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The Need for Ichthyological Surveys of the Major Rivers of Western North America[1]

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EXPLORATIONS OF THE COLORADO, Sacramento, and Columbia Rivers, the major drainages of western North America, have been made by adventurers and scientists for more than 100 years, yet the fish fauna of these basins, particularly of the Colorado and the Columbia, are still imperfectly or poorly known. The reason for this is apparent when one considers the magnitude of these rivers and the ruggedness of the terrain they cross.

A comparison of the known genera of fluvial fishes inhabiting these basins is given in Table 1, with the Klamath River included for convenience. The term fluvial is used for representatives strictly confined to fresh water, but a list of anadromous forms (*1*) appears at the end of the table. Thus, the Pacific salmon, *Oncorhynchus,* is omitted from the Sacramento and Klamath Rivers because no forms restricted to fresh water are known therein, although the genus is a member of the anadromous group in both of these drainages.

The need for surveys of the western rivers may be summarized briefly as follows:

(1) It is desirable to learn what kinds of native fishes inhabit the basins.

(2) At the same time, needed information on introduced species can be obtained.

(3) Surveys would yield a wealth of comparative material necessary for the solution of problems of speciation in fishes of the West and elsewhere.

(4) Data are needed to enable a critical appraisal of fish management problems created by the construction of dams and the haphazard introduction of alien species.

(5) It is past time to bring to bear the data of ichthyology on the problems of the Pleistocene histories of these rivers.

(6) Surveys are needed as an aid in interpreting the environment of archeological sites, particularly in the Southwest, through the collection and interpretation of fossils.

The need for these surveys is urgent because of changes caused by: (1) the effects of dams and diversions, water-power development, water storage, and irrigation practices; (2) pollution from mining operations; (3) destruction of vegetation by livestock resulting in increased floods and erosion (particularly serious in the Southwest); and (4) introduction of exotic species.

Water development is particularly critical. Postwar projects are planned for the construction of dams on a scale heretofore unparalleled in the West. In the Central Valley of California alone, no fewer than 23 new or enlarged reservoirs, 2 diversions (from the Klamath to the Sacramento Rivers—biological suicide), and 8 canals are proposed (*4*). The effects of these obstructions, diversions, and canals will be serious for the native fish fauna, as already demonstrated for the valuable fish resources of the Central Valley.

Up to 1915 there were in operation 7 diversions of waters from the Colorado basin,[2] 4 into the Bonneville and 3 into the Mississippi basins (*2*). In addition, 5 other diversions were planned at that time and, although only 3 reservoirs had been built, 47 were proposed. Of these, 5 have been constructed since, and 12 others have been built or are under construction, thereby bringing new problems to the aquatic life of the Colorado. The zoogeographical effects of these diversions and the changes wrought by the reservoirs have received only slight attention or none at all.

In the Columbia River basin the aberrant sucker, *Chasmistes,* is confined to Utah Lake (Bonneville basin), and *Deltistes,* the only endemic genus known from the Klamath system, is restricted to Klamath Lake, along with close relatives of *Chasmistes.* Elsewhere, the relict *Chasmistes* is known only from Pyramid Lake, in the interior drainage of the Lahontan basin, Nevada. Although the subgenus *Siboma* occurs in both the Sacramento and Columbia Rivers,

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The author is grateful to Drs. Leonard P. Schultz and Carl L. Hubbs for assistance in preparation of Table 1.

[2] Not including the diversion into Imperial Valley, California, which does not involve problems in zoogeography.

it is known in the latter only from the Upper Snake and Bonneville basins. The representative of the genus *Couesius, C. greeni* Jordan, in the Columbia, has been discovered only in Lake Pend d'Oreille (Columbia River) and Stuart Lake (Fraser River). In the Colorado the record for *Couesius* (based on unknown from coastwise streams south of the Columbia but is present in the Fraser River; *Iotichthys* is a relict confined to the Bonneville basin; *Snyderichthys* (*3*) thus far has been found only in the Bonneville basin and Little Wood River, a tributary of the Snake River; and *Oregonichthys* is restricted to the Willa-

TABLE 1

COMPARISON OF THE FLUVIAL FISH FAUNA OF FOUR RIVERS OF WESTERN NORTH AMERICA
(Genera in bold face are restricted to the basin indicated.)

Family	Colorado River[1]	Sacramento River[2]	Klamath River	Columbia River[3]
Petromyzonidae	.....	*Entosphenus*	*Entosphenus*	.....
(Lampreys)	.....	*Lampetra*	.....	*Lampetra*
Coregonidae	*Prosopium*	.....	.....	*Prosopium*
(Whitefishes)	.....	.....	.....	*Leucichthys*[4]
Salmonidae	*Salmo*	*Salmo*	*Salmo*	*Salmo*
(Trouts)	.....	.....	.....	*Oncorhynchus*
	.....	*Salvelinus*	*Salvelinus*[5]	*Salvelinus*
Catostomidae	*Catostomus*	*Catostomus*	*Catostomus*	*Catostomus*
(Suckers)	*Pantosteus*	*Pantosteus*?[6]	.....	*Pantosteus*
	.....	.....	*Chasmistes*	*Chasmistes*
	Xyrauchen	.....	.....	.....
	.....	.....	**Deltistes**	.....
Cyprinidae	**New genus**	*Ptychocheilus*	.....	*Ptychocheilus*
(Minnows)	*Gila (Gila)*	*Gila (Siboma)*	*Gila (Klamathella)*	*Gila (Siboma)*
	Rhinichthys	*Rhinichthys*	*Rhinichthys*	*Rhinichthys*
	.....	*Siphateles*	*Siphateles*	*Siphateles*
	Couesius? (see text)	.....	.....	*Couesius*
	Agosia	.....	.....	.....
	Tiaroga	.....	.....	.....
	Meda	.....	.....	.....
	Lepidomeda	.....	.....	.....
	Plagopterus	.....	.....	.....
	New genus	.....	.....	.....
	.....	**Mylopharodon**	.....	.....
	.....	**Orthodon**	.....	.....
	.....	**Hesperoleucus**[7]	.....	.....
	.....	**Lavinia**	.....	.....
	.....	**Pogonichthys**	.....	.....
	.....	.....	.....	*Richardsonius*
	.....	.....	.....	**Iotichthys**[8]
	.....	.....	.....	**Acrocheilus**

[1] Including the Pleistocene tributary White River of eastern Nevada.
[2] Including the Pleistocene connectives: Russian, Gualala, and Navarro Rivers; San Francisco Bay streams; and Pajaro-Salinas basin.
[3] Including the Snake River and the Pleistocene connectives: Fraser and Umpqua Rivers, Puget Sound, Malheur and Bonneville basins.
[4] *L. gemmifer*, a glacial relict confined to Bear Lake, Bonneville basin.
[5] Now extinct in the Klamath basin.
[6] Perhaps introduced (Feather River drainage).
[7] Known also from a tributary of the Warner Lakes basin of southeastern Oregon.
[8] Known only from the Bonneville basin in Utah.

Ceratichthys squamilentus Cope) is open to question, for the species has not been taken since the capture of the type in 1870. *Tiaroga* and *Meda*, of the Colorado, are restricted to the Gila River basin, and *Lepidomeda* is known only from the Middle Colorado (basin of Pleistocene White River, Meadow Valley Wash, Virgin River, and Little Colorado River). *Meda* and *Lepidomeda*, together with *Plagopterus* (also of the Colorado), form a unique subfamily of cyprinids, the Plagopterinae, which constitutes the only group of spined minnows in the New World. Of the peculiar cyprinids of the Columbia, *Mylocheilus* is mette and Umpqua Rivers, Oregon. *Columbia*,[3] *Novumbra*, and *Archoplites* are survivors of an ancient fauna which probably antedated the barrier of the Rocky Mountains.

The known fish fauna of these rivers therefore comprises a large number of relicts, many of which are of restricted distribution or are rare. Others have be-

[3] G. Whitley (*Austral. Nat.*, May 1940, p. 243) claimed that *Columbia* was preoccupied by *Columbia* Rang and erected *Columatilla* to replace it. H. A. Rehder, associate curator of Molluscs, U. S. National Museum, kindly checked the reference and found that Rang's name is spelled *Colombia* (spelling and citation correctly given by Neave). *Columatilla* Whitley therefore falls as a synonym of *Columbia* Eigenmann.

come greatly reduced since the turn of the century by processes already described. The rest of the fauna can be divided into (1) marine derivatives: *Entosphenus, Lampetra, Salmo, Oncorhynchus, Salvelinus, Hysterocarpus,* and *Lota*; (2) widespread genera: *Prosopium, Leucichthys, Catostomus, Pantosteus, Rhinichthys, Cyprinodon,* and *Cottus*; and (3) genera restricted to Western North America: *Chasmistes, Ptychocheilus, Gila, Siphateles, Agosia, Richardsonius,* and *Poeciliopsis*[4] (in addition to those in bold face, Table 1). The percentage of the fluvial genera confined to each of the major basins is as follows: Colorado River—19 genera, 8 endemic, 42 per cent; Sacramento River—18 genera, 7 endemic, 39 per cent; Columbia River—25 genera, 8 endemic, 32 per cent. These figures are probably least accurate for the Columbia, as this is the largest basin, and most accurate for the much smaller and better-known Sacramento.

Of the known genera of the West with strictly fluvial members, 31 out of 45, or 69 per cent, are confined thereto.[5] Only 12, or 27 per cent, of the genera also occur east of the Rockies, and 6, or 13 per cent, occur on both sides of the North Pacific.

The factors responsible for changes which have already strongly affected the endemic fish fauna of the Western rivers continue to operate and will very likely be accelerated in the next decade. In time, therefore, a clear picture of the original fauna may no longer be obtainable, and consequently the surveys should be undertaken as soon as possible.

TABLE 1 (*continued*)

COMPARISON OF THE FLUVIAL FISH FAUNA OF FOUR RIVERS OF WESTERN NORTH AMERICA
(Genera in bold face are restricted to the basin indicated.)

Family	Colorado River	Sacramento River	Klamath River	Columbia River
	.....	.....	.....	**Mylocheilus**
	.....	.....	.....	**Oregonichthys**[9]
	.....	.....	.....	**Snyderichthys**
	.....	.....	.....	**New genus**
Novumbridae (Mud-minnows)	.....	.....	.....	**Novumbra**[10]
Cyprinodontidae (Killifishes)	*Cyprinodon*	.....	.....	.....
	Crenichthys[11]	.....	.....	.....
Poeciliidae (Top-minnows)	*Poeciliopsis*	.....	.....	.....
Percopsidae (Trout-perches)	.....	.....	.....	**Columbia**[12]
Centrarchidae (Sunfishes)	.....	**Archoplites**[13]	.....	.....
Embiotocidae (Surf-perches)	.....	**Hysterocarpus**[14]	.....	.....
Gadidae (Cods)	.....	.....	.....	*Lota*[14]
Cottidae (Sculpins)	*Cottus*	*Cottus*	*Cottus*	*Cottus*
Anadromous forms:				
Petromyzonidae (Lampreys)	.....	*Entosphenus*	*Entosphenus*	*Entosphenus*
	.....	*Lampetra*	.....	*Lampetra*
Acipenseridae (Sturgeons)	.....	*Acipenser*	*Acipenser*	*Acipenser*
Salmonidae (Trouts)	.....	*Salmo*	*Salmo*	*Salmo*
	.....	*Oncorhynchus*	*Oncorhynchus*	*Oncorhynchus*
	.....	.....	.....	*Salvelinus*
Osmeridae (Smelts)	.....	*Spirinchus*	.....	*Spirinchus*
	.....	.....	*Thaleichthys*	*Thaleichthys*

[9] *O. cumingii* (Günther), described from "California," is of very uncertain status.
[10] This family and its only known genus and species, *Novumbra hubbsi* Schultz, constitutes a rare relict found only in the Chehalis River basin at and near Satsop, Washington (Puget Sound drainage).
[11] A relict inhabiting the basin of Pleistocene White River and the adjacent Railroad Valley, Nevada.
[12] The only trout-perch west of the Rocky Mountains. *Columatilla* Whitley is a synonym; see text.
[13] This relict is the only native sunfish west of the Rocky Mountains.
[14] The only known fresh-water representative of the marine family.

[4] *Poeciliopsis* occurs in Pacific streams from Arizona to Colombia.

[5] Including *Pantosteus delphinus jordani* and *Gila nigrescens*, which have spilled over into the headwaters of the Missouri and the Río Grande, respectively.

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