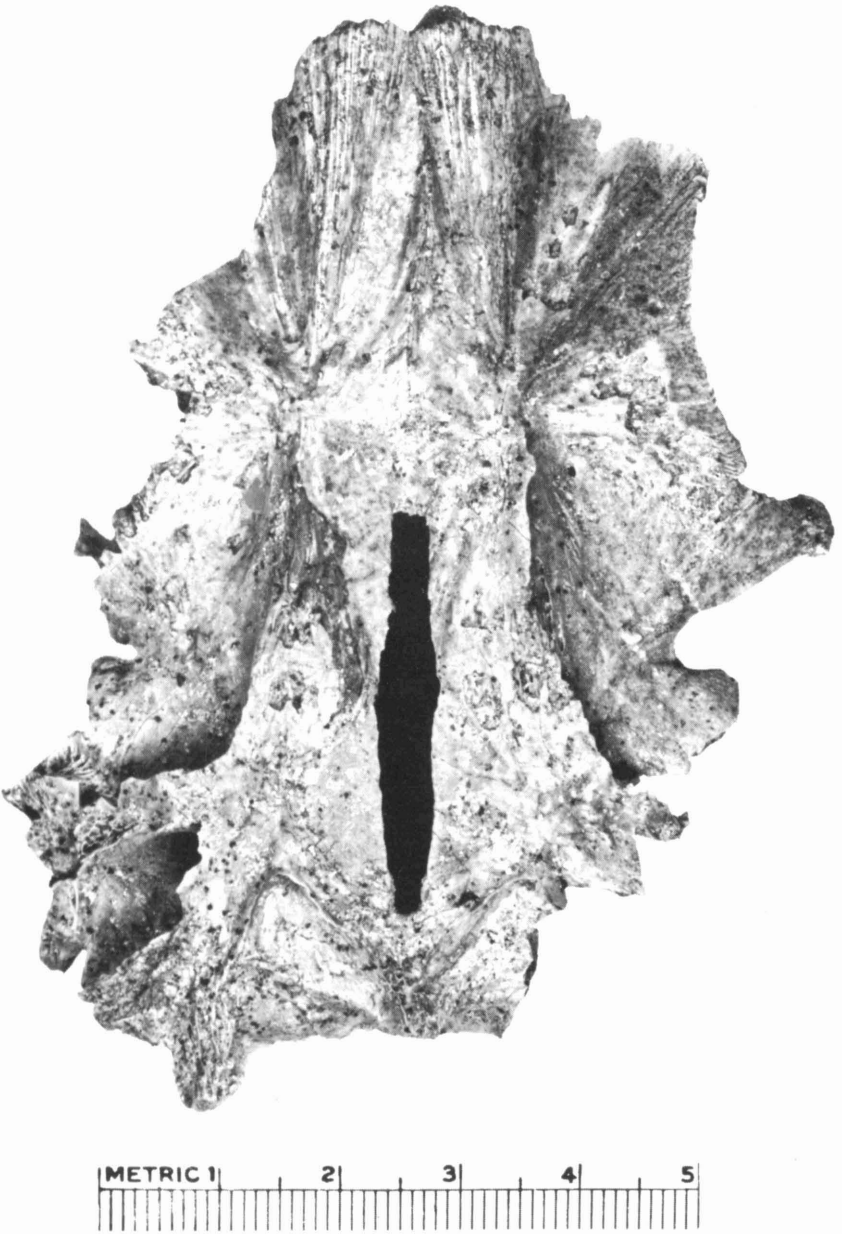
about 1.5 miles SE Fossil Butte, Sec. 14, T. 4S, R. 1W. Late Pliocene Glenns Ferry formation, lacustrine facies.

The maxilla is 40.5 mm long; 22.3 mm deep, as measured between the crests of the dorsal and ventral keels; and 7.3 mm in least depth posterior to the keels. The bone is robust, especially anteriorly, with a strongly sculptured area of insertion for the palatomaxillary ligament, the maxillaris dorsalis, and the maxillaris ventralis. The last insertion is expanded, resulting in a high shoulder that obliterates the narrow neck characteristic of the maxilla of catostomid fishes. The anterodorsal process is stout and perpendicular to the axis of the body of the bone. The ventral keel is fully under the anterior half of the body of the bone and is posteriorly concave and anteriorly projected. The dorsal keel is medial, truncate, and small. The dentary process is robust and truncate. The anteromedian process is robust at the base and has a deep dorsal fossa.

PARATYPE.—UMMP V55550: the dorsal part of a neurocranium (Fig. 3) with part of the otic region intact ventrally. This fossil was circumstantially associated with the holotype at the type locality and agrees with it in characteristics relative to other catostomids, as we interpret them. In addition, it is similar in color, bone texture, and state of preservation. The color of both fossils is a characteristic ochraceous pink. The following are characteristics and dimensions of the paratype: frontoparietal fontanelle present; pterotic expanded dorsally, separating the fossae for the dilator operculi and adductor operculi; frontals distinctly striate anteriorly and laterally; dorsal crests of frontals high and distinct; lateral edge of frontals concave above orbits; greatest length of fossil, 95 mm; fontanelle, 32.5 mm long and 5 mm wide at widest point, near frontoparietal suture; width between frontal crests, across anterior end of fontanelle, ca. 20 mm; right frontal, 58 mm in greatest length, 43 mm long anterior to fontanelle, 28 mm in greatest width, and 22.5 mm wide above orbit; width of skull from median line to tip of right sphenotic, 36.5 mm.

DIAGNOSIS—A sucker referred to *Deltistes* on the basis of the depth (55 per cent of the length) and the anteriorly foreshortened and thickened aspect of the maxilla. *D. owyhee* differs from *D. luxatus* (Fig. 4B) in the larger anterodorsal process, the higher shoulder at the insertion

FIG. 3. Dorsal view of neurocranium of *Deltistes owyhee*, n. sp., UMMP V55550, paratype; × 1.5.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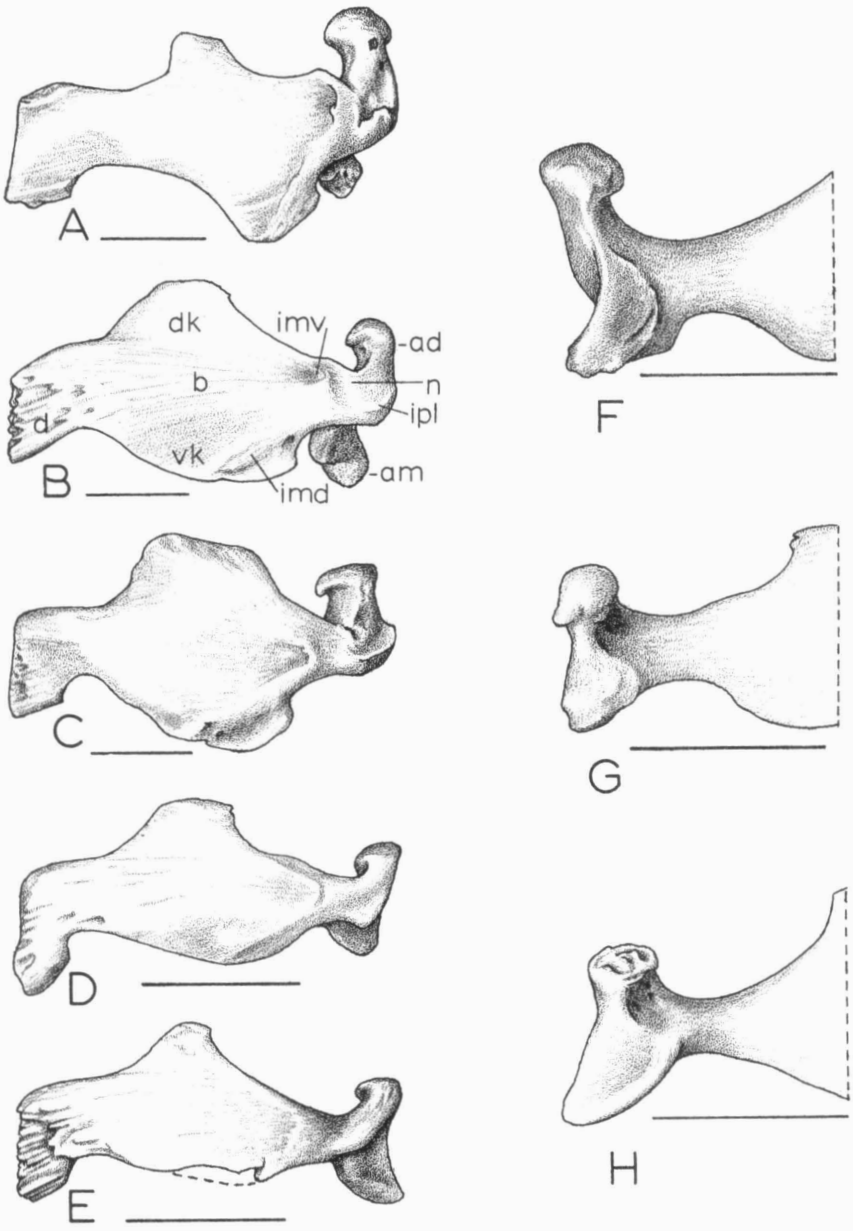
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of the maxillaris ventralis, the small truncate dorsal keel, the posteriorly concave ventral keel, and the truncate dentary process. It differs from *D. ellipticus* (Fig. 4C), described below, in the presence of the shoulder at the insertion of the maxillaris ventralis, the smaller dorsal keel, and the concave posterior edge of the ventral keel. *D. owyhee* differs from *Chasmistes* in the high, anterior, ventral keel; the robust and perpendicular anterodorsal process; and the posterior position of the anteromedian process. It differs from *Catostomus* in the presence of the shoulder at the insertion of the maxillaris ventralis, the reduced dorsal keel, and the large size.

REFERRED MATERIAL.—UMMP V55551: one incomplete right maxilla, collected by R. R. Miller and party. UM-IDA-1-61 = U.S.G.S. Cenozoic locality 20475, Idaho, Elmore Co.: from an abandoned railroad grade, in SW ¼ Sec. 16, T. 5S, R. 8E (Indian Cove quadrangle, 1948). Late Pliocene–Early Pleistocene Glenns Ferry formation. UMMP V55552: one left maxilla of an immature individual, collected by R. R. Miller and party. UM-IDA-7-61, Idaho, Owyhee Co.: about 6 airline miles S of Bruneau along cut as road drops from mesa westward into valley of Sugar Creek, elevation 3000 feet. UMMP V55553: two incomplete left maxillae, from the same locality as the holotype.

DISCUSSION.—On the basis of the maxilla, *D. owyhee* is the most distinctive member of its group. The extreme development of the area of insertion of the maxillaris ventralis and the concave posterior edge of the ventral keel is not seen in other western North American suckers. It is most reminiscent of the maxilla of the Asian carp, *Cyprinus carpio* L. This suggests that *D. owyhee* was a large omnivore with a subterminal mouth. The great depth of the neurocranium indicates that

FIG. 4. Right maxillae of suckers. A–E, lateral views; F–H, mesial views of anterior ends. A, holotype of *Deltistes owyhee,* n. sp., UMMP V55549. B, *Deltistes luxatus,* UMMZ 179364, Klamath Lake, Oregon. C, holotype of *Deltistes ellipticus,* n. sp., UMMP V55554. D, G, *Chasmistes brevirostris,* UMMZ 180686, Copco Lake, California; standard length ± 360 mm. E, holotype of *Chasmistes spatulifer,* n. sp., UMMP V55556. F, *Chasmistes* cf. *C. batrachops,* UMMP V55558. H, paratype of *Chasmistes spatulifer,* n. sp., UMMP V55557.

Anatomical terms used in the text are indicated on B as follows: *ad,* anterodorsal process; *am,* anteromedian process; *d,* dentary process; *dk,* dorsal keel; *imd,* insertion, maxillaris dorsalis; *imv,* insertion, maxillaris ventralis; *ipl,* insertion, palatomaxillary ligament; *n,* neck of the maxilla; *b,* body of the maxilla; *vk,* ventral keel. The scale in each case indicates one centimeter.

the body shape was terete in *D. owyhee,* rather than deep-bodied as in *Cyprinus carpio.*

The name *owyhee,* given as a noun in apposition to the generic name, refers to the county in Idaho from which the specimens were obtained.

Deltistes ellipticus, new species

SYNONYMY.—*Deltistes,* Miller, 1965:574, 576; Taylor, 1966:74.

HOLOTYPE.—UMMP V55554: a right maxilla (Fig. 4C), complete except for the anteromedian process, collected by R. R. Miller and party. UM-IDA-9-61, Idaho, Owyhee Co.: most westerly of three road cuts on state highway 45, about 1.5 miles SE Fossil Butte, Sec. 14, T. 4S, R. 1W. Late Pliocene Glenns Ferry formation, lacustrine facies.

The maxilla is 32.5 mm long, 19 mm in greatest depth, 4.5 mm deep through the neck anterior to the keels, 5.5 mm deep posterior to the keels, and 8.5 mm deep through the dentary process. The anterodorsal process is 3.3 × 4.5 mm just below the head, which is 5.0 mm in greatest length. The anterodorsal process and the area of insertion of the maxillaris ventralis are especially robust. The keels are expanded and high; the dorsal one is truncate and the ventral one is convex posteriorly and projects anteriorly. The dentary process is truncate. There is no shoulder at the insertion of the maxillaris ventralis.

DIAGNOSIS.—A sucker referred to *Deltistes* on the basis of the foreshortened, robust, and deep maxilla with a well-developed, anterior, ventral keel. Distinguishable from the two other known species of *Deltistes* by the high and long dorsal keel, which is truncate anteriorly and posteriorly, and the absence of a prominent shoulder dorsal to the insertion of the maxillaris ventralis. It is also distinguished by the combination of a postdorsally truncate dentary process and a postventrally convex ventral keel. The maxilla is the deepest of those known for the genus *Deltistes;* the greatest depth is 60 per cent of the greatest length. The truncate dorsal keel is most like that in *Chasmistes cujus,* but *D. ellipticus* differs from that species in the shorter neck and the strong anteroventral projection on the ventral keel.

REFERRED MATERIAL.—UMMP V55555: three incomplete maxillae, collected by R. R. Miller and party. UM-IDA-1-61 = U.S.G.S. Cenozoic locality 20475, Idaho, Elmore Co.: from an abandoned railroad grade, in SW ¼ Sec. 16, T. 5S, R. 8E (Indian Cove quadrangle, 1948). Late Pliocene–Early Pleistocene Glenns Ferry formation.

DISCUSSION.—On the basis of the form of the maxilla, *D. ellipticus* is the closest known relative of *D. luxatus* (Fig. 4B). In view of the age and geographic relationship it would be reasonable to postulate that *D. ellipticus* is ancestral to *D. luxatus,* except that *D. ellipticus* appears to be the more specialized of the two forms. The ancestors of *D. luxatus* might have separated from the progenitors of *D. ellipticus* before our sample of *ellipticus* existed in its specialized (deep and robust) form, or *luxatus* might have subsequently become more generalized.

The name *ellipticus,* is given as a masculine adjective in the nominative singular and refers to the ellipsoid shape of the maxilla.

Chasmistes spatulifer, new species

SYNONYMY.—*Chasmistes,* Miller, 1965:574, 576; Taylor, 1966:74.

HOLOTYPE.—UMMP V55556: a nearly complete right maxilla (Fig. 4E), collected by R. R. Miller and party. UM-IDA-1-61 = U.S.G.S. Cenozoic locality 20475, Idaho, Elmore Co.: from fine sand in an abandoned railroad grade, in SW ¼, Sec. 16, T. 5S, R. 8E; 2730 feet elevation (Indian Cove quadrangle, 1948). Late Pliocene–Early Pleistocene Glenns Ferry formation.

The maxilla is that of an adult fish that might have been approximately 425 mm in standard length. The length of the bone is 25.6 mm as measured from the anterodorsal process to the postventral corner, and 25.0 mm as measured from the anteromedian process to the postdorsal corner. The distance between the anterodorsal process and the anterodorsal point of the dorsal keel is 10 mm. The distance between the crest of the insertion for the palatomaxillary ligament and the tip of the anteromedian process is 8.5 mm. The maxilla has a maximum depth of 9.5 mm (ventral keel broken), a least depth of 2.6 mm through the neck, and a depth of 7 mm through the dentary process.

PARATYPE.—UMMP V55557: an anterior fragment of a right maxilla (Fig. 4H), 18 mm in greatest length, collected from the Late Pliocene–Early Pleistocene Glenns Ferry formation, from the type locality of *Acrocheilus xestes* and *Catostomus arenatus* (U.S.G.S. Cenozoic locality 19128). The bone shows the diagnostic characteristics as described for the holotype: the slender neck of the bone, the obtuse angles of the anterior processes to the neck, and especially the broad, spatulate shape and ventral deflection of the anteromedian process.

DISCUSSION.—See next account.

The name, *spatulifer,* meaning spatula bearer, is from the Latin words *spathe,* spatula, and *fero,* carry or bear.

Chasmistes cf. *C. batrachops* Cope

Abundant remains of a large sucker referable to *Chasmistes* have been collected by R. R. Miller and party from the deposits of Fossil Lake, Oregon (Lake Co.: center Sec. 8, T. 26S, R. 19E; Crescent quadrangle, 1958, 1:250,000). The maxillae of these suckers show similarity and intermediacy to *C. spatulifer* and *C. brevirostris* Cope. The general shape of the specimens from Fossil Lake is similar to that of some maxillae of *C. brevirostris* that we have examined (Fig. 4D and G), but differs from these in the direction of similarity to *C. spatulifer,* especially in the obtuse angle of the anterodorsal process to the axis of the body of the bone and the anteroventral deflection and somewhat spatulate shape of the anteromedian process.

Fossils of more than one age appear in the strata of the Fossil Lake region. Neurocrania of suckers referred to as *Chasmistes* sp. and *C. oregonus* Starks (in Jordan, 1907) from Fossil Lake show variation ranging toward *C. batrachops* (Fig. 4F) from the same system, suggesting successional populations (Uyeno and Miller, 1963:16). The entire series from Fossil Lake appears to be intermediate between *C. spatulifer* and *C. brevirostris* in the form of the maxilla, geographic distribution, age, and, perhaps, phylogeny.

Catostomus Lesueur; Subgenus *Pantosteus* Cope

Catostomus arenatus, new species

SYNONYMY.—*Pantosteus,* Miller, 1965:574, 576; *Catostomus (Pantosteus),* Taylor, 1966:74; Smith, 1966:114.

HOLOTYPE.—UMMP V55560: a nearly complete right maxilla (Fig. 5C), collected by R. R. Miller and party. UM-IDA-2-61 = U.S.G.S. Cenozoic locality 19128, Idaho, Owyhee Co.: south of Hammett, SW ¼ Sec. 1, T. 6S, R. 8E, 1550 feet E, 650–1050 feet N of SW corner; 2600 feet elevation (Hammett quadrangle, 1948, 1:24000). Late Pliocene–Early Pleistocene Glenns Ferry formation, fluviatile facies.

The specimen is similar to a right maxilla of *C. columbianus* (Fig. 5A, UMMZ 181769-S, 194 mm S.L.), differing in the narrower anterior constriction, greater depth of the body, and the more prominent area of insertion for the palatomaxillary ligament. Measurements of the

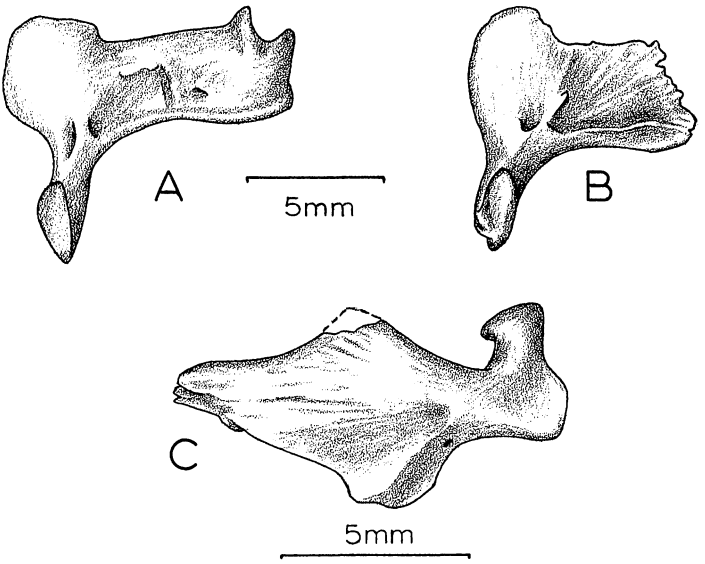

FIG. 5. A, mesial view of the right mandible of *Catostomus columbianus,* 194 mm in standard length, UMMZ 181769, from Crooked River, Oregon. B, mesial view of the paratype, UMMP V55559, of *C. arenatus,* n. sp. C, lateral view of the right maxilla of the holotype of *C. arenatus,* n. sp., UMMP V55560.

maxillae of *arenatus* and Recent *columbianus* are, respectively: greatest length, 10.95 mm, 11.0 mm; greatest depth, 5.1 mm (broken, estimate, 5.7 mm), 5.0 mm; least width of anterior constriction, 1.8 mm, 2.3 mm.

PARATYPE.—UMMP V55559: a nearly complete right dentary (Fig. 5B), collected by Gerald R. Smith, from the same locality as the holotype.

The nearly complete dentary is that of a young adult. The greatest length of the shaft of the dentary is 8.6 mm, and its depth at the dorsal process is 5.4 mm. The length of the gnathic ramus is 4.2 mm, its width 2.9 mm. The dorsal process is flattened rather than weakly saucer-shaped, but this may be the result of wear.

DIAGNOSIS.—A mountain sucker of the subgenus *Pantosteus* (see Smith, 1966:44) by reason of the reduced dorsal keel and the deep, an-

teriorly placed ventral keel of the maxilla. The greater depth of the maxilla serves to distinguish *C. arenatus* from its closest relative, *C. columbianus* (Eigenmann and Eigenmann). Our estimate of the greatest depth of the holotype is 5.7 mm, giving a ratio of depth to length of 1.92. The corresponding ratios in a sample of 14 *C. columbianus* ranged from 2.03 to 2.38 with a mean of 2.19. In addition, *C. arenatus* differs in the more prominent, truncate area of attachment of the palatomaxillary ligament and in the anterior abruptness of the ventral keel.

C. arenatus differs from other members of the subgenus *Pantosteus* except *C. columbianus* in the less abrupt angle of the gnathic ramus to the shaft of the dentary (less than 90°) and the less extensive median deflection of the gnathic ramus (Smith, 1966:17). It can be differentiated from *C. columbianus* by the more robust dentary, the shorter and broader gnathic ramus, and the position of the mesial opening of the mental foramen (posterior and ventral to its position in the living species, being nearly confluent with the adjacent depression rather than separated from it by a broad ridge). The anterior edge of the dorsal process arises from the shaft in a gently curving convex arch, whereas in *C. columbianus* the edge arises more abruptly (Fig. 5A). The anterolateral edge of the gnathic ramus bears a well-developed groove between dorsal and ventral ridges, whereas in *C. columbianus* only the ventral ridge is well developed.

Discussion.—*Catostomus arenatus* is probably a direct ancestor of *Catostomus columbianus* which now occupies the lower Columbia River basin including the Snake River drainage below the Great Falls of the Snake, the Wood River drainage, and streams populated by postglacial dispersal in British Columbia. Our material does not indicate any great changes in oromandibular osteology in the approximately three million years separating our samples. The diagnostic differences between *C. arenatus* and *C. columbianus* are slight—perhaps equivalent to those observed between closely related Recent species of *Catostomus*. *C. columbianus* is one of the generalized members of *Pantosteus,* and is a species that bridges the gap between *Pantosteus* and *Catostomus s.s. C. arenatus* thus occupies the same phylogenetic position, but at a time when the other species of *Pantosteus* might not have been as specialized as those that exist now.

The name, *arenatus,* "with sand," suggests the possible ecological environment of the holotype and refers to the type locality, formerly the Sand Point local fauna (Hibbard, 1959:19).

ICTALURIDAE

Ictalurus Rafinesque; Subgenus *Ameiurus* Rafinesque

Ictalurus vespertinus, new species

SYNONYMY.—*Amiurus* sp., Cope, 1883*a*:161; *Ictalurus,* Miller, 1959: 194; *Ictalurus* [?], Uyeno and Miller, 1962:340; *Ictalurus* [?], Uyeno and Miller, 1963:16; *Ictalurus* sp., Miller, 1965:573, 576, 577; Taylor, 1966: 74.

HOLOTYPE.—UMMP V55561: a right lower jaw (Fig. 6), collected by R. R. Miller and party. UM-IDA-9-62, Idaho, Owyhee Co.: road cuts on state highway 45 about 1.5 miles SE Fossil Butte, Sec. 16, T. 4S, R. 1W. Late Pliocene Glenns Ferry formation, lacustrine facies.

The bone is described by the following measurements: length, 69 mm; length of tooth row, 49 mm; greatest width of tooth row, 7 mm; height of angular, 20 mm; length of anteroventral ridge of dentary, 23 mm; maximum depth of anteroventral ridge of dentary, 8.5 mm (measured from nearest external tooth row); least depth of dentary posterior to anteroventral ridge, 8 mm (measured from nearest external tooth row); greatest anterolateral extent of angular, 25 mm (measured from posterior tip of retroarticular).

PARATYPES.—UMMP V40606: a right pectoral spine (Fig. 7), 32 mm long, with weak anterior dentations near the base of the shaft and strong, retrorse dentations on the posterior edge of the shaft, collected by G. R. Smith. U.S.G.S. Cenozoic locality 20765, Idaho, Twin Falls Co.: SW ¼ Sec. 28, T. 7S, R. 13E, 300–400 feet E, 2100 feet N of SW corner; 3025 feet elevation (Hagerman quadrangle, 1950, 1:24000). Late Pliocene Glenns Ferry formation, floodplain facies.

USNM 22348: an incomplete right cleithrum (Fig. 7), 18 mm in greatest length, from the same locality as UMMP V40606.

DIAGNOSIS.—A bullhead catfish (subgenus *Ameiurus*) of the genus *Ictalurus,* distinguished from the larger fork-tailed catfishes (subgenus *Ictalurus*) by (1) the short midventral keel on the cleithrum, (2) the early and constant development of an abrupt elevation on the angular, and (3) the anteroventral ridge on the dentary. From other bullheads, the new species is distinguished by the slender dentary, with a long tooth row relative to the least depth of the bone; the broad dentigerous part of the dentary that narrows only slightly posteriorly and forms a strong shelf on the dorsal surface of the bone; the larger, more retrorse posterior dentations of the pectoral spines; and the short mid-

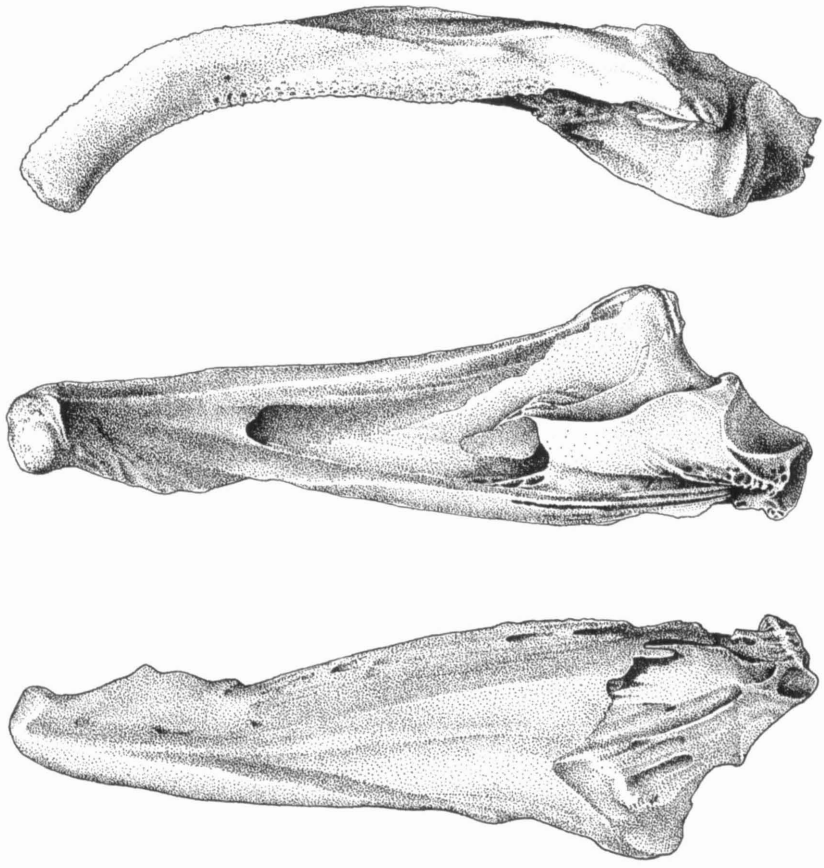

FIG. 6. Right lower jaw of *Ictalurus vespertinus,* n. sp., UMMP V55561, holotype; × 1.5. Top, dorsal view; middle, mesial view; bottom, reversed lateral view.

ventral keel of the cleithrum. *I. vespertinus* resembles *I. nebulosus* (Lesueur) in the shape of the lower jaw and the pectoral spines, but differs from that species in the pattern of rugosity on the postventral process of the cleithrum and the wider dentary tooth row. Also, the dentary of the new species is not so curved inward anteriorly and posteriorly as in *I. nebulosus,* thus indicating that it was not as blunt-headed as that species. The new species differs from *I. catus* (L) in the restriction of rugosity to the ventral half of the postventral process of the cleithrum, the longer (and broader) tooth row and the lesser depth of the dentary, and the much stronger retrorse dentations of the pectoral spines. It differs from *I. natalis* (Lesueur) in the absence of the

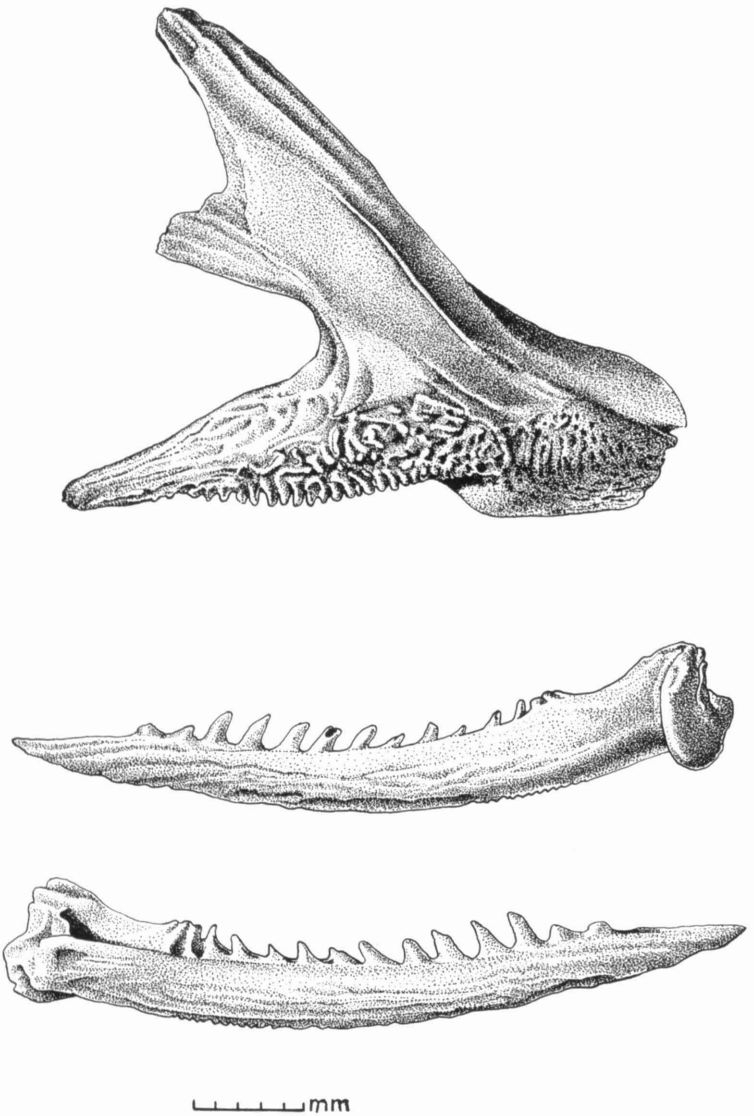

FIG. 7. *Ictalurus vespertinus,* n. sp. Above, incomplete right cleithrum, USNM 22348, paratype, × 5.3. Below, right pectoral spine, UMMP V40606, paratype, in lateral and mesial views.

anteroventral deflection of the ventral edge of the angular, and from *I. melas* (Rafinesque) in the characteristics distinguishing it from *I. nebulosus* and *I. catus*.

DISCUSSION.—*I. vespertinus,* like *I. catus* to which it is similar, may be intermediate relative to the bullheads, subgenus *Ameiurus,* and the larger, fork-tailed catfishes, subgenus *Ictalurus*. The short midventral keel on the cleithrum, the anteroventral ridge and long tooth row of the dentary, and the abrupt elevation of the anterior part of the angular (in 15 specimens of all sizes) align the fossil species with *Ameiurus*. *I. vespertinus* was somewhat larger than modern bullheads, except *I. catus*. A regression of length of the lower jaw on total length of specimens of *I. nebulosus* and *I. catus* suggests that the type specimen, a jaw 69 mm long, belonged to a fish that was about 20 inches long.

The name, *vespertinus,* is a Latin adjective referring to the western distribution of the species in North America.

CENTRARCHIDAE

Archoplites Gill

Archoplites taylori, new species

SYNONYMY.—Percidae, Cope, 1883*a*:164; *Lepomis,* Miller, 1959:194; *?Lepomis,* Uyeno and Miller, 1963:18; *Archoplites* sp., Miller, 1965: 575, 576, 577; Taylor, 1966:74.

HOLOTYPE.—UMMP V55562: a nearly complete left dentary (Fig. 8) collected by Robert R. Miller. U.S.G.S. Cenozoic locality 19128, Idaho, Owyhee Co.: south of Hammett, SW ¼ Sec. 1, T. 6S, R. 8E, 1550 feet E, 650–1050 feet N of SW corner; 2600 feet elevation (Hammett quadrangle, 1948, 1:24000). Late Pliocene–Early Pleistocene Glenns Ferry formation, fluviatile facies.

The dentary is 15 mm in greatest length and 2.8 mm deep at the anterior part of the bone, with a tooth row 11.5 mm long. The partly dentigerous dorsoposterior part of the bone is long, gently rounded, and evenly curved. The posteroventral process is broken off at the fourth ventral foramen. The anterior one-third of the tooth row is wider and bears more rows (about 4) of larger teeth than the posterior two-thirds.

PARATYPES.—USNM 22346: one prevomer (Fig. 9) with an abruptly elevated tooth-bearing surface, which is 11.2 mm wide and 3.5 mm long, collected by D. W. Taylor. U.S.G.S. Cenozoic locality 20765,

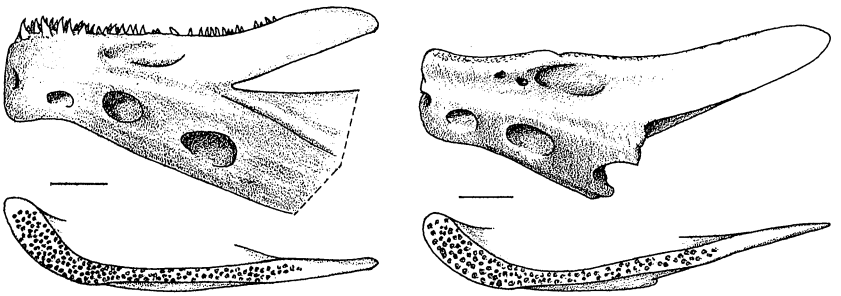

FIG. 8. Left, lateral and dorsal views of left dentary of female, 124 mm in standard length, of *Archoplites interruptus,* UMMZ 179938 (No. 3 of 6), from California. Right, same views of left dentary of holotype of *Archoplites taylori,* n. sp., UMMP V55562. Eeach scale represents 2 mm.

Idaho, Twin Falls Co.: SW ¼ Sec. 28, T. 7S, R. 13E, 300–400 feet E, 2100 feet N of SW corner; 3025 feet elevation (Hagerman quadrangle, 1950, 1:24000). Late Pliocene Glenns Ferry formation, floodplain facies. USNM 22349: an incomplete right preopercle 19.4 mm in greatest length and 7.2 mm in greatest width at the angle, serrate ventrally and posteriorly, with the same data as the preceding.

REFERRED MATERIAL.—UMMP V55563: five dentaries, 6 incomplete maxillae, 9 incomplete premaxillae, 2 angulars, and 5 incomplete preopercles, all taken with the holotype. USNM 22315: one right preopercle (Fig. 9), 17 mm long, serrate ventrally and posteriorly, with sensory canal pores arranged as in *A. interruptus,* collected by D. W. Taylor. U.S.G.S. Cenozoic locality 19128, Idaho, Owyhee Co.: south of Hammett, SW ¼ Sec. 1, T. 6S, R. 8E, 1550 feet E, 650–1050 feet N of SW corner; 2600 feet elevation (Hammett quadrangle, 1948, 1:24000). Late Pliocene–Early Pleistocene Glenns Ferry formation, fluviatile facies.

DIAGNOSIS.—(Based partly on paratypes.) A sunfish of the genus *Archoplites* by reason of the form of the lower jaw, especially the position and size of the mental foramina and the form of the tooth row; the serrate preopercle; and the sharply raised tooth patch and small teeth of the prevomer. Differs from *Lepomis* in the shape of the dentary and the size of the prevomerine tooth patch and teeth, and from *Chaenobryttus* in the relative size of the teeth, the shape of the dentary tooth patch, and the elevated prevomerine tooth patch. Differs from the Recent *Archoplites interruptus* (Girard) in the less abrupt demarcation

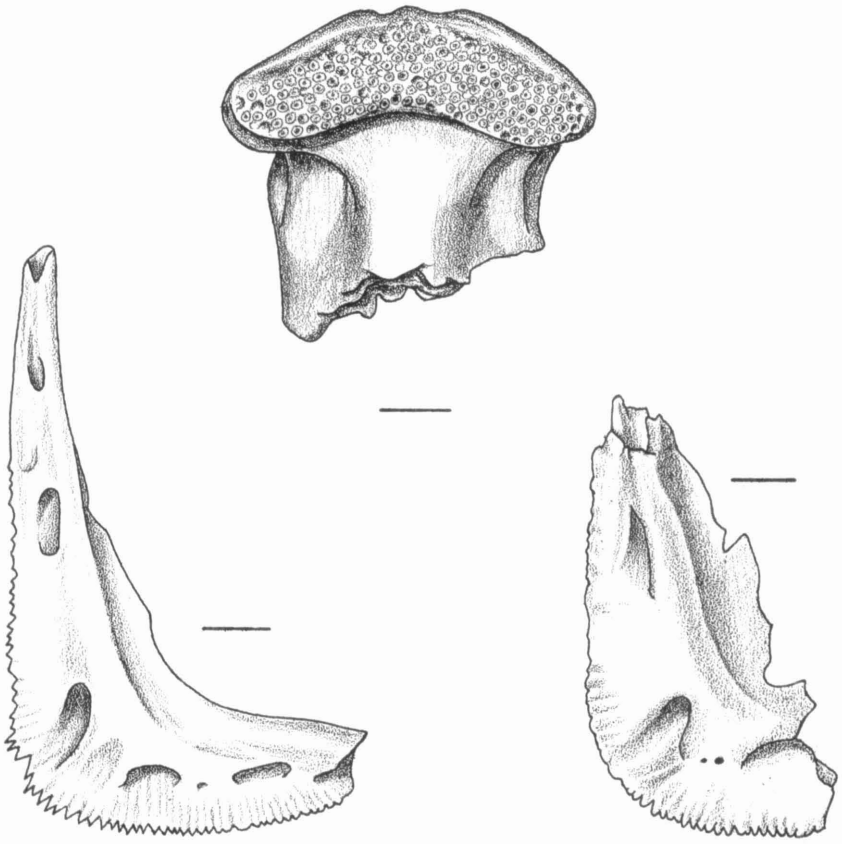

FIG. 9. Top, ventral view of prevomer of paratype of *Archoplites taylori,* n. sp., USNM 22346. Left, lateral view of right preopercle of female, 124 mm in standard length, of *A. interruptus,* UMMZ 179938 (No. 3 of 6), from California. Right, lateral view of right preopercle of paratype of *A. taylori,* n. sp., USNM 22315. Each scale represents 2 mm.

of the anterior part of the dentary tooth row; the relatively larger dorsoposterior process of the dentary; the greater anterolateral curvature of the dentary (indicating bluntly rounded jaws); and the greater width at the angle of the preopercle.

DISCUSSION.—This genus is known otherwise by one living species in the Sacramento River system and adjacent drainages, California (Fig. 1), and from fossil occurrence in the Early or Middle Pleistocene of Washington (Miller, 1965:576). The occurrence in Lake Idaho and the

Great Valley, California, in addition to a similar pattern in the cyprinid genus *Mylopharodon* (Uyeno, 1961), provides evidence for a former hydrographic connection between the Snake River or its antecedent and the Sacramento drainage (Miller, 1965:576).

The species is named for Dwight W. Taylor of Arizona State University, who collected the paratypes as well as many of the fossils reported here, and who has contributed much to the study of the zoogeography and paleoichthyology of western North America.

SUMMARY

The fish fauna of Lake Idaho, with about 20 known species, was more diverse than that of any Recent lake in the western United States. The five most speciose modern lakes have the following number of native species: Klamath Lake, Oregon, about 14; Clear Lake, California, about 14; Utah Lake, Utah, about 13; Bear Lake, Idaho-Utah, 11; and Flathead Lake, Montana, 10. Seven of the 20 species of Lake Idaho, belonging to six genera and four families, are described and discussed in this paper. In the approximately 3.5 million years since the existence of the fishes described here, five of the seven lines have become extinct in the area occupied by Lake Idaho; two are represented by descendent species.

The minnow, *Acrocheilus xestes,* represents a stage in the evolution of *Acrocheilus alutaceus,* an inhabitant of rivers and lakes in the Columbia and Fraser river drainages. Both forms have jaws adapted to scraping food material from the substrate. *Acrocheilus xestes,* known from jaws only, is possibly the same as one of the species of *Diastichus,* described by Cope, which are known only from pharyngeal bones and teeth.

Three of the suckers in the fauna probably occupied the open waters of the lake except, possibly, for spawning runs. *Deltistes owyhee* probably had a subterminal mouth, as indicated by the morphology of the maxilla. The species represents a phyletic line of large, specialized fishes now extinct. *Deltistes ellipticus* is more closely related to *D. luxatus* of Klamath Lake, but appears to have been more specialized than that form. *Chasmistes spatulifer* is a relative of suckers remaining in several isolated localities in western United States (Fig. 1). Its relationships are also in the direction of Klamath Lake, being associated with *C. brevirostris* of that system through the geographic and temporal intermediary of *C. batrachops* and its successional forms in Fossil Lake, Oregon.

Catostomus (Pantosteus) arenatus is probably directly ancestral to *C. columbianus* which inhabits rivers in the Columbia River and associated drainages today. This pair has jaws adapted in the same way as *Acrocheilus*. The *Pantosteus* and *Acrocheilus* are the only lines described here that have survived in the area of Lake Idaho. They are accompanied in this respect by these additional members of the fauna: *Catostomus macrocheilus,* a *Prosopium,* a *Salmo,* and a *Ptychocheilus.*

The catfish, *Ictalurus vespertinus,* was a widespread inhabitant of the lake, appearing in many of the strata. Its closest relative appears to be *I. catus* of eastern United States, with which it is aligned in the subgenus *Ameiurus.*

Archoplites taylori is a sunfish close to the Recent *A. interruptus* of the Great Valley and adjacent areas of California. This distributional relationship to a Recent relative is shown by other members of the Lake Idaho fauna: *Mylopharodon hagermanensis* Uyeno and, perhaps, *Mylopharodon(?) condonianus* (Cope), are related to *M. conocephalus* (Baird and Girard) of the Great Valley.

Several basic patterns emerge upon consideration of the zoogeographic association of the fish fauna of Lake Idaho. At least six of the fossil species are succeeded in the area by Recent species. Two or three species show close relationships to two species in the Great Valley of California (See Miller, 1965:576; Taylor, 1966:17; Wheeler and Cook, 1954). Two species show relatively distant relationship to two species in the Klamath system of Oregon and California (See Miller, 1965:576; Taylor, 1966:17). One species has no relatives in western United States, but is close to a species in eastern United States. At least five of the species represent lines that have become extinct.

The fish fauna of Lake Idaho, as presently understood, is summarized in the following list (it is highly probable that the number of species of *Catostomus* will be reduced):

Salmonidae
- *Salmo copei* Uyeno and Miller
- *Prosopium* sp.

Cyprinidae
- *Acrocheilus xestes* Miller and Smith, n. sp.
- *Diastichus macrodon* Cope
- *Diastichus parvidens* Cope
- *Mylocyprinus robustus* Leidy
- *Mylopharodon hagermanensis* Uyeno
- *Mylopharodon(?) condonianus* (Cope)
- *Ptychocheilus* cf. *P. oregonensis* (Richardson)
- *Sigmopharyngodon idahoensis* Uyeno

Catostomidae
- *Catostomus macrocheilus* Girard
- *Catostomus cristatus* Cope
- *Catostomus "reddingi"* Cope
- *Catostomus shoshonensis* Cope
- *Catostomus arenatus* Miller and Smith, n. sp.
- *Chasmistes spatulifer* Miller and Smith, n. sp.

Deltistes ellipticus Miller and Smith, n. sp.
Deltistes owyhee Miller and Smith, n. sp.
Ictaluridae
Ictalurus vespertinus Miller and Smith, n. sp.
Centrarchidae
Archoplites taylori Miller and Smith, n. sp.
Cottidae
"Cottus" divaricatus Cope

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