Introduction + misc

Guide to the Freshwater Fishes of Mexico

By Robert Rush Miller

INTRODUCTION

This is the first book to treat all of the freshwater fishes of Mexico. It represents more than fifty years of field work in Mexico. I have arbitrarily set the limit for fresh water at a salinity of 1.0 parts per thousand (ppt). Thus most fishes that invade continental waters above tidal level are included (Castro-Aguirre, 1978 and pers. comm. 1989). More than 500 species are treated. All are illustrated, many in color.

The book is designed to help you, the user, identify all of these fishes with keys, illustrations, and distribution maps. The keys are based on distinguishing field characters that are described and illustrated in the text and on the accompanying photographs, drawings, and color plates. On the principle that a picture is worth a thousand words, I have tried to obtain high quality illustrations that will readily facilitate identification, rather than including detailed descriptions of each species.

Anyone who is interested in Mexican freshwater fishes can identify them with this book, except for a small core of known but as yet undescribed species (mentioned in the pertinent family accounts). Its intended audience is much wider than that of ichthyologists and fishery biologists. Students, amateur naturalists, aquarists, fishermen, ecologists, behaviorists, conservation biologists, physiologists, biogeographers and environmental consultants should be able to identify fishes of interest or glean useful information from the species accounts and distributional data. This book should stimulate badly needed studies on life history and ecology that could result in major advances in our knowledge of the Mexican fauna, of its relationships to its Neotropical and Nearctic relatives, and of

tropical biodiversity.

Although only about one-fifth the area of the continental United States, Mexico possesses a rich and diversified freshwater fish fauna that comprises at least 503 species -- about 65 percent that of the United States and Canada combined. Its diversity stems from a highly varied physical geography, a complex geological history, large latitudinal extent (32330N in the NW to 14330'N in the S), isolation of the great tropical highland region known as the Mesa Central (which contains the important, highly endemic RUo Lerma fauna), a large intrusion of marine groups many of which have beome permanent freshwater residents, and the largest river system in Middle America, the RUo Grijalva-Usumacinta of Guatemala and Mexico, that lies well within the tropics and supports a highly endemic fish fauna (Miller 1988).

The physiography of the Atlantic slope, with the large latitudinal shift and great differences in altitude and vegetation between the low-lying coastal plain and the elevated Sierra Madre Oriental, creates a range of climatological conditions that permit both neotropical and temperate species to find favorable ecological niches. It also forms a broad transition zone between northern and southern species.

The Mexican fauna is derived about equally from Nearctic/Holarctic sources, Neotropical or Middle American elements, and species derived from marine ancestors. The Northern elements are essentially limited to the Mexican Plateau (much of which is now endorheic). Each of these three sources constitutes roughly 30% of the fauna. The remainder (<10%) comprises the important autochthonous family Goodeidae on the Mesa Central (Miller and Smith 1986; Smith and Miller 1986). About 25 percent of the species are primary freshwater fishes (127) and 43 percent are secondary freshwater fishes (218). The three largest families of freshwater fishes in Mexico are the Poeciliidae, with 86 species, the Cyprinidae, with 76, and the Cichlidae, with 45.

It is often difficult to decide what constitutes a

freshwater fish, since the lower limits of sea water and the upper limits of fresh water have not been rigidly defined and few reliable salinity records are available for Mexico's continental waters. Fishes from interior localities (e.g., in the Cuatro CiEnegas basin, Coahuila), and from warm, mineralized springs (e.g., at San Diego, Chihuahua) are included although in such places the salinity may reach 1.5 ppt or higher. Fishes that regularly enter fresh water at some life-history stage are included (e.g., the herring, Lile stolifera, many ariids, **Menidia** beryllina, Pseudophallus starksi, the genus Centropomus, many gerreids, Pomadasys, mullets, and flatfishes), whereas sporadic records of marine fishes that barely invade fresh water (e.g., one record of Mugil trichodon) are generally excluded. Some decisions had to be made **arbitrarily**. I have, however, tended to accept fishes classified as "borderline freshwater" so as to make this work more inclusive and useful. This designation fits, for example, some species of Eleotris and both species of **Dormitator**, family Eleotridae, although the latter two are normally brackish water and estuarine in their habitat predilections. Additional fishes that invade continental (but not necessarily fresh) waters are admirably treated by Castro-Aguirre (1978). Also, when all but one or two representatives of a family that is widely distributed in fresh water are known only from salt and brackish water, such species have been included for completeness (e.g., **Floridichthys polyommus**, Fundulus grandissimus, F. persimilis, and **Menidia** colei).

Even fishes classified as primary freshwater species (Myers 1938, 1949), which are said to be "intolerant of sea water", provide frequent exceptions to this "rule". World examples among the **Cyprinidae** are Rutilus rutilus (Linnaeus), the European roach, which has been recorded in mesohaline water of 10-18 ppt salinity (Nellen 1965); the Far Eastern Tribolodon brandti (Dybowski), which can live in full sea water, but cannot complete its life cycle there (Gritsenko 1974); the American Mylocheilus caurinus (Richardson), the peamouth chub of the Columbia River (McPhail & Lindsey 1970), which also has been taken in the ocean.

Other examples are the channel catfish, Ictalurus punctatus (Rafinesque), which has been reported in 15.1 ppt (Schwartz, 1964), and the bluegill, Lepomis macrochirus Rafinesque in 17.4 ppt (Renfro, 1960:89). In Mexico, the Mexican tetra (Characidae), Astyanax mexicanus (Filippi), invades mangrove-lined, brackish-water estuaries along the Mexican east coast (Miller 1966, and subsequent observations).

Forty-eight families are included and keyed out, although one (Percichthyidae) is not native. Its inclusion is justified on the grounds that a single representative inhabits the lower Rio Grande and its identification would otherwise be impossible. Regarding the spelling of family names, I agree fully with the view of Ernst Mayr (1989) who asks "Why have the pedantic requirement that they [family names] must be 'corrected', to be formed exactly according to Greek or Latin grammar?" Thus I reject such proposed modifications as the inharmonious Eleotrididae for the euphonious Eleotridae; taxonomists are held in low enough regard for changing long-familiar scientific names of fishes without **crucifying** firmly-established family **names!** All species are illustrated and most of their distributions are mapped on the basis of over 3,000 collecting stations and pertinent literature records. Exotic species are generally excluded (carp, goldfish, and grass carp are exceptions), but an effort is made to list established introductions and to refer the reader to the pertinent literature. Intracontinental transfers are a particularly annoying problem and I caution students to be wary of publishing seemingly valid range extensions of well known species. (An extreme example is the capture of the American eel, confined to the Atlantic Ocean basin, in the Pacific-slope RUo Balsas; no species of Anguilla is known from the Eastern Pacific.)

The sequence of families follows that of Nelson (1984), with slight subsequent modifications. Within families, genera and species are listed alphabetically for convenience to the user. Methods of counting and measuring follow those of Hubbs and Lagler (1958) unless specific exceptions are made, as in

cyprinodontiforms.

Ranges given in the Keys refer to Mexican distributions only; in the Annotated List they include the known distribution of the species. The conservation status of species is given whenever appropriate.

Scientific and Common Names

Man is by nature curious about similarities and differences between objects and events in his physical universe. The development of the human mind appears to have been closely related to the perception of discontinuities in nature. Thus folk taxonomic systems, the antecedent of our present formal taxonomy, originated early in our cultural history (Raven et al., 1971). Then, more than two hundred years ago the Swedish naturalist Carl von LinnE (Carolus Linnaeus) gave a two-word name to every species he knew. Since that time, scientific names have been used to name animals and plants. Many animal and plant species -- e.g., Gasterosteus aculeatus, threespine stickleback; Zea mays, maize -- still carry the names Linnaeus gave them in 1758.

Thus a species name consists of two parts, each usually made up from Latin or Greek roots. The first part, called the genus, is capitalized but the second part, the species, is not. Both are printed in italics (Cichlasoma fenestratum, mojarra negra); sometimes the genus name is abbreviated to its first letter (C. fenestratum). A third part of the species name, often omitted, is the authority who first proposed the name, e.g. the freshwater drum, Aplodinotus grunniens Rafinesque. In some technical papers, the date of the original description may also be included, thus, A. grunniens Rafinesque, 1819.

With occasional exceptions these names mean something: they describe the organism (in Latin, Ictalurus means "fish cat", thus catfish, and punctatus means "spotted", in reference to the characteristic spotting on the body), or refer to its locality

(Gambusia yucatana, for the state of YucatDn), or honor a person, for example its discoverer (Cyprinodon alvarezi, for JosE Alvarez). Species names may be (1) an adjective, which must agree with the gender of the genus, e.g., Poeciliopsis (feminine) fasciata (feminine ending) -- not fasciatus (masculine) or fasciatum (neuter); (2) a noun in apposition, such as the Spanish vernacular Popoche in the combination Algansea popoche, or the translation into Spanish of the English vernacular "largemouth" in Notropis bocagrande (the endings of these names remain the same irrespective of the gender of the genus); (3) a patronym, named in honor of a personal name that is Latin or from a modern personal name that is or has been Lati ni 7ed. Examples are Eleotris **pisonis** from a person named Piso, Catostomus **clarki** after Captain William Clark, of the famous Lewis and Clark Expedition, and Xiphophorus helleri named for Prof. Karl Heller. An excellent aid to understanding and forming scientific names is by Brown (1956).

Other scientific names, those for families, orders, etc. are not italicized, but all are capitalized. Family names for fishes and other animals end in -idae (e.g., Cyprinidae, the minnows); subfamily names end in **-inae** (Cyprinodontinae) and are plural in usage (e.g., the Cichlidae are). Generic names are in the nominative singular; thus it is wrong to say "Centropomus are found".

The basic categories in the taxonomic hierarchy, used by all scientists and for all biological classifications, are phylum (Chordata), class (Osteichthyes), order (Perciformes), family, genus, and species.

A species can be thought of as all the individuals, wherever they live, that can successfully court and mate with each other and produce fertile offspring.

Subspecies are **arbitrarily** defined and none is formally recognized in this book. In the last 25 years, however, it is noteworthy that many taxa formerly regarded as subspecies now enjoy full specific status. Also arbitrarily defined are genera, families, and other higher categories. Only the species is

regarded by many to be non-athitrary, a real entity, and a pivotal concept in the study of evolution (Futuyma, 1986). In this book I have remained conservative in the use of generic names. It is well known, for example, that the American cyprinid genus Notropis, with 107 species listed by Robins et al. (1980), is not monophyletic (the included species do not possess a unique geneology), but to split off some (e.g. Cyprinella) rather than all of the natural groups makes the remainder paraphyletic. The same argument applies to Cichlasoma, which in its broadest sense may not be monophyletic, but until the entire generic concept is properly evaluated, the remaining species of **Cichlasoma** become paraphyletic. It is the species, not the genera, that are of interest to those using this book. I therefore retain the generic names Notropis, **Arius**, and **Cichlasoma**, as constituted prior to recent proposals to split these into two or more genera.

The great virtue of **scientific** names is that they are more precise and widespread than common names: the same organisms bear the same names in all countries. Even in China and Russia, which use different alphabets (and **very** different common names!), the names are the same and given in the Roman alphabet, used for this purpose throughout the world.

Laymen are often greatly upset (and scientists too) when scientific names have to be changed. Research and discovery never cease, and, in practice, scientists often disagree on which genus a species belongs to, or even on whether a named species is valid. If two species are combined into one, the older name is used for the union. This is called the Law of Priority. If a person subsequently gives a different name to a species that proves still later to belong to an already named species, the second name is called a synonym and is placed in synonymy.

Unlike scientific names, common names are not subject to rules and anyone can coin them. An excellent guide for doing this carefully, developed over many years, is that given in the 5th edition of Common and Scientific Names for Fishes from the United States and Canada (Robins et **al.**, 1990). For species only occurring in Mexico I have tried to find currently used Spanish

vernaculars, but many small Mexican fishes have no common names and I have either coined some (as for the popular splitfins, family Goodeidae) or not used any.

Gaps in knowledge of Mexican fishes that need filling are briefly outlined: (1) the complete life history is not known for any Mexican freshwater fish; behavioral studies have thus far emphasized only certain **cyprinodontiforms (Cyprinodon**, goodeids, some poeciliids); (2) generic revisions are badly needed as the phylogeny of major groups is inadequately known; (3) more geological research on Cenozoic history (especially Miocene to Pleistocene), using "hard-rock" geology, paleolimnology, paleohydrology, modern dating methods and faunal/floral correlations are needed to help solve the complex evolutionary history of biotas and terrain; (4) the need to maintain the great biodiversity in Mexico's aquatic ecosystems has become urgent with the knowledge that already twenty-two kinds of fishes have either become extinct (12, with 2 extinct genera) or extirpated (10) from the country. Effective conservation measures are needed to slow and halt such losses.

It is hoped that this book will stimulate the filling of these gaps. I regard this work as a stepping stone to future knowledge.

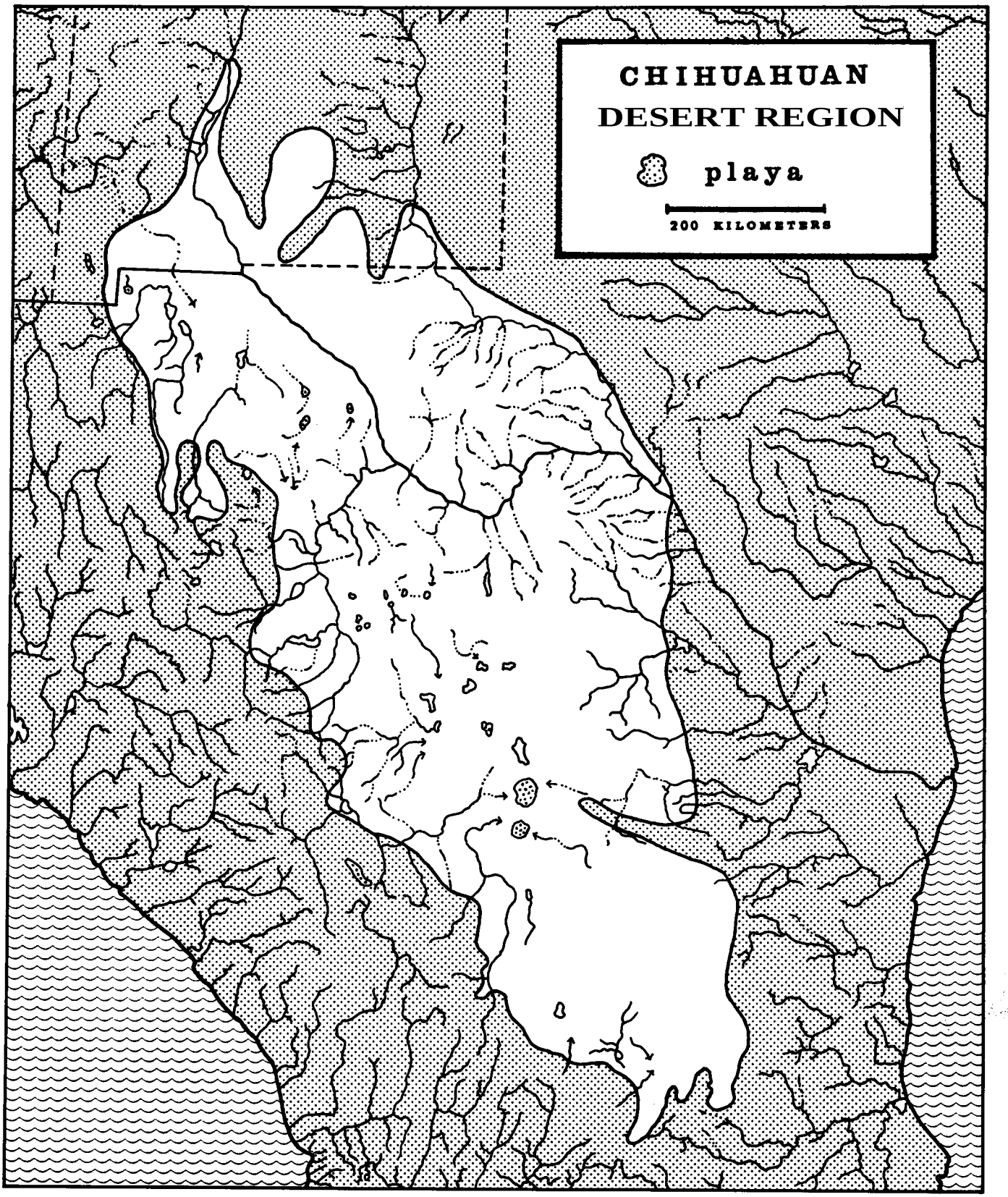
The Generic Name of the American Mountain Mullet (Agonostomus monticola) and the Number of American Species

Robert Rush Miller

The genus Agonostomus is based on A. telfairii Bennett (1831, Proc. Comm. Sci. Corresp. Zool. Soc. London, pt. 1:166) from Mauritius, that lives also on Reunion, Madagascar, and the Comoro Islands (Boulenger 1916:99-100, fig. 60; Pellegrin 1933:182-183, fig. 100). A second species from this region, A. dobuloides Valenciennes (in Cuvier and Valenciennes 1836:171), may not be valid. Otherwise, "mountain mullets" are confined to the New World, from southeastern and southern United States through many Caribbean Islands and Mexico into Colombia and Venezuela in the Atlantic drainage, and from the Gulf of California southward along the mainland of Middle America into central Panama and the Galapagos Islands in the Pacific. Schultz (1946:385) erred in listing the genus from New Zealand and New South Wales (=Aldrichetta Whitley 1945) and his "one record" from Hawaii is of doubtful provenance. Regan (1906-08:66) recognized six American species but subsequent workers (e.g., Meek and Hildebrand 1916:333-336) have relegated most of these to the synonymy of Agonostomus monticola (Bancroft in Cuvier 1834). Seale (1932) described Agonostomus hancocki on the basis of two specimens from Chatham (=San Cristobal) Island in the Galapagos, but did not compare it with any other species. More than 30 years ago Hubbs (1953:146) wrote that "... the genus Agonostomus is in great need of revision". No such revision has been made nor is one presented here. The object of this account is to determine (1) whether a single genus, Agonostomus, should be used for these essentially freshwater mullets in both the New World and certain islands of the Weste;m Indian Ocean or whether the American form or forms should be separated as the genus Dajaus, and (2) whether there is more than one valid American species. Ebeling (1961), among others (Hubbs 1953, Follett 1960, Gilbert 1978:40) was uncertain if more thjan one

valid species occurs in the eastern Pacific and what name (or names) is applicable.

Agonostomus and the related genus Joturus are primarily freshwater fishes (only prejuveniles are marine) found in swift, clear streams, in rapids and at the base of waterfalls. They have considerable food value.


CHIHUAHUAN
DESERT REGION
playa
200 KILOMETERS