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A LIST OF THE FRESHWATER AND ANADROMOUS FISHES OF CALIFORNIA [1]

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This list is the second revision of the check list of the freshwater, anadromous, and euryhaline fishes of California published by Shapovalov and Dill (1950) and first revised by Shapovalov, Dill, and Cordone (1959). The present list consists of a main list of native and established exotic species and five supplementary lists: (i) native species extinct in California, (ii) exotic species unsuccessfully introduced or of uncertain status, (iii) marine fishes successfully introduced into the Salton Sea, (iv) forms and names new to the main list since 1959, and (v) forms and names removed from the main list since 1959. The main list is composed of 124 full species, comprising 66 native freshwater and anadromous species, 13 native euryhaline or marine species which occasionally penetrate into fresh water, and 45 introduced species. The 124 species comprise 25 families and 64 genera.

INTRODUCTION

Two previous editions of this list have been published (Shapovalov and Dill 1950; Shapovalov, Dill, and Cordone 1959). Since publication of the 1959 list, many changes have occurred in both the composition of this fauna and the nomenclature applied to many of its fishes.

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First, a number of fishes have been introduced into the State. Some of these have been introduced by the California Department of Fish and Game as part of its research and management program. Others have been introduced illegally, either deliberately or inadvertently, especially by sportsmen and aquarists, or through escape from ornamental fish farms.

Second, some forms have become extinct in State waters.

Third, some new forms have been described and the taxonomic or nomenclatural status of a number of others has been revised. Some of these revisions have been made in the direction of condensation, simplification, and uniformization of group names; others have been in the opposite direction of greater diversification. With full recognition that opinions on taxonomy and nomenclature may differ decidedly, we have attempted to include in the list all revisions that have been proposed in scientific publications and not subsequently refuted.

The list itself is preceded by several introductory sections. Those entitled "Scientific Names" and "Common Names", which are of a background nature, are printed here with little change from our previous list.

PURPOSE

Two major objectives in publishing a check list of California freshwater and anadromous fishes were cited in the 1950 edition and reiterated in the first revision (1959). These were to: (i) establish the basis for compilation of a detailed handbook of these fishes, and (ii) promote stability and uniformity in both their common and scientific names. Publication of a key to these species by Kimsey and Fisk (1960) and especially, the publication of "Inland Fishes of California" by Moyle (1976), have aided in achievement of the first goal. The second objective has neared achievement with regard to common or vernacular names. However, uniformity in the nomenclature of scientific names continues as a never-to-be attained goal.

This list, like the previous ones, will of course become obsolete in time, and another edition will be necessary. We suggest that its future authors, or any who propose to publish local, state, or nationwide lists, can materially advance stability in fish nomenclature by attempting to resolve differences through consultation with those who have authored existing lists. We have done this consistently, have invariably met with cooperation, and have thereby resolved most nomenclatural problems.

SCIENTIFIC NAMES

In scientific naming, stability is largely dependent upon the thoroughness and care of the taxonomist. Any proposed revisions must be carefully evaluated. For example, Schultz (1957:48–49) stated:

"The evaluation of generic characters and recognition of genera is possible only when a comprehensive study is made of a family on a world-wide basis and when there is established the nature of the similarities and differences among groups of species. . .

"The problem of how far to progress nomenclatorially in recognizing generic categories must be resolved in a practical manner so that biologists are not presented with a confusion of ill-defined genera. Usually this confusion and lack of agreement among ichthyologists and fishery biologists results from inadequate studies of a family. Obviously, no dependable solution is possible on how many

genera and subgenera to recognize in a family until the zoological relationships of all its species have been adequately compared morphologically, physiologically, and as to habits. No doubt, after this work has been done, a middle of the road or even a conservative attitude on the number of phyletic lines to name would meet with general acceptance. Too often in ichthyology there is a tendency either to unite genera without adequate study or to establish new genera without any attempt to review the family. The least confusion results if the present status of each genus in a family is retained until such time as it is thoroughly studied."

We are in accord with this opinion but believe that the ideas expressed are applicable to species and subspecies as well. Subspecies in particular are subject to much lumping and partitioning, at times without secure evidence. Some ichthyologists have questioned the existence of certain forms in our list while, on the other hand, they have proposed hitherto unknown forms for inclusion. In almost every case, we have let the decision hinge on the appearance in the literature of substantiating data. The publication of new scientific names and elimination of familiar ones without sufficient supporting evidence simply creates further confusion in fish nomenclature.

Bailey (1956:328–329) has given considerable thought to the problem of subspecies: "... the common taxonomic practice of dividing geographically variable species into named races, or subspecies, has been subjected to critical scrutiny. It has been noted that the pattern of geographic variation in some species takes the form of a rather gradual and progressive gradient, termed a cline. It is now agreed by many taxonomists that despite the high biological significance of this type of variation it is undesirable to assign subspecific names on the basis of clinal gradients. . .

"Commonly the differences between geographic subspecies are slight and are best expressed as average conditions applying to a considerable fraction of individuals, but not to all. It is my revised opinion that acceptable subspecies should evidence high uniformity over the respective ranges and should differ one from another with high constancy. Zones of intergradation should be rather narrow. If they are wide the variation merges insensibly into a clinal gradient. . .

"The ichthyologist, in studying material, often perceives differences among populations from various parts of the geographic range of a species. Such discoveries may presage the definition of validly recognizable subspecies. The premature use of such information without publication of the full data is disconcerting to other workers, who are unable to evaluate the basis for the action. The different stocks sometimes turn out to be fully distinct species. . ."

Another excellent discussion of the subject which supplements the above statements was presented by Bailey, Winn, and Smith (1954:148-150). The following excerpt seems particularly pertinent:

"Many clinal variations in the morphology of fishes may be caused partly or wholly by gradients of environmental factors, especially temperature. The assumption that all taxonomic characters, such as meristic counts, are governed solely by genetic factors is no longer tenable. . . Whether the gradient is caused by heredity or the environment, we reject the practice of establishing subspecies on characters that show clinal variation. Furthermore, the insistence that a cline be a perfectly smooth gradient, we regard only as an academic problem. Minor irregularities are to be anticipated because of local genetic emphasis, sampling

errors, environmental variations that impose structural change, and other vagaries."

We concur in the statements above and in keeping with them have employed binomials instead of trinomials wherever sufficient published evidence exists to show that a cline truly exists. This has been done, for example, for *Notemigonus crysoleucas* (Hart 1952: 33-38, *77;* Bailey et al. 1954: 123-124, 149); and *Ictalurus punctatus* (Bailey et al. 1954: 130). Subspecific partitioning of many species in the main list may be of questionable validity; however, we retain the status quo and await the publication of evidence showing whether the trinomials are justified.

Scientific names used in this list conform to the provisions of the International Code of Zoological Nomenclature, 1964, and subsequent amendments.

Space does not permit an explanation of each change in scientific names used in bringing this list up to date. However, most of the major changes are discussed in appropriate text sections. Recourse to the references will provide further details. Some of the more important relatively recent references include: Miller (1958), Bond (1961), Walker, Whitney, and Barlow (1961), Bailey and Bond (1963), Rosen and Bailey (1963), Bailey and Uyeno (1964), Smith (1966), Hubbs (1967), Kljukanov (1970), Hopkirk (1973), Ross (1973), Moyle (1976), and Hubbs, Follett, and Dempster (1979).

COMMON NAMES

Stability in common names can best be achieved by adhering closely to a workable set of criteria, as outlined below.

The selection of common names for fishes in this list is complicated by two somewhat paradoxical factors: the multiplicity of names which have already been applied to certain species and, in the case of certain other forms, the dearth of common names. Thus, members of the genus *Cyprinodon* have been called by such varied names as desert minnow, desert killifish, pursy minnow, pygmy fish, and pupfish. Conversely, a large number of native cyprinids are so similar and indistinctive in appearance that the layman has never recognized their specific differences nor called them by any name other than the rather general ones, such as chub or shiner. This list attempts to reconcile such difficulties by assigning one official common name to each species and subspecies.

The basic rules or criteria for the selection of common names remain essentially identical with those presented in our previous lists. Such guides are necessary to prevent arbitrary selection based on personal preference, and have again proved of practical value in the objective establishment of the revised common names. Insofar as possible, we have adhered to them, as follows:

1. Names should agree with those in actual common use; or when there is no common or vernacular use, with those in published literature. Strictly "book names" should be avoided.
2. Names should agree, if possible, with those in other authoritative lists, especially those of the Committee on Names of Fishes of the American Fisheries Society (Robins et al. 1980) and Hubbs et al. (1979).
3. Names should indicate relationship and not confuse it.
4. Names should be descriptive.
5. Preference should be given to names which are short, distinctive, interesting, catchy, romantic, or euphonious.

Each of these qualifications has exceptions which make it useless by itself. Therefore, each principle listed above should be read as though it were prefaced by the words, "Other considerations being equal . . ." For example, the name Sacramento perch does not meet either Rule 3 or 4 above, since this species (*Archoplites interrupt4* is not a true perch. However, since this name is so commonly used (Rule 1) and since it agrees fully with the name used in lists such as those cited in Rule 2, it would be foolish to select another.

Aside from such considerations, in this revision, as in the previous one, we have attempted continued advancement of the twin ideals of stability for individual names and the designation of relationships through the selection of common names according to a definite plan. Such aims, long recognized by ornithologists, are well exemplified by the names listed in "The Distribution of the Birds of California" (Grinnell and Miller 1944). Thus, in our list, wherever possible the same basic common name has been given to all members of a single genus, with prefixes added to that common name for each full species of that genus. In the case of subspecies, additional prefixes have been added to the specific name. For example, all members of the genus *Gila* have been termed chub, members of the *Gila bicolor* group have been termed tui chub, and each subspecies of that group is further designated by an additional term such as Mohave for *G.b. mohavensis,* the Mohave tui chub.

It should be noted that this method will permit the retention of at least part of the common name even if the species or subspecies undergoes a revision which will change the scientific name. This, in part, answers the criticism of the Committee on Names of Fishes of the American Fisheries Society (Robins et al. 1980): "The practice of applying a name to each genus, a modifying name for each species, and still another modifier for each subspecies, while appealing in its simplicity, has the defect of inflexibility." Further, "If a fish is transferred from genus to genus, or shifted from species to subspecies or vice versa, the common name should nevertheless remain unaffected. It is not a primary function of common names to indicate relationship."

We contend, nevertheless, that an important and vital function of common names is to reveal rather than confuse relationships. It is quite true that some of the most deeply rooted vernaculars are completely misleading; little can now be done in these cases to establish meaningful names. Furthermore, when a name is entered in an official list it should not be changed unless there are important reasons to do so. However, changing a name to demonstrate the proper relationship of a form known to professional fisheries people but unfamiliar to laymen does not present a serious problem and to us is justifiable. In any event, long usage of both the first and present revisions has shown that the system is workable and has meaning, with no major difficulties encountered.

Some authors; e.g., Robins et al. (1980) and Alden H. Miller (Grinnell and Miller 1944), believe that generally only full species deserve common names. Nevertheless, we have listed common names for each subspecies, with full recognition that a number of them may not endure. One reason prompting this decision is that certain subspecies have been distinguished as entities almost from the beginning, and it would seem unfortunate to obscure (through omission) such names as Paiute or Kamloops.

It should also be noted that a number of systematists have disagreed with certain of our groupings; e.g., that for the native trouts, in which assignment to

specific or subspecific status is, in some instances, original with the authors. However, a firm nomenclature has never been developed for some of these plastic groups. And, as we have stated before, even after some decided changes in scientific nomenclature, most of our common names can still be retained with enough recognizable parts to promote stability.

SCOPE

The main list covers both native and successfully established exotic species. The supplementary lists include native species believed to be extinct in California and exotic species unsuccessfully introduced or of uncertain occurrence.

We have attempted to include all native forms whose occurrence has been reported and not disproved in the literature, as well as those verified through examination of collections. The existence of some of these as valid species or subspecies (*Catostomus occidentalis lacusanserinus,* for example) has been questioned by some workers. Our criterion for inclusion of such forms is very simple: we have tried to include all forms whose taxonomic identity has not yet been disproved in published literature.

Possibly certain other records of occurrence are based on misidentification. Possibly some of the native species are no longer a part of our fauna. Native forms which now appear to be extinct in State waters include *Salvelinus malma, S. confluentus, Gila crassicauda, G. elegans,* **Pogonichthys** *ciscoides, Ptychocheilus lucius,* **Cyprinodon** *nevadensis calidae,* and *C. n. shoshone.* It is practically impossible, however, to prove or disprove such suppositions. Hence, in the case of the native species it has been thought best to err on the side of inclusiveness and continue them in the main list. On the other hand, only those exotic or introduced species of which breeding populations are known to have survived are included in this list.

Fishes recorded only from outside California have not been included even if the stream in question flows into or out of this State; e.g., the Klamath and Truckee rivers. However, in the case of the Colorado River, a boundary stream, fishes recorded from the Arizona side of the stream have been included.

Hybrids have also been omitted. Both interspecific and intergeneric hybrids of a number of the species listed have been recorded from the natural waters of California (see, for example, Hubbs and Miller 1943).

Marine Fishes Successfully Introduced into the Salton Sea

Most of the fishes in the main list are strictly freshwater or anadromous. For the sake of completeness, we have also listed those marine and brackishwater species which we know have penetrated into fresh water. Strictly marine species from the Gulf of California which have been introduced into and have successfully spawned in the Salton Sea, an inland body of water with salinity exceeding that of ocean water are, however, omitted from the main list. They are included below, since they have established breeding populations in an inland body of water. The history of these introductions by the California Department of Fish and Game has been related by Anon. (1958) and Walker et al. (1961).

HAEMULIDAE-grunt family

Anisotremus davidsonii (Steindachner)—sargo

Introduced in 1951. The first sargo known to have been spawned in the Sea, a juvenile young-of-the-year, was taken in October 1956. The first verified catch

of an adult was made on 17 September 1958. Since then sargo up to 305 mm in length have been taken in considerable numbers by sport fishermen.

SCIAENIDAE—croaker family

Bairdiella icistia (Jordan and Gilbert)—bairdiella

First introduced in October 1950, the population of bairdiella is now very large.

Cynoscion xanthulus Jordan and Gilbert—orangemouth corvina

First introduced in October 1950, it is now present in large numbers, and like the sargo and bairdiella, should remain so unless the salinity of the Sea becomes too high.

The shortfin corvina, *Cynoscion parvipinnis,* also introduced in 1950, established a breeding population but has not been observed for a number of years.

Forms and Names New to the Main List Since 1959

Numerous changes in scientific and common names have taken place since the 1959 check list was prepared. Changes involving common names and minor revisions in scientific names are not discussed. Forms and scientific names not listed in or differing from those listed in the 1959 check list are included in this revised edition, with a brief explanation for their inclusion. Included are 19 species and subspecies of exotic fishes which have become established in California waters since 1959.

Although the California freshwater fish fauna has been studied for many years, some undiscovered species may remain. Collecting in coastal fresh waters may uncover additional euryhaline forms. Taxonomists may be expected to continue to describe new forms but at a lesser rate than in the past. For example, some taxonomists have recognized a trout from northern California as a distinct species and have proposed the common name of redband trout, but have not yet published a scientific name (Hoopaugh 1974). The escape or release into the wild of tropical and other ornamental fishes may be anticipated and some of these may become established.

And, although such activities have a much lower priority now than in the past, the introduction of exotic game and forage fishes by the California Department of Fish and Game may also result in addition of other species. The fish management program of the Inland Fisheries Branch includes an evaluation of the various aquatic habitats and what might constitute the most suitable game and/or forage species, either native or exotic, for them. Each potential import is thoroughly studied and screened to insure against detriment to existing aquatic resources.

PETROMYZONTIDAE—lamprey family

Lampetra folletti (Vladykov and Kott)—Modoc brook lamprey

Vladykov and Kott (19766) described this nonparasitic species of lamprey from the Klamath River system in Modoc County, California, as *Entosphenus folletti.* We follow Hubbs (1971) in treating *Entosphenus* as a subgenus of *Lampetra.*

Lampetfa hubbsi (Vladykov and Kott)—Kern brook lamprey

Vladykov and Kott (1976*a*) described this nonparasitic species of lamprey from the Friant-Kern Canal, east of Delano, San Joaquin Valley, as *Entospbenus hubbsi.* We follow Hubbs (1971) in treating *Entosphenus* as a subgenus of *Lampetra.*

fampetra lethophaga Hubbs—Pit-Klamath brook lamprey

The addition of this species is based on its description by Hubbs (1971). It is found in the drainage basin of the Pit River in northeastern California, and in the upper Klamath River in south-central Oregon. In the past it has been misidentified as *Lampetra planeri* and *Entosphenus tfidentatus.*

Lampetra pacifica Vladykov-Pacific brook lamprey

This small, nonparasitic lamprey was described as a new species by Vladykov (1973). In California, it is recorded from various streams in the Sacramento-San Joaquin River system. It is quite similar to *L. richafdsoniand* may not be specifically distinct from it. Before 1973 it had frequently been recorded as *L. planeri* or *L. richardsoni.*

Lampetra richardsoni Vladykov and Follett—western brook lamprey

Vladykov and Follett (1965) described this new nonparasitic species of lamprey from " . . . streams of British Columbia, Washington, Oregon, and possibly Alaska". Follett subsequently informed J. D. Hopkirk that the range of the western brook lamprey was more recently known to include California (Hopkirk 1973:20). Various authors had previously listed it as *L. planeri,* the name used in our 1959 check list, but now removed from our main list.

Lampetra tridentata (Gairdner)—Pacific lamprey

The Pacific lamprey was listed as *Entosphenus tfidentatus* in our 1950 and 1959 check lists, but we now follow Hubbs (1971) in treating *Entosphenus* as a subgenus of *Lampetfa.*

ACIPENSERIDAE—sturgeon family

Acipenser medirostris medirostris Ayres—American green sturgeon

We follow Lindberg and Legeza (1965:33) in recognizing this subspecies. In our 1959 check list we listed only the full species, *Acipenser medirostris* Ayres.

CLUPEIDAE—herring family

Clupea harengus pallasii Valenciennes-Pacific herring

In our 1959 list the Pacific herring was listed as *Clupea pallasii.* However, Svetovidov (1952) has shown that this form is actually a subspecies of *C. harengus.*

OSMERIDAE—smelt family

Hypomesus nipponensis McAllister-freshwater smelt

This species was introduced into California from Japan as a forage fish (air shipment of eggs) in 1959 (Wales 1962). At the time it was misidentified as *H. olidus.* This strictly freshwater species has since become firmly established in at least several waters in California.

Hypomesus transpacificus McAllister—delta smelt

In his revision of the smelt family, McAllister (1963) described this new species, known only from the lower parts of the Sacramento and San Joaquin rivers. It had previously been referred to in the literature as *Hypomesus olidus,* the name we used in our 1959 check list.

McAllister described two subspecies, *H. transpacificus transpacificus* and *H. transpacificus nipponensis.* However, we follow Kljukanov (1970) in treating the two as distinct species.

COREGONIDAE—whitefish family

Prosopium williamsoni (Girard)—mountain whitefish

Our 1959 list placed this species in the genus *Coregonus.* We now follow Norden (1961), who described the characters separating the two genera.

SALMONIDAE—salmon and trout family

Salmo clarkii pleuriticus Cope—Colorado River cutthroat trout

This subspecies was dropped from the main list in our 1959 check list because published reports of its occurrence in the Salton Sea were dubious. The reported specimens may have been misidentified; in any case, if correctly identified they almost certainly consisted of individuals washed into the basin from the Colorado River many years ago. No specimens from the Salton Sea are known to exist in any collections.

On 11 September 1974, the California Department of Fish and Game collected 21 specimens of this subspecies from the lower three of the five Williamson Lakes of the southern Sierra Nevada. These trout were descendant from a 1931 plant of Colorado River cutthroat trout fry hatched from eggs taken from Trapper's Lake, Colorado (Gold, Gall, and Nicola 1978).

Salvelinus confluentus (Suckley)—bull trout

Although the view that the Dolly Varden, *Salvelinus malma,* is the only recognizable member of the genus in the American northwest has been widely accepted, the subject has been a matter of some controversy for over a century. Morton (1970) concluded that *S. malma* was the only valid species and that there were no valid subspecies. More recently, Cavender (1978) presented morphometric, meristic, osteological, and distributional evidence to support his view that there are two widely distributed forms of *Salvelinus* native to the western United States and Canada: the Dolly Varden, *S. malma,* and the bull trout, *S. confluentus.* He records both species from the McCloud River drainage in California, although his only record from there of *S. malma* consists of two specimens in the National Museum of Natural History (then U.S. National Museum) labeled as having been sent by Livingston Stone from the McCloud River in 1877. It is on the basis of this publication that we have included both species in our main list, even though we think it virtually inconceivable that both species could have coexisted within the confines of the McCloud River.

CYPRINIDAE—carp or minnow family

Gila bicolor (Girard)—tui chub

Bailey and Uyeno (1964) changed the name of this species from *Siphateles bicolor,* the name used in our 1959 check list, to *Gila bicolor.*

Gila bicolor mohavensis (Snyder)—Mohave tui chub

Although this fish had been accorded full species rank for many years, Miller (1973) regarded it as a subspecies because he was unable to discover characters that would separate it specifically from all populations of *Gila bicolor* in the Lahontan Basin.

Gila bicolor snyderi Miller-Owens tui chub

This subspecies was described by Miller (1973). In our previous check list it was listed as *Siphateles bicolor obesus.* It is confined to the isolated Owens Valley in eastern California.

Gila bicolor thalassina (Cope)—Goose Lake tui chub

This subspecies was not included in the 1950 and 1959 check lists because of the belief that it was extinct in Goose Lake, Modoc County (Hubbs and Miller 1948:70–71). A prolonged drought (1929-1934), when Goose Lake was virtually dry, may have led Hubbs and Miller to this conclusion. Recent collections made by T. J. Mills (Calif. Dep. Fish and Game, pers. commun.) revealed that this chub is once again abundant in Goose Lake. Its identity as *G. b. thalassina* was confirmed by C. E. Bond (15 August 1978 letter to T. J. Mills).

Gila bicolor vaccaceps Bills and Bond—Cowhead Lake tui chub

Tui chubs from Cowhead Lake, Modoc County, were first recognized as distinct by Hubbs and Miller (1948) and ultimately described by Bills and Bond (1980). The Lake is now dry and the chubs are confined to the small outlet slough.

Gila coerulea (Girard)—blue chub

This species, from the Klamath River system, was listed in our 1959 check list as *Gila bicolor.* Bailey and Uyeno (19644) have explained why it should be called *G. coerulea.*

Gila elegans Baird and Girard—bonytail chub

In our 1959 check list we used the name *Gila robusta,* and treated the form from the Colorado River as a subspecies, *G. robusta elegans. G. robusta elegans* is regarded as having specific status by Minckley and Deacon (1968) and Hopkirk (1973:32).

Hesperoleucus symmetricus mitrulus Snyder—upper Pit western roach
Hesperoleucus symmetricus navarroensis Snyder—Navarro western roach
Hesperoleucus symmetricus parvipinnis Snyder—Gualala western roach
Hesperoleucus symmetricus venustus Snyder—Venus western roach

In our 1959 check list these subspecies were accorded full specific rank. We now concur with Moyle (1976:180) and Hubbs et al. (1979) that they should be treated as subspecies of *H. symmetricus.* Hopkirk (1973: 48-51) discusses some of the taxonomic problems involved and the need for a thorough revision of the genus.

Lavinia exilicauda chi Hopkirk—Clear Lake hitch

Hopkirk (1973:55–56) described this subspecies from Clear Lake in central California, separating it from *Lavinia exilicauda exilicauda* of previous authors. He remarked that it ". . . is a lake-adapted subspecies with a high number of gill rakers. In this respect, it agrees with *Pogonichthys ciscoides* and *Hysterocarpus traskii lagunae* from Clear Lake basin."

Pogonichthys ciscoides Hopkirk—Clear Lake splittail

Hopkirk (1973:30–31) described this species from Clear Lake in central California, distinguishing it from *Pogonicbthys macrolepidotus* of previous authors. He noted that it ". . . is a lake-adapted species with fine gill rakers, terete body, terminal mouth, and small fins."

CATOSTOMIDAE—sucker family

Catostomus fumeiventris Miller—Owens sucker

This species was described by Miller (1973). Originally confined to the Owens Valley in eastern California, it has been introduced into June Lake in the Mono Lake Basin, and possibly into the Santa Clara River Basin by way of the Los Angeles Aqueduct.

Catostomus luxatus (Cope)—Lost River sucker

We follow Hubbs et al. (1979) in placing the species listed in our 1959 edition as *Deltistes luxatus* in the genus *Catostomus.*

Catostomus occidentalis humboldtianus Snyder—Humboldt western sucker

Catostomus occidentalis mniotiltus Snyder—Monterey western sucker

These subspecies were treated as full species in our 1959 list. They are currently recognized as subspecies of *Catostomus occidentalis* (Hopkirk 1973:69; Moyle 1976214, Hubbs et al. 1979).

Catostomus platyrhynchus (Cope)—mountain sucker

In our 1959 check list we listed *Pantosteus lahontan,* Lahontan mountain sucker. Smith (1966) united *Pantosteus platyrhynchus* and *P. lahontan* as *Catostomus ptatyrhynchus.*

Catostomus santaanae (Snyder)—Santa Ana sucker

In our 1959 check list this species was listed as *Pantosteus santaanae* Snyder. Smith (1966) relegated *Pantosteus* to a subgenus of *Catostomus.*

COBITIDIDAE—loach family

Misgurnus anguillicaudatus (Cantor)—oriental weatherfish

On 12 April 1968, J. A. St. Amant collected loaches in a portion of the Westminster flood control channel, Orange County (St. Amant and Hoover 1969). Identified as *Misgurnus anguillicaudatus* by C. L. Hubbs, this was the first verified record of free-living loaches in California. Their source is believed to be the Pacific Goldfish Farm, from which some loaches escaped into the channel as early as the 1930's. A thriving population was present upstream from the original collection site in 1977 and another population was discovered in the adjacent Bolsa Chica Channel in 1979 (F. G. Hoover, pers. commun.).

ICTALURIDAE—North American freshwater catfish family

Ictalurus furcatus (Lesueur)—blue catfish

The blue catfish is presently established in four reservoirs and several ponds in San Diego and Riverside counties and several ponds at the Imperial Wildlife Area in Imperial County. The initial plant of blue catfish in California was made by the California Department of Fish and Game in October 1966, when 1,758 fish from Stuttgart, Arkansas, were released in Lake Jennings, San Diego County (Richardson et al. 1970). A single 1.7-kg specimen was collected from the San Joaquin River near Mossdale, San Joaquin County, in December 1978 by the Department's Bay-Delta Study (Taylor 1980). Currently about 20 commercial fish farmers in California are licensed to rear and sell this species.

Pylodictis ofivaris (Rafinesque)—flathead catfish

A collection of four young-of-the-year specimens from the Highline Canal and its tributaries, near Niland, Imperial County, constituted the first California record for this species (Bottroff, St. Amant, and Parker 1969). They were probably progeny from the original introduction by the Arizona Came and Fish Department of 600 fish into the Colorado River above Imperial Dam. The flathead catfish is now common in the Colorado River and adjacent waters from Imperial Dam upstream to Headgate Rock Dam near the town of Parker. It is also common in the All American Canal system, including various drains and canals in Imperial Valley.

CYPRINODONTIDAE—killifish family

Cyprinodon milleri LaBounty and Deacon—Cottonball Marsh pupfish

LaBounty and Deacon (1972) described this pupfish from Cottonball Marsh, located in an isolated sector of the northwest portion of Death Valley. Previously these pupfish had been considered to be a population of *C. salinus.*

Lucania parva (Baird)—rainwater killifish

Hubbs and Miller (1965) describe the establishment of this cyprinodont in streams and sloughs tributary to San Francisco Bay and in Irvine Lake, Orange County. With respect to the Bay, where it was first recorded in 1958, the authors state, "It is obvious that *Lucania parva* has become well established about San Francisco Bay and contiguous waters, with vast increase in numbers and in range." However, only a few specimens (three in November 1963 and six in June 1964) were taken from Irvine Lake and the status of this population is unknown. Another population was discovered in 1976 in Arroyo Seco Creek, a tributary of Vail Lake, Riverside County (McCoid and St. Amant 1980).

POECILIIDAE—livebearer family

Poecilia latipinna (Lesueur)—sailfin molly

In our 1959 check list we listed *Mollienesia latipinna. Mollienesia* was synonymized with *Poecilia* by Rosen and Bailey (1963). The 1959 report mentioned that this species was established in canals and ditches tributary to the Salton Sea. It is now by far the most abundant species in these habitats, as well as in the shallow margins of the Sea itself (Black 1980).

Poecilia mexicana mexicana (Steindachner)—Orizaba shortfin molly

The Orizaba shortfin molly has been established in the Salton Sea area for many years. It was first reported in 1964 from a small pond and its tributary about 8 km north of the Salton Sea (St. Amant 1966). Further collections were made in this general area in subsequent years.

Populations of shortfin mollies have persisted in scattered locations in the drains and natural watercourses entering the Salton Sea and in the margins of the Sea itself (Black 1980). Although much less abundant and widespread here than the sailfin molly, *Poecilia latipinna,* it may nevertheless be considered a permanent member of the fish fauna in these waters.

Poeciliopsis gracilis (Heckel)—Porthole livebearer

Mearns (1975) reported the collection of four specimens of this species on 27 July 1974, from an irrigation canal near Mecca, Riverside County. He suggested the common name porthole livebearer. The specimens were identified by C. L. Hubbs. Later in the year Mearns collected additional specimens at the same site. The presence of recently born young, the wide range of sizes, and the persistence of the fish for at least a 4-month period suggested that *P. gracilis* was a reproducing resident of this canal. Introduction was presumably through direct release by aquarists or escapement from a nearby tropical fish farm. Additional collections of this species from the same canal have been made as late as 1980 (J. A. St. Amant, pers. commun.).

ATHERINIDAE-silverside family

Menidia audens Hay-Mississippi silverside

The Mississippi silverside was introduced into the Blue Lakes and Clear Lake in Lake County in 1967 to test its effectiveness in controlling the Clear Lake gnat and chironomid midges (Cook and Moore 1970). These fish were obtained from Lake Texoma, Oklahoma. The Blue Lakes plant was authorized by the Fish and Came Commission whereas the Clear Lake plant was not. About 6,000 fish were released in Upper Blue Lake and 3,000 in Lower Blue Lake and Clear Lake. Within a year progeny from the original plant were abundant in the last two waters, and since then a virtual population explosion of silversides has taken place.

A combination of experimental introductions by the Department of Fish and Game, illegal introductions by bait fishermen, and dispersal via man-made waterways has resulted in wide distribution of this species. Moyle, Fisher, and Li (1974) reported the presence of silversides in Putah and Cache creeks in Yolo County and in eight reservoirs and ponds in Alameda and Santa Clara counties. Collections described by Meinz and Mecum (1977) demonstrated the occurrence of an abundant, reproducing population in the Sacramento-San Joaquin Delta. From here they have ready access to the California Aqueduct, the Delta-Mendota Canal, and associated water storage and conveyance systems and eventually southern California reservoirs.

SYNGNATHIDAE-pipefish family

Syngnathus leptorhynchus Cirard-bay pipefish

The bay pipefish has been recorded from the mouth of the San Lorenzo River, Santa Cruz County, and from the Navarro River, Mendocino County (Moyle 1976:283).

COTTIDAE—sculpin family

Cottus perplexus **Gilbert and Evermann-reticulate sculpin**

A collection of reticulate sculpins was made from the Middle Fork of the Applegate River (Rogue River drainage) in California on 2 March 1971, by F. H. Everest and recorded by Bond (*1973*). *Cottus perplexus* is the most abundant representative of the genus in the Rogue. It is not known from coastal streams south of the Rogue.

Cottus pitensis Bailey and Bond—Pit sculpin

Bailey and Bond (1963) described this sculpin as a new species. This common species of the Pit river system in northeastern California had been collected frequently over the years but had been considered to be *Cottus gulosus,* except by Bond (1961), who treated it as an undescribed species.

PERCICHTHYIDAE—temperate bass family

Morone chrysops (Rafinesque) —white bass

Von Geldern (1966) described the original introductions of white bass into California by the California Department of Fish and Game, under the name *Roccus chrysops.* We follow Robins et al. (1980) and others in placing this species in the genus *Morone,*

About 160 fingerlings were planted in Nacimiento Reservoir, San Luis Obispo County, in November 1965 and 64 adults were released into the same water in February 1966. The fingerlings were obtained from Lake McConaughy in Nebraska and the adults from Tenkiller Reservoir in Oklahoma. Additional plants in Nacimiento included 600 yearlings and adults in July 1968 from Lahontan Reservoir in Nevada and 200 adults in February 1967 from Utah Lake in Utah. The Nacimiento population is now well established.

The California Department of Fish and Game and the Arizona Game and Fish Department cooperated in a series of plants of white bass in the lower Colorado River in 1968 and 1969. However, the species failed to become established in this location.

The popularity of white bass at Nacimiento Reservoir has led to illegal introductions into other waters of the State. One such water is Kaweah Reservoir, Tulare County, where it is firmly established.

Morone saxatilis (Walbaum)—striped bass

In the 1959 list this species was listed as *Roccus saxatilis.* We follow Robins et al. (1980) and others in placing it in the genus *Morone.*

CENTRARCHIDAE—sunfish family

Lepomis gulosus (Cuvier)—warmouth

The warmouth was designated *Chaenobryttus gulosus* in our 1959 list. However, for reasons described by Bailey et al. (1970:75), we believe that *gulosus* should be regarded as a species of *Lepomis.*

L epomis macrochirus purpurescens Cope—southeastern bluegill

In June 1975, 88 adult southeastern bluegill were stocked in Perris Lake,

Riverside County, by the California Department of Fish and Game (Henry 1979). They were obtained through the cooperation of the Florida Game and Fresh Water Fish Commission from one of its hatcheries. They have reproduced and are firmly established. Specimens collected from Perris Lake have been stocked in several small ponds for experimental purposes and use as broodstock for future plants.

Micropterus coosae Hubbs and Bailey—redeye bass

Kimsey (1954) recorded the original importation into California of 40 redeye bass for use as broodstock by the California Department of Fish and Game at Central Valleys Hatchery, Elk Grove, California. In reviewing the history and status of this introduction (Kimsey 1957) concluded, "No redeye bass were planted in the open waters of the State and none are now present in California."

A second attempt to establish the redeye bass in California was successful (Goodson 1966). Broodstock imported from Tennessee and Georgia in the spring of 1968 spawned successfully at Central Valleys Hatchery, and their progeny were stocked in seven widely separated waters: Lake Oroville, Butte County; Alder Creek, Sacramento County; South Fork Stanislaus River, Tuolumne County; Dry Creek, Nevada County; Santa Ana River, Riverside County; Sisquoc River, Santa Barbara County; and Santa Margarita River, San Diego County. Several thousand fingerlings and yearlings were stocked in these waters. It appears that only the Lake Oroville and South Fork Stanislaus River populations are firmly established (Lambert 1980). The remainder apparently did not survive.

Micropterus punctulatus henshalli Hubbs and Bailey—Alabama spotted bass

This subspecies is thriving in Perris Lake, Riverside County. The original introduction consisted of 94 2-year-olds stocked by the California Department of Fish and Game in January 1974 (Brown, Aasen, and von Geldern 1977). An additional 29 fish were taken to the Department's Central Valleys Hatchery to provide a broodstock. These spotted bass were collected by the Alabama Department of Conservation and Natural Resources from Lewis Smith Lake, Alabama.

Reproduction of the bass held at Central Valleys Hatchery provided fish for a second introduction into Perris Lake in August 1974. In late 1974 between 2,000 and 3,000 fingerlings from this hatchery were stocked in Millerton Lake, Fresno County. In early 1975, this plant was supplemented with 150 adults collected from Perris Lake. Another 300 adults and subadults collected from Perris Lake in March and April 1977 were released in San Vicente Reservoir, San Diego County. Both the Millerton and San Vicente populations are successfully established. Additional bass from Perris have since been stocked in New Hogan Reservoir, Calaveras County; Lake Isabella, Kern County; and Lake Oroville, Butte County.

Micropterus salmoides salmoides (Lacepède)—northern largemouth bass

Micropterus salmoides floridanus (Lesueur)—Florida largemouth bass

The nominate subspecies is the form widely distributed throughout the State. The Florida largemouth bass was imported into California in May 1959. A shipment of about 20,400 fingerlings from Holt State Fish Hatchery near Pensacola, Florida, was planted in upper Otay Reservoir, San Diego County, on an experimental basis (Sasaki 1961; Bottroff and Lembeck 1978). A self-sustaining population was soon established and transplants were made to other San Diego County reservoirs. It is now established in other waters in the State.

PERCIDAE-perch family

Percina macrolepida Stevenson-bigscale logperch

In our 1959 check list we listed and described the introduction of ***Percina caprodes,*** the logperch, into California. Since then, Stevenson (1971) described the bigscale logperch from Texas. Subsequent examination of specimens from California revealed them to be ***P. macrolepida*** rather than ***P. caprodes*** (Sturgess 1976).

EMBIOTOCIDAE-surfperch family

Hysterocarpus traskii traskii Gibbons-Sacramento tule perch
Hysterocarpus traskii lagunae Hopkirk-Clear Lake tule perch
Hysterocarpus traskii porno Hopkirk-Russian River tule perch

Hopkirk (1973:83–92) revised the genus ***Hysterocarpus.*** He described the tule perch from the Russian River as a new subspecies and remarked, "The subspecies *pomo* is adapted for existence in small rivers. In body shape and in certain meristic characters, it represents an evolutionary parallel, not a relative, of the nominate subspecies," In his description of the new subspecies of tule perch from the Clear Lake Basin in central California, Hopkirk noted that it ". . . is adapted for pelagic or lacustrine existence, as evidenced by the attenuate body, higher number of gill rakers, and silvery coloration." Remaining populations in the State are apparently referable to the nominate subspecies.

CICHLIDAE—cichlid family

Tilapia mossambica Peters-Mozambique tilapia

The first breeding population of this tilapia species in California was discovered in 1964 in a small pond and its tributary near the Salton Sea in Imperial County (St. Amant 1966). This population, which may no longer exist, originated from a nearby tropical fish farm (Sargent's). Subsequent authorized introductions in various ponds and waterways in the late 1960's and early 1970's for mosquito and aquatic weed control, plus unauthorized introductions and natural movement of fish from one area to another, have culminated in the establishment of the Mozambique tilapia in southern California.

Hoover and St. Amant (1970) observed free-living populations of *T. mossambica* in irrigation canals and drains in Bard Valley, Imperial County, in 1968. They remain abundant there as well as in similar habitat in the Palo Verde Valley, Imperial and Riverside counties. Isolated populations have been reported from drains in the Imperial Valley, Imperial County, and the Coachella Valley, Riverside County. Lake Elsinore in Riverside County and the Salton Sea support abundant, reproducing populations. The identity of this tilapia from the Salton

Sea, however, remains uncertain, having been variously identified as *T. mossambica* or *T. aurea.*

In recent years *T. mussambica* has established breeding populations in a series of watercourses entering the Pacific Ocean in Orange and Los Angeles counties (Knaggs 1977). They are concentrated in the estuarine portions of various flood control channels and channelized river beds such as the Los Angeles, Santa Ana, and San Gabriel rivers.

Tilapia zillii (Gervais)—redbelly tilapia

The redbeffy tilapia was one of three tilapia species authorized by the Fish and Came Commission in 1971 for use in California. Its purported ability to control aquatic weeds was responsible for the interest in this species. During the early 1970's, it was stocked in several ponds in central California and in numerous ponds, canals, and drains in southern California. Except for the very southeastern corner of the State, it was believed that *T. zillii* could not survive winter temperatures and that small fish would have to be introduced periodically to achieve weed control. Howver, until killed by the exceptionally cold winter of 1972-73, they overwintered in the central California ponds. It was this unexpected tolerance to cold temperatures that prompted the Fish and Game Commission in 1974 to place the redbefly tilapia on the prohibited species fist for that portion of the State north of the Tehachapi Mountains.

Stocking in southern California, on the other hand, led to the permanent establishment of *T. zillii* and the likelihood of further spread of this highly adaptable species. They are abundant and breeding in all drains entering the Salton Sea and are also abundant in the Sea itself (Black 1980). They are likely to be encountered in certain canals and ditches in Bard and Imperial valleys, Imperial County, and in the Coachella Valley, Riverside County. Breeding populations have been discovered in four backwaters of the Colorado River downstream from the Palo Verde Diversion Dam and in Lake Cahuilla, Riverside County. Two specimens have been reported from the marine environment near Huntington Beach and in Newport Bay, Orange County (Knaggs 1977).

GOBIIDAE—goby family

Acanthogobius flavimanus (Temminck and Schlegel)—yellowfin goby

This species was first collected by personnel of the California Department of Fish and Game in the San joaquin River off Prisoners Point on 18 January 1963 (Brittan, Albrecht, and Hopkirk 1963). It soon spread rapidly (Brittan et al. 1970) and is now widely established in the Sacramento-San Joaquin Delta, the San Francisco Bay area, and various coastal lagoons. The origin of these fish is not known; they may have been carried in a ship's seawater system.

Tridentiger trigonocephalus (Gill)—chameleon goby

Miller and Lea (1972), who list this species as occurring in the shallows of both Los Angeles Harbor and San Francisco Bay, state that it was inadvertently introduced from the Orient. Moyle (1976:344) remarks that it, ". . . has not yet been collected in fresh water in California but can be expected there, since it occurs in brackish Lake Merritt in Oakland and in the lower reaches of streams in its native Asia." Hubbs and Miller (1965:44), however, refer to data indicating that Lake Merritt is a freshwater fake, although it connects directly with San Francisco Bay.

Forms and Names Removed from the Main List Since 1959

PETROMYZONTIDAE-lamprey family

L ampetra planeri (Bloch)-brook lamprey

Several different species of "brook lampreys" in California have been listed or identified as *Lampetra planeri* and we included this species in our 1959 list. It should be removed from California faunal lists as it is a European form not found in North America (W. I. Follett, pers. commun.).

OSMERIDAE—smelt family

Hypomesus olidus (Pallas) -pond smelt

The fish we listed in our 1959 check list under this name has since been described as a new species, *H. transpacificus,* by McAllister (1963).

SALMONIDAE-salmon and trout family

Salmo clarkii evermanni Jordan and Grinnell-San Gorgonio cutthroat trout

After finding a record that cutthroat trout from Lake Tahoe had been planted in the southern California stream from which ***Salmo evermanni*** was later obtained, Benson and Behnke (1961) closely compared the "type" and two "cotypes" of ***evermanni*** with specimens of ***Salmo*** *clarkii henshawi* from Lake Tahoe. They found no significant differences and concluded that ***evermanniwas*** a synonym.

Salmo *gairdnerii regalis* Snyder-royal silver rainbow trout

La Rivers (1962) questioned the taxonomic validity of both *S. g. regalis* of Lake Tahoe and *S. g. smaragdus* of Pyramid Lake. He argues convincingly against the acceptance of these rainbow subspecies as Great Basin endemics, believing that the specimens examined by Snyder (1914, 1918) were probably either introduced rainbow or rainbow-cutthroat hybrids. Widespread stocking of rainbow trout in the Lahontan system beginning in the 1860's was likely the original source of these specimens.

One of us (Cordone) collected 226 rainbow trout from the limnetic zone of Lake Tahoe in the early 1960's. Seventy-three of these were marked fish, survivors from plants of hatchery-reared rainbow. Many of these specimens, both marked and unmarked, possessed the phenotypic appearance of the royal silver trout noted by Snyder (1918), "It is distinguished by the absence of spots, by the blue or green dorsal surface, the silvery sides and white belly, and the loose scales which, when the fish is caught, adhere to the fingers like bits of foil." Behnke (1972) examined some of these specimens and concluded, "The silvery, smoltlike appearance, supposedly diagnostic for S. *regalis* can be duplicated by hatchery rainbow trout after a period of life in Lake Tahoe."

CYPRINIDAE—carp or minnow family

Pimephales promelas *confertus* (Girard)—southwestern fathead minnow

We follow Taylor (1954:42) and Vandermeer (1966:465) in not recognizing subspecies in *Pimephales promelas,* primarily because most of the variation over

its range appears to be clinal. Even if subspecies were recognized, the populations of the fathead minnow in California are from such diverse out-of-state localities that it would be difficult to single out subspecies.

Plagopterus argentissimus Cope—woundfin

Inclusion of this spiny-rayed cyprinid in our previous check lists was based on its occurrence in the Gila River to its mouth at Yuma, just across the Colorado River from California (Gilbert and Scofield 1898). It has now, however, been removed from the present list because it has not been taken even in the lower Gila River since 1894 (Miller and Lowe 1964), is known today only from the Virgin River system (Miller and Hubbs 1960; Minckley 1973:115), and there are no records of its actual occurence in California. It may be noted, however, that Miller and Lowe (1964) state that it has been used as a baitfish on the "lower Colorado River".

Rhinichthys osculus carringtonii (Cope)—Pacific speckled dace

W. I. Follett (pers. commun.) states: "We are not recognizing ***Rhinichthys osculus carringtonii*** (originally described from Warm Springs, Box Elder County, Utah) as occurring in California. Dr. Hubbs now regards as a misidentification ***Agosia nubila carringtonii*** Culver and Hubbs, 1917, Lorquinia, 1 (2):83, from Santa Ana River, California." On this basis we are dropping this form from our list.

Siphateies bicolor formosus (Girard)—Sacramento tui chub

If this were a valid subspecies, its current name would be *Gila bicolor formosa*. Moyle (1976:164) comments on it as follows: "The name *G. b. formosa* was originally applied to tui chubs that were supposed to have lived in the Sacramento-San Joaquin Valley. Since only a few poorly preserved specimens of the form are known, the subspecies may be based on a mislabeled collection (C. L. Hubbs, pers. commun.)." For these reasons, we are dropping this form from the main list.

CATOSTOMIDAE—sucker family

Catostomus latipinnis Baird and Girard—flannelmouth sucker

This species, native to the Colorado River system, is now found only in Salt River Canyon, the Virgin River, and the mainstem Colorado River upstream from Lake Mead (Minckley 1973:157). Like *Plagopterus argentissimus*, it may never have occurred in the California portion of the Colorado River except for an occasional specimen washed down from upstream waters.

Ictiobus cyprinella (Valenciennes)—bigmouth buffalo

This exotic species was included in the first two lists on the basis of its occurrence in several reservoirs of the Los Angeles Aqueduct system in Los Angeles and Inyo counties following its illegal introduction in the 1940's, presumably by commercial fishermen (Evans 1950). However, none has been collected from these waters since the late 1960's and they probably no longer exist in the State (F. G. Hoover, pers. commun.). Since this species, along with the black buffalo, *Ictiobus niger*, and the smallmouth buffalo, *Ictiobus bubalus*, are present

in Arizona waters, they may be expected on occasion to find their way into the lower Colorado River and connected waters. On the basis of a photograph, C. L. Hubbs and J. A. St. Amant identified a specimen collected from a waterway in southern California in 1969 as *I. bubalus.*

Pantosteus lahontan Rutter—Lahontan mountain-sucker

Smith (1966) united *Pantosteus lahontan* and *P. platyrhynchus* as *Catostomus platyrhynchus,* which replaces *P. lahontan* in our present list.

ICTALURIDAE—North American freshwater catfish family

Ictalurus melas melas (Rafinesque)—northern black bullhead

Ictalurus natalis natalis (Lesueur)—northern yellow bullhead

Ictalurus nebulosus nebulosus (Lesueur)—northern brown bullhead

We follow Hubbs et al. (1979) and Bailey (1956:328–329; pers. commun.) in dropping recognition of these trinomials. They probably represent only clinal variations.

CENTRARCHIDAE—sunfish family

Micropterus dolomieu dofomieu Lacepède—northern smallmouth bass

We follow Hubbs et al. (1979) and Bailey (1956:328–329; pers. commun.) in dropping recognition of this trinomial. It probably represents only clinal variation.

ELEOTRIDIDAE—sleeper family

Eleotris picta Kner and Steindachner—spotted sleeper

This species was added to the 1959 list on the basis of a single specimen caught by a fisherman at the canal spillway between Winterhaven and the Colorado River in Imperial County on 16 April 1952 (Hubbs 1953). However, none has been taken from California waters since that time (Minckley 1973:259; Moyle 1976:70).

REVISED MAIN LIST
Native Species and Established Exotic Species

This revised list consists of 124 full species, which may be subdivided as follows: 66 native freshwater and anadromous species (including 6 which are probably extinct), 13 native euryhaline or marine species which occasionally penetrate into fresh water, and 45 introduced species. The 124 species comprise 25 families and 64 genera.

Species which have been introduced into California waters are denoted by an asterisk (*), marine or euryhaline fishes which occur occasionally in fresh water by an "O", and extinct species by a dagger (†).

PETROMYZONTIDAE—lamprey family

1. *Lampetra ayresii* (Günther)—river lamprey
2. *Lampetra folletti* (Vladykov and Kott)—Modoc brook lamprey
3. *Lampetra hubbsi* (Vladykov and Kott)—Kern brook lamprey
4. *Lampetra lethophaga* Hubbs—Pit-Klamath brook lamprey
5. *Lampetra pacifica* Vladykov-Pacific brook lamprey
6. *Lampetra richardsoni* Vladykov and Follett-western brook lamprey
7. *Lampetra tridentata* (Gairdner)—Pacific lamprey

ACIPENSERIDAE-sturgeon family

8. *Acipenser medirostris* Ayres-green sturgeon
   8a. *Acipenser medirostris medirostris* Ayres-American green sturgeon
9. *Acipenser transmontanus* Richardson-white sturgeon

ELOPIDAE-tenpounder family

10. *Elops affinis* Regan-machete 0

CLUPEIDAE-herring family

11. *Alosa sapidissima* (Wilson&-American shad *
12. *Clupea harengus* Linnaeus-herring 0
    12a. *Clupea harengus pallasii* Valenciennes-Pacific herring 0
13. *Dorosoma petenense* (Gunther)-threadfin shad *

OSMERIDAE-smelt family

14. *Hypomesus nipponensis* McAllister-freshwater smelt *
15. *Hypomesus pretiosus* (Girard)—surf smelt 0
16. *Hypomesus transpacificus* McAllister—delta smelt
17. *Spirinchus thaleichthys* (Ayres)—longfin smelt 0
18. *Thaleichthys pacificus* (Richardson)—eulachon

COREGONIDAE-whitefish family

19. *Prosopium williamsoni* (Girard)—mountain whitefish

SALMONIDAE-salmon and trout family

20. *Oncorhynchus gorbuscha* (Walbaum)—pink salmon
21. *Oncorhynchus keta* (Walbaum)—chum salmon
22. *Oncorhynchus kisutch* (Walbaum)—coho salmon (silver salmon)
23. *Oncorhynchus nerka* (Walbaum)—sockeye salmon' (anadromous form); kokanee salmon (freshwater form •)
24. *Oncorhynchus tshawytscha* (Walbaum)—chinook salmon (king salmon)
25. *Salmo aguabonita* Jordan-golden trout
    25a. *Salmo aguabonita aguabonita* Jordan-South Fork Kern golden trout
    25b. *Salmo aguabonita whitei* Evermann-Little Kern golden trout
26. *Salmo clarkii* Richardson-cutthroat trout
    26a. *Salmo clarkii clarkii* Richardson—coast cutthroat trout
    26b. *Salmo clarkii henshawi* Gill and Jordan-Lahontan cutthroat trout
    26c. *Salmo clarkii pleuriticus* Cope-Colorado River cutthroat trout
    26d. *Salmo clarkii seleniris* Snyder-Paiute cutthroat trout
27. Salmo gairdnerii Richardson-rainbow trout
    27a. *Salmo gairdnerii gairdnerii* Richardson-steelhead rainbow trout
    27b. *Salmo gairdnerii aquilarum* Snyder-Eagle Lake rainbow trout
    27c. *Salmo gairdnerii gilberti* Jordan-Kern River rainbow trout
    27d. *Salmo gairdnerii kamloops* (Jordan)--Kamloops rainbow trout *
    27e. *Salmo gairdnerii stonei* Jordan—Shasta rainbow trout
28. *Salmo trutta* Linnaeus-brown trout *
29. *Salvelinus confluentus* (Suckley)—bull trout †
30. *Salvelinus fontinalis* (Mitchill)—brook trout *
31. *Salvelinus malma* (Walbaum)—Dolly Varden †
32. *Salvelinus namaycush* (Walbaum)—lake trout *
    32a. *Salvelinus namaycush namaycush* (Walbaum)—common lake trout *

CYPRINIDAE—carp or minnow family

33. *Carassius auratus* (Linnaeus)—goldfish *
34. *Cyprinus carpio* Linnaeus—common carp *
35. *Gila bicolor* (Girard)—tui chub
    35a. *Gila bicolor bicolor* (Girard)—Klamath tui chub
    35b. *Gila bicolor mohavensis* (Snyder)--Mohave tui chub
    35c. *Gila bicolor obesa* (Girard)—Lahontan coarseraker tui chub
    35d. *Gila bicolor pectinifer* (Snyder)-Lahontan fineraker tui chub
    35e. *Gila bicolor snyderi* Miller-Owens tui chub
    35f. *Gila bicolor thalassina* (Cope)—Goose Lake tui chub
    35g. *Gila bicolor vaccaceps* Bills and Bond—Cowhead Lake tui chub

36. *Gild coerulea* (Girard)—blue chub
37. *Gila crdssicdudd* (Baird and Girard)—thicktail chub †
38. *Gild elegans* Baird and Girard-bonytail chub †
39. *Gila orcuttii* (Eigenmann and Eigenmann)—arroyo chub
40. *Hesperoleucus symmetricus* (Baird and Girard)—western roach
    40a. *Hesperoleucus symmetricus symmetricus* (Baird and Girard)-Sacramento western roach
    40b. *Hesperoleucus symmetricus mitrulus* Snyder-upper Pit western roach
    40c. *Hesperoleucus symmetricus navarroensis* Snyder-Navarro western roach
    40d. *Hesperoleucus symmetricus parvipinnis* Snyder—Gualala western roach
    40e. *Hesperoleucus symmetricus subditus* Snyder-Monterey western roach
    40f. *Hesperoleucus symmetricus venustus* Snyder-Venus western roach
41. *Lavinia exilicauda* Baird and Girard-hitch
    41a. *Lavinia exilicauda exilicauda* Baird and Girard-Sacramento hitch
    41 b. *Lavinia exilicauda chi* Hopkirk—Clear Lake hitch
    41c. *Lavinia exilicauda hdrengus* Girard-Monterey hitch
42. *Mylopharodon conocephalus* (Baird and Girard)—hardhead
43. *Notemigonus crysoleucas* (Mitchill)—golden shiner *
44. *Notropis lutrensis* (Baird and Girard)—red shiner •
45. *Orthodon microlepidotus* (Ayres)—Sacramento blackfish
46. *Pimephales promelas* Rafinesque—fathead minnow *
47. *Pogonichthys ciscoides* Hopkirk—Clear Lake splittail †
48. *Pogonichthys macrolepidotus* (Ayres)—Sacramento splittail
49. *Ptychocheilus grandis* (Ayres)—Sacramento squawfish
50. *Ptychocheilus lucius* Girard—Colorado squawfish †
51. *Rhinichthys osculus* (Girard)—speckled dace
    51a. *Rhinichthys osculus ktdmdthensis* (Evermann and Meek)-Klamath speckled dace
    51 b. *Rhinichthys osculus nevddensis* Gilbert-Amargosa speckled dace
    51c. *Rhinichthys osculus robustus* (Rutter)—Lahontan speckled dace
52. *Richardsonius egregius* (Girard)—Lahontan redside
53. *Tinca tinca* (Linnaeus)—tench •

CATOSTOMIDAE-sucker family

54. *Catostomus fumeiventris* Miller-Owens sucker
55. *Catostomus luxatus* (Cope)—Lost River sucker
56. *Catostomus microps* Rutter-Modoc sucker
57. *Catostomus occidentalis* Ayres-western sucker
    57a. *Catostomus occidentalis occidentalis* Ayres-Sacramento western sucker
    57b. *Catostomus occidentalis humboldtianus* Snyder-Humboldt western sucker
    57c. *Catostomus occidentalis lacusanserinus* Fowler—Goose Lake western sucker
    57d. *Catostomus occidentalis mniotiltus* Snyder-Monterey western sucker
58. *Catostomus platyrhynchus* (Cope&mountain sucker
59. *Catostomus rimiculus* Gilbert and Snyder-Klamath smallscale sucker
60. *Cdtostomus sdntddnde* (Snyder)-Santa Ana sucker
61. *Catostomus snyderi* Gilbert-Klamath largescale sucker
62. *Catostomus tdhoensis* Gill and Jordan-Tahoe sucker
63. *Chdsmistes brevirostris* Cope-shortnose sucker
64. *Xyrauchen texanus* (Abbott&humpback sucker

COBITIDIDAE—loach family

65. *Misgurnus anguillicaudatus* (Cantor)—Oriental weatherfish *

ICTALURIDAE-North American freshwater catfish family

66. *Ictalurus catus* (Linnaeus)—white catfish *
67. *Ictalurus furcatus* (Lesueur)—blue catfish *
68. *Ictalurus melas* (Rafinesque)—black bullhead *
69. *Ictalurus natalis* (Lesueur)—yellow bullhead *
70. *Ictalurus nebulosus* (Lesueur)—brown bullhead *
71. *Ictalurus punctatus* (Rafinesque)—channel catfish *
72. *Pylodictis olivaris* (Rafinesque)—flathead catfish *

CYPRINODONTIDAE—killifish family

73. *Cyprinodon macularius* Baird and Girard-desert pupfish
74. *Cyprinodon milleri* LaBounty and Deacon—Cottonball Marsh pupfish
75. *Cyprinodon nevadensis* Eigenmann and Eigenmann-Nevada pupfish
    75a. *Cyprinodon nevadensis nevadensis* Eigenmann and Eigenmann--Saratoga Nevada pupfish
    75b. *Cyprinodon nevadensis amargosae* Miller-Amargosa Nevada pupfish
    75c. *Cyprinodon nevadensis calidae* Miller-Tecopa Nevada pupfish †
    75d. *Cyprinodon nevadensis shoshone* Miller-Shoshone Nevada pupfish †
76. *Cyprinodon radiosus* Miller-ens pupfish
77. *Cyprinodon salinus* Miller-Salt Creek pupfish
78. *Fundulus parvipinnis* Girard—California killifish
    78a. *Fundulus parvipinnis parvipinnis*—southern California killifish
79. *Lucania parva* (Baird and Girard)—rainwater killifish *

POECILIIDAE—livebearer family

80. *Gambusia affinis* (Baird and Girard)—mosquitofish *
    80a. *Gambusia affinis affinis* (Baird and Girard)—western mosquitofish •
81. *Poecilia latipinna* (Lesueur)—sailfin molly *
82. *Poecilia mexicana* Steindachner-shortfin molly *
    82a. *Poecilia mexicana mexicana* Steindachner—Orizaba shortfin molly *
83. *Poeciliopsis gracilis* (Heckel)—porthole livebearer *

ATHERINIDAE-silverside family

84. *Atherinops affinis* (Ayres)—topsmelt 0
85. *Menidia audens* Hay-Mississippi silverside •

GASTEROSTEIDAE-rtickleback family

86. *Gasterosteus aculeatus* Linnaeus-threespine stickleback
    86a. *Gasterosteus aculeatus aculeatus* Linnaeus-armored threespine stickleback
    86b. *Gasterosteus aculeatus microcephalus* Girard-semiarmored threespine stickleback
    86c. *Gasterosteus aculeatus williamsoni* Cirard-unarmored threespine stickleback

SYNGNATHIDAE—pipefish family

87. *Syngnathus leptorhynchus* Girard-bay pipefish 0

COTTIDAE—sculpin family

88. *Clinocottus acuticeps* (Gilbert)-sharpnose sculpin 0
89. *Cottus aleuticus* Gilbert—coastrange sculpin
90. *Cottus asper* Richardson-prickly sculpin
91. *Cottus asperrimus* Rutter-rough sculpin
92. *Cottus beldingii* Eigenmann and Eigenmann-Paiute sculpin
93. *Cottus gulosus* (Girard)—riffle sculpin
94. *Cottus klamathensis* Gilbert-marbled sculpin
95. *Cottus perplexus* Gilbert and Evermann-reticulate sculpin
96. *Cottus pitensis* Bailey and Bond-Pit sculpin
97. *Leptocottus armatus* Girard-Pacific staghorn sculpin 0
    97a. *Leptocottus armatus armatus* Girard-northern Pacific staghorn sculpin 0
    97b. *Leptocottus armatus australis* Hubbs-southern Pacific staghorn sculpin 0

PERCICHTHYIDAE-temperate bass family

98. *Morone chrysops* (Rafinesque)—white bass *
99. *Morone saxatilis* (Walbaum)—striped bass *

CENTRARCHIDAE-sunfish family

100. *Archoplites interruptus* (Girard)—Sacramento perch
101. *Lepomis cyanellus* Rafinesque—green sunfish •
102. *Lepomis gibbosus* (Linnaeus)—pumpkinseed *
103. *Lepomis gulosus* (Cuvier)—warmouth *
104. *Lepomis macrochirus* Rafinesque—bluegill •
    104a. *Lepomis macrochirus macrochirus* Rafinesque-northern bluegill •
    104b. *Lepomis macrochirus purpurescens* Cope-southeastern bluegill *
105. *Lepomis microlophus* (Günther)—redear sunfish *
106. *Micropterus coosae* Hubbs and Bailey-redeye bass •

107. *Micropterus dolomieu* Lacepède—smallmouth bass •
108. *Micropterus punctulatus* (Rafinesque)—spotted bass *
108a. *Micropterus punctulatus punctulatus* (Rafinesque)—northern spotted bass *
108b. *Micropterus punctulatus henshalli* Hubbs and Bailey-Alabama spotted bass *
109. *Micropterus salmoides* (Lacepède)—largemouth bass *
109a. *Micropterus salmoides salmoides* (Lacepède)—northern largemouth bass *
109b. *Micropterus salmoides floridanus* (Lesueur)—Florida largemouth bass *
110. *Pomoxis annularis* Rafinesque-white crappie *
111. *Pomoxis nigromaculatus* (Lesueur)—black crappie *

PERCIDAE-perch family

112. *Perca flavescens* (Mitchill)—yellow perch *
113. *Percina macrolepida* Stevenson-bigscale logperch *

EMBIOTOCIDAE-surfperch family

114. *Cymatogaster aggregata* Gibbons-shiner perch 0
115. *Hysterocarpus traskii* Gibbons-tule perch
115a. *Hysterocarpus traskii traskii* Gibbons-Sacramento tule perch
115b. *Hysterocarpus traskii lagunae* Hopkirk—Clear Lake tule perch
11 5c. *Hysterocarpus traskii pomo* Hopkirk-Russian River tule perch

CICHLIDAE—cichlid family

116. *Tilapia mossambica* (Peters)-Mozambique tilapia *
117. *Tilapia zillii* (Gervais)—redbelly tilapia *

MUGILIDAE—gray mullet family

118. *Mugil cephdfus* Linnaeus-striped mullet 0

GOBIIDAE—goby family

119. *Acanthogobius flavimanus* (Temminck and Schlegel)—yellowfin goby *
120. *Clevelandia ios* (Jordan and Gilbert&-arrow goby 0
121. *Eucyclogobius newberryi* (Girard)—tidewater goby
122. *Gillichthys mirabilis* Cooper-longjaw mudsucker 0
123. *Tridentiger tngonocephdfus* (Gill I-chameleon goby 0 *

PLEURONECTIDAE—righteye flounder family

124. *Platichthys stellatus* (Pallas)—starry flounder 0
124a. *Platichthys stellatus rugosus* Girard-southern starry flounder 0

REVISED SUPPLEMENTARY LISTS

Native Species-Extinct in California

We have included in this section only those native species which, at least according to the literature, at one time were well established. Not included are the woundfin, *Plagopterus argentissimus,* and the flannelmouth sucker, *Catostomus latipinnis,* which rarely, if ever, entered California waters. To avoid confusion, we have also omitted, both from this and the main list, the Clear Lake minnow which was described by Hopkirk (1973:57–59) as *Endemichthys grandipinnis,* from specimens last collected in 1939 and 1940. He observed that it was apparently extinct. He is now reconsidering its generic allocation (J. D. Hopkirk, pers. commun.).

Excluding the above, we believe that the following eight native fishes no longer exist in California.

SALMONIDAE—salmon and trout family

Salvelinus confluentus (Suckley)—bull trout

Salvelinus malma (Walbaum)—Dolly Varden

These species (there is some question that at one time both existed in the McCloud River) have likely become extinct in California as a result of man-made

environmental changes and the introduction of exotic trout into the McCloud River drainage. The last known specimens, probably bull trout, were taken in 1975 (Moyle 1976:146). Intensive sampling of the McCloud River and its tributaries in recent years has failed to locate either species (S. J. Nicola, pers. commun).

CYPRINIDAE—carp or minnow family

Gila crassicauda (Baird and Girard)—thicktail chub

This chub was once common in the Central Valley, Clear Lake in Lake County, and at least one tributary to south San Francisco Bay. A combination of man-caused habitat changes and the introduction of exotic fishes has led to its apparent extinction (Miller 1963). The last known specimen was taken in 1957 from Steamboat Slough in the Sacramento River Delta (Calif. Dep. Fish and Game 1978). A report to Moyle (1976:172) that a specimen was collected from Cache Slough, near Rio Vista, in 1958 was in error (P. B. Moyle, pers. commun.).

Gila elegans Baird and Girard-bonytail chub

This species, listed in our 1959 list as *Gila robusta elegans,* Colorado River bonytail chub, has not been found in the California portion of the Colorado River in recent years and may be considered extinct in the State (Colorado River Wildlife Council 1977; Calif. Dep. Fish and Game 1978).

Pogonichthys ciscoides Hopkirk-Clear Lake splittail

It was not until Hopkirk (1973) published the results of his studies that the Clear Lake splittail was recognized as a distinct species. By this time it was probably already extinct, since none had been collected since the late 1960's. Cook, Moore, and Conners (1966) described the early history of the species. It was very abundant until the early 1940's, when it declined drastically, and occasional resurgences did nothing to halt the overall decline. Habitat destruction and exotic fishes are believed responsible for its extinction.

Ptychocheilus lucius Girard—Colorado squawfish

Although still present in a few localities in the upper Colorado River drainage, the Colorado squawfish apparently has become extinct in California waters. Once abundant in the lower Colorado River, it was probably already extinct in this area by the early 1960's (Moyle 1976:195). It has not been collected there since 1952 (Calif. Dep. Fish and Game 1978). Environmental degradation and exotic fishes are again believed responsible for the loss.

CYPRINODONTIDAE-killifish family

Cyprinodon nevadensis calidae Miller—Tecopa Nevada pupfish

This subspecies, originally from north and south Tecopa Hot Springs, Inyo County, has become extinct in recent years (Moyle 1976:256) as a result of activities by man which led to destruction of its habitat.

Cyprinodon nevadensis shoshone Miller—Shoshone Nevada pupfish

This subspecies, from Shoshone Springs, Inyo County, like *C.n. calidae,* has also become extinct in recent years (Moyle 1976256) as a result of activities by man leading to destruction of its habitat.

Exotic Species-Unsuccessfully Introduced or of Uncertain Status

It is extremely difficult to establish rigid criteria for the inclusion or exclusion of fishes in the list that follows. Some situations are obvious. For example, we have included a species in this list whenever it was introduced as part of a planned program or was known to have had a large escapement of the species, say from a tropical fish farm, even if subsequent investigations have failed to locate it. On the other hand, if only a single specimen or a very few specimens, even if positively identified, were recorded, we have omitted such species from the main list but have tried to mention them below. Obviously, these are judgmental assessments.

The occurrence of a single or a few specimens of tropical or other ornamental fishes probably represents releases by home aquarists. Brittan and Grossman (1979) describe a specimen of pacu, *Colossoma* sp., native to South America, caught by an angler in 1977 from the Sacramento River in Yolo County. Another pacu was reportedly taken from the California Aqueduct in 1979 (Calif. Dep. Fish and Game, Region 5 monthly report for November 1979). Minckley (1973:185) refers to a specimen of walking catfish, *Clarias batrachus,* taken by an angler from the All American Canal in Imperial County west of Yuma, Arizona. Another specimen was taken by an angler from Legg Lake, Los Angeles County (J. A. St. Amant, pers. commun.). A South American aruana, *Osteoglossum bicirrhosum,* was caught by an angler in Lake Berryessa (Calif. Dep. Fish and Game, Region 3 news release for 18 June 1972). Two mature tiger barbs, *Barbus tetrazona,* were collected in 1963 from the small stream flowing from Warm Springs Sanctuary in Owens Valley, Inyo County (Naiman and Pister 1974). None has been taken since then, despite repeated collecting efforts.

Escapements and releases from ornamental fish farms apparently have been the source of a number of established exotics, such as *Misgurnus anguillicaudatus, Poecilia latipinna, P. mexicana,* and *Poeciliopsis gracilis.* Other ornamental species have escaped but in small numbers, and fortunately have, not established permanent populations. For example, among the exotics collected by St. Amant and Hoover (1969) from the Westminster flood control channel in Orange County in 1968 were the guppy, *Lebistes reticulatus;* green swordtail, *Xiphophorus hellerii;* southern platyfish, *X. maculatus;* variable platyfish, *X. variatus;* molly, *Poecilia sphenops;* zebra danio, *Brachydanio rerio;* and angelfish, *Pterophyllum* sp. None of these has since been taken in this channel, despite repeated collecting attempts. Mearns (1975) took a specimen of *Xiphophorus hellerii* in 1974 from a drain to the Salton Sea, and G. F. Black (pers. commun.) collected another from the same drain in 1979.

The 1959 supplementary list included 14 species of exotic bait fishes that were being used along the Colorado River (Miller 1952). None of these has become established in California and apparently they are no longer being used as bait in this area, so we have deleted them from the list that follows.

The exotic fishes listed below fall into several groups:

1. Fishes known to have been introduced but which have not survived; e.g., No. 2.
2. Fishes reported, possibly erroneously, to have been introduced, but which have not survived; e.g., No. 9.
3. Fishes which have been reported from this State but whose identification is questioned by the authors; e.g., No. 21.

4. Fishes which have not been recorded from the State for many years; e.g., No. 24.

As will be seen by our annotations, we know of no demonstrable evidence that any of them are successfully established in the fresh waters of California today.

As the general sources for the history and lack of success of most of these introductions are fairly well known, there is little point in listing all the references concerning the status of these fishes. We have alluded to specific literature only when our opinion differs from that of the authors cited, or when such inclusion serves to clarify the exact status of the species.

ANCUILLIDAE-freshwater eel family

1. *Anguilla rostrata* (Lesueur)—American eel

Introduced in 1874, 1879, and 1882. There are no authentic records of survival. However, an occasional eel is collected from various waters in the State. Skinner (1971) reported the capture of two eels from the Sacramento-San joaquin Delta. The first, taken in 1964, was identified by C. L. Hubbs as an American eel. The second, caught in 1969, was identified as a European eel, *Anguilla anguilla* Linnaeus, by W. I. Follett. Skinner suggested that the most logical explanation for the occurrence of both eels is that they were transported from abroad in the ballast of commercial ships. In 1978 an unidentified species of *Anguilla* was captured in the Los Angeles River (J. A. St. Amant, pers. commun.).

PLECOGLOSSIDAE-ayu family

2. *Plecoglossus altivelis* Temminck and Schlegel-ayu

Large numbers of eggs and fry of this native Japanese food and sport species were stocked in California on the recommendation of Dr. John W. Dewitt, Professor of Fisheries at Humboldt State University, Arcata. Following approval from the Fish and Game Commission, plants of this species were made annually from 1961 through 1965. About 3,845,000 eggs and fry were stocked during this period: 200,000 eggs and fry in Morris Lake, Mendocino County; 395,000 eggs in Ruth Reservoir, Trinity County; and 3,250,-080 eggs and fry in the Eel River below For-tuna, Humboldt County (J. W. Dewitt, pers. commun.) . No survivors were reported.

COREGONIDAE-whitefish family

3. *Coregonus clupeaformis* (Mitchill)-lake whitefish

3a. *Coregonus clupeaformis clupeaformis* (Mitchill)—Great Lakes whitefish

All introductions of this whitefish were made during the last century. Even the few old reports of recapture (circa 1880) are considered highly dubious.

4. *Prosopium gemmiferum* (Snyder)-Bonneville cisco

In January of 1964, 1965, and 1966, 21,506 spawning Bonneville cisco and about 250,000 cisco eggs were collected from Bear Lake, Utah-Idaho, and transported to Lake Tahoe (Frantz and Cordone 1965, 1967). About 205,000 green eggs, 3,000 eyed eggs and alevins, and 15,888 ripe adults were released in Lake Tahoe *over* the 3-year span. None is known to have survived.

SALMONIDAE-salmon and trout family

5. *Salmo clarkii* Richardson--cutthroat trout

5a. *Salmo clarkii lewisi* (Girard)—Yellowstone cutthroat trout

Several shipments of cutthroat trout eggs have been brought in from other states, and plants made in California waters. It is probable that most of them were S. *c. lewisi.* There are no records of survival.

6. *Salmo salar* Linnaeus-Atlantic salmon (anadromous form); landlocked Atlantic salmon (freshwater form)

Both forms have been planted several times. The old records of their survival may be dubious; there are no authentic recent records.

7. *Thymallus arcticus* (Pallas)—Arctic grayling

Several early attempts were made to introduce this form, and it apparently met with a brief success in Yosemite National Park following plants made during the 1929-1933 period. However, the last authentic report of its survival there (in Grayling Lake) appears to have been in 1934.

More recently, the California Department of Fish and Game imported large numbers of grayling eggs from Arizona and Wyoming. Resultant fry and fingerlings were stocked in one stream and 57 high mountain lakes scattered from the southern Sierra Nevada into northern California. Approximately 156,000 fish were released during the period 1969 to 1975. Good survival and growth were documented at many of these waters but actual reproduction has not been confirmed.

ESOCIDAE—pike family

8. *Esox americanus* Gmelin—redfin pickerel

8a. *Esox americanus vermiculatus* Lesueur-grass pickerel

9. *Esox lucius* Linnaeus-northern pike

E. lucius was supposedly introduced in 1891, but one of the fish resulting from this shipment was identified in 1896 as *E. vermiculatus* (now *E. a. vermiculatus*). Possibly both species were included. There are no records of capture of either species after 1896.

10. *Esox masquinongy* Mitchill-muskellunge

10a. *Esox masquinongy ohioensis* Kirtland—Ohio muskellunge

Introduced into Lake Merced, San Francisco County, in 1893. None survived.

CHANIDAE-milkfish family

11. *Chanos chanos* (Forsskål)—milkfish

Milkfish from the Hawaiian Islands were planted in a stream in Solano County in 1877. There are no records of their survival there. The species is an ocean fish which occasionally enters fresh water.

CYPRINIDAE—carp or minnow family

12. *Ctenopharyngodon idella* (Valenciennes)—grass carp

Illegal introductions of grass carp into California have been made in the past and may still be continuing. Despite the fact that this species of Chinese carp is officially prohibited in the State, and thus may not be imported,

transported, or possessed, some farm pond owners have been importing grass carp from commercial fish farmers in Arkansas and Pennsylvania. The Department has thus far uncovered four instances of grass carp introductions: 12 fingerlings were released in a small pond in Ventura County in 1975, 48 fingerlings were planted in a small pond in El Dorado County in 1975, 2,800 fingerlings and 200 0.34-kg fish were released in seven ponds on a ranch in Napa County in 1975, and 20 grass carp fingerlings were stocked in a small pond in Mendocino County in 1978. The latter plant apparently did not survive the trip from Pennsylvania, but the remaining lots from Arkansas survived and were healthy and growing rapidly until they were removed by the Department.

In May 1980 about 850 hybrids of female grass carp and males of another Chinese carp, the bighead carp, *Aristichthys nobilis,* were released in several man-made waterways in the Coachella Valley. Further releases are anticipated as part of a study to assess the aquatic weed control potential of this hybrid.

ICTALURIDAE-North American freshwater catfish family

13. *Ictalurus platycephalus* (Girard)—flat bullhead

On the basis of a survey made in 1925, Coleman (1930) recorded "The Great Blue, or Forked-Tail Cat—*Ictalurus furcatus,* Cuv. and Vincen.," and "The Brown-Spotted Cat—*Ameirus* [sic.] *platycephalus,* Girard," from Clear Lake, Lake County. Neither has been recorded from the Lake since that time, despite extensive collecting. We believe that Coleman confused *Ictalurus catus* (found in Clear Lake and often called "forked-tail catfish" or "blue cat") with his "*furcatus*". We suspect that his record of *I. platycephalus* is based upon his erroneous interpretation of fishermen's reports.

ORYZIIDAE-tooth-carp family

14. *Oryzias latipes* (Temminck and Schlegel)—medaka

The statements by Snyder (1935), "It has been found in San Francisquito Creek", and Coates (1942:185), ". . . this fish has been turned loose in parts of California, where it is reported to be thriving", are the sole bases for its admission to this list. In a conversation with Snyder on 21 March 1943, he told us (Dill) that some of his students had collected this form in San Francisquito Creek, Santa Clara County. He did not recall the date or other circumstances.

CYPRINODONTIDAE-killifish family

15. *Cynolebias bellottii* Steindachner-Argentine pearlfish

This was the most widely used of the so-called "annual fishes" stocked in several locations in the State, principally in Butte, Kern, and Riverside counties, for mosquito control purposes. Bay (1966) described the first field tests with this species at the University of California, Riverside. Survivors of the tests persisted in the Riverside ponds for 5 years despite repeated floodings and dryings but finally died out (E. F. Legner, Univ. Calif., Riverside, pers. commun.). Additional field tests with the Argentine pearlfish were described by E. C. Bay (pers. commun.). Tests in experimental ponds were conducted in 1966 and 1967 in Kern and Butte counties. The species failed

to become established.

Experimental rice plots and ponds on the grounds of the Butte County Mosquito Abatement District were the sites of tests conducted in 1973 and 1974 using the black pearlfish, *Cynolebias nigripinnis,* and White's pearlfish, *Cynolebias whitei* (K. J. Hiscox, Butte County Mosquito Abatement Dist., pers. commun.). The fish did not reproduce and the study was terminated.

POECILIIDAE-livebearer family

16. *Gambusia affinis holbrooki* Girard-eastern mosquitofish

The eastern mosquitofish has been widely distributed in the public waters of California by various mosquito abatement districts (E. F. Legner and K. J. Hiscox, pers. commun.). It is believed to be more tolerant of colder temperatures than the western mosquitofish. The two subspecies hybridize readily and in California collections of pure *G. a. holbrooki* have yet to be made in the wild.

17. *Lebistes reticulatus* (Peters)-guppy

Besides the almost certain release of guppies by tropical fish fanciers, guppies have been stocked on numerous occasions in wastewater treatment ponds throughout the State where access to public waters is possible (K. J. Hiscox, pers. commun.). In 1968 the Fish and Game Commission approved a request by the University of California, Riverside, to stock guppies in dairy and poultry waste lagoons in San Bernardino County (E. C. Bay, pers. commun.). Also in 1968, the Commission permitted the Kings Mosquito Abatement District to release guppies in lower Mill Creek in Tulare and Kings counties. None of the foregoing introductions led to the establishment of permanent populations. However, wild populations can be anticipated in suitable areas with year-round warmwater temperatures.

18. *Rivulus hartii* (Boulenger)-Trinidad rivulus

St. Amant (1970) first observed and collected this species in a small ditch near a tropical fish farm in Imperial County in 1967. It was identified by C. L. Hubbs. Additional specimens were collected in 1968 and both adults and juveniles were taken in 1969. The population has since disappeared.

19. *Xiphophorus variatus* (Meek)-variable platyfish

St. Amant and Sharp (1971) collected approximately 200 adult and juvenile *Xiphophorus variatus,* native to Mexico, from a drain ditch 6.4 km east of Oasis, Riverside County, on 24 December 1969. C. L. Hubbs confirmed the identification. This was the first record of an established population, but it has since died out.

ATHERINIDAE-silverside family

20. *Labidesthes sicculus* (Cope)—brook silverside

The brook silverside was one of five species authorized by the Fish and Came Commission in 1963–64 for introduction into experimental ponds beside Clear Lake. These ponds, plus a deep well, were constructed in 1963 by the Lake County Mosquito Abatement District "... for the express purpose of evaluating experimental fishes and their influence on biological productivity" (Cook 1968). The *Labidesthes,* obtained from Ohio, did well in one pond for 3 years and reproduced, but then died out from unknown causes.

CENTRARCHIDAE—sunfish family[4]

21. *Ambloplites rupestris* (Rafinesque)—rock bass

It is recorded in the literature as having been introduced in 1874 and again in 1891, and another record of a plant of "rock bass" in 1917 was furnished by E. H. Glidden of the then California Division of Fish and Game. Brief statements by Neale (1931) and Anon. (1934) as to its limited success in California, and its occasional listing in State fish rescue records up to 1939, are the only bases for belief that this fish ever endured. The terminology used in these rescue records (published in the Biennial Reports of the California Division of Fish and Game) has often been inexact. We have been unable to find a single verifiable record of the occurrence of the rock bass in California.

22. *Enneacanthus gloriosus* (Holbrook)—bluespotted sunfish

This species is listed in the accession list for Steinhart Aquarium as having been collected in March 1931 in the vicinity of Willows, California. The identification was made by Alvin Seale, but the specimens were not saved. We believe this to be a misidentification.

23. *Lepomis macrochirus* Rafinesque—bluegill

23a. *Lepomis macrochirus speciosus* (Baird and Girard)—southwestern bluegill

According to Miller (1952), "The southwestern bluegill . . . is also now evidently established in the Colorado River through introduction . . . *(fide* C. L. Hubbs in letter of 10 May 1951, to R. D. Beland, and letter from Beland of 23 August 1951 to W. A. Dill)." Its current status is unknown.

PERCIDAE—perch family

24. *Stizostedion vitreum* (Mitchill)—walleye

Miller (1967) summarized the history of walleye introductions in California. The first introduction occurred in 1874, when 16 fish from the Missiquoi River in Vermont were stocked in the Sacramento River near Sacramento. One was caught by an angler but nothing further was recorded from the plant.

The second attempt spanned the years 1959 to 1963, when the California Department of Fish and Game, through the cooperation of the Minnesota Conservation Department, secured large numbers of eggs from walleye captured in the Detroit River, Minnesota. About 5,350,000 fry and 34,590 fingerlings were stocked in five southern California warmwater reservoirs in 1959, 1960, 1962, and 1963. These plants were successful in that good survival and growth were experienced, but anticipated angling benefits did not accrue and the program was abandoned. Natural spawning did not take place and the original plants gradually died out.

[4] "*Lepomis euryorus* McKay". Seale (1930) lists "Sunfish, *Eupomotis euryoris*" in an article entitled, "List of twenty fresh water fishes found in California that may be used in small aquariums or garden pools." The Steinhart Aquarium accession list for 1931 records "*Apomotis euryorus*" as collected near Willows, California. The identification was made by Alvin Seale; the specimens were not saved. Hubbs and Hubbs (1932) have proved that the nominal species "*Lepomis euryorus*" is a hybrid between *Lepomis cyanellus* and *Lepomis gibbosus*. Both of these species are resident in California but *L. gibbosus* has not yet been recorded from near Willows nor do we have any records of its presence in the State as early as 1930 or 1931.

CICHLIDAE—cichlid family

25. *Cichlasoma beani* (Jordan)-green guapote

A well-established population of this species was discovered in 1975 in several small ponds adjacent to Putah Creek in Solano County by A. D. Castro, Aquarist with the California Academy of Sciences (pers. commun.). Identification was made by W. I. Follett. Sampling in 1979 did not uncover any specimens and some of the ponds were dry, so apparently the species did not survive (R. L. Reavis, Calif. Dep. Fish and Came, pers. commun.).

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REFERENCES

Anon. 1934. The rock bass (*Ambloplites rupestris*). Aquarium J. 7(10): 192

———. 1958. The Salton Sea story. Outdoor Calif. 19 (12) :4-7, 13.

Bailey, R. M. 1956. A revised list of the fishes of Iowa with keys for identification. Pages 327-377 *in* Iowa Fish and Fishing (Third edition). Iowa St. Cons. Comm.

Bailey, R. M., and C. E. Bond. 1963. Four new species of freshwater sculpins, genus *Cottus,* from western North America. Univ. Mich. Mus. Zool. Occ. Papers no. 634, 27 p.

Bailey, R. M., J. E. Fitch, E. S. Herald, E. A. Lachner, C. C. Lindsey, C. R. Robins, and W. B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada (Third edition). Amer. Fish. Soc., Special Publ. 6, 150 p.

Bailey, R. M., and T. Uyeno. 1964. Nomenclature of the blue chub and the tui chub, cyprinid fishes from western United States. Copeia 1964(1):238–239.

Bailey, R. M., H. E. Winn, and C. L. Smith. 1954. Fishes from the Escambia River, Alabama and Florida, with ecological and taxonomic notes. Proc. Acad. Nat. Sci. Phila. (106) :109–164.

Bay, E. C. 1966. Adaptation studies with the Argentine pearl fish, *Cynolebias bellottii,* for its introduction into California. Copeia 1966(4) :839–846.

Behnke, R. J. 1972. The systematics of salmonid fishes of recently glaciated lakes. Can., Fish. Res. Bd., J. 29(6):639–671.

Benson, S. B., and R J. Behnke. 1961. *Salmo evermanni* a synonym of *Salmo clarkii henshawi.* Calif. Fish Came 47(3):257–259.

Bills, F.T., and C. E. Bond. 1980. A new subspecies of tui chub (Pisces: Cyprinidae) from Cowhead Lake, California. Copeia 1980(2) :320–322.

Black, G. F. 1980. Status of the desert pupfish *Cyprinodon macularius* (Baird and Girard), in California. Calif. Dep. Fish and Came, Inland Fish. Endangered Species Program, Special Publ. BO-1, 42 p.

Bond, C. E. 1961. Keys to Oregon freshwater fishes. Agr. Expt. Sta. Oregon St. Univ. Tech. Bull. 58, 42 p.

———. 1973. Occurrence of the reticulate sculpin, *Cottus perplexus,* in California, with distributional notes on *Cottus gulosus* in Oregon and Washington. Calif. Fish Game 59(1) :93-94.

Bottroff, L. J., and M. E. Lembeck. 1978. Fishery trends in reservoirs of San Diego County, California, following the introduction of Florida largemouth bass, *Micropterus salmoides floridanus.* Calif. Fish Game 64(1):4–23.

Bottroff, L. J., J. A. St. Amant, and W. Parker. 1969. Addition of *Pylodictis olivaris* to the Californian fauna. Calif. Fish Came 55 (1):90.

Brittan, M. R., A. B. Albrecht, and J. B. [sic] Hopkirk. 1963. An oriental goby collected in the San Joaquin River Delta near Stockton, California. Calif. Fish Game 49(4) :302–304.

Brittan, M. R., and G D. Grossman. 1979. A pacu (*Colossoma,* family Characidae) caught in the Sacramento River. Calif. Fish Game 65(3) :170–173.

Brittan, M. R., J. D. Hopkirk, J. D. Conners, and M. Martin. 1970. Explosive spread of the oriental goby *Acanthogobius flavimanus* in the San Francisco Bay-Delta region of California. Proc. Calif. Acad. Sci. 38(11):207–214.

Brown, D., K. D. Aasen, and C. E. von Geldern, Jr. 1977. Alabama spotted bass grow at record rate in Lake Perris, California. Calif. Fish *Game* 63(1):60–64.

California Department of Fish and Game. 1978. At the crossroads, 1978, a report on California's endangered and rare fish and wildlife. Calif. Dep. Fish and Game x+ 103 p.

Cavender, T. M. 1978. Taxonomy and distribution of the bull trout, *Salvelinus confluentus* (Suckley), from the American northwest. Calif. Fish Game 64(3):137–174.

Coates, C. W. 1942. Tropical fishes for a private aquarium. Cleveland and New York, the World Publ. Co., xi+226 p.

Coleman, G. A. 1930. A biological survey of Clear La&e, lake County. Calif. Fish Game 16(3):221–227.

Colorado River Wildlife Council. 1977. Endemic species of the Colorado river system, a status report. Colorado River Wildl. Council, Endemic Species Committee, 16 p.

Cook, S. F., Jr. 1968. The potential role of fishery management in the reduction of chaoborid midge populations and water quality enhancements. Calif. Vector News 15 (7) :63-70.

Cook, S. F., Jr., *and* R. L. Moore. 1970. Mississippi silversides, *Menidia audens* (Atherinidae), established in California. Amer. Fish. Soc., Trans. 99(1):70–73.

Cook, S. F., jr., R. L. Moore, and J. D. Conners. 1966. The status of the native fishes of Clear Lake, Lake County, California. The Wasmann J. Biol. 24(1):141–160.

Evans, W. A. 1950. Notes on the occurrence of the bigmouth buffalo in southern California. Calif. Fish Game 36(3):332–333.

Frantz, T. C., and A. J. Cordone. 1965. Introduction of the Bonneville cisco (*Prosopium gemmiferum* Snyder) in Lake Tahoe, California and Nevada. Calif. Fish Game 51 (4):270–275.

———. 1967. Final introductions of the Bonneville cisco (*Prosopium gemmiferum* Snyder) into Lake Tahoe, California and Nevada. Calif. Fish Game 53(3):209–210.

Gilbert, C. H., and N. B. Scofield. 1898. Notes on a collection of fishes from the Colorado Basin in Arizona. Proc. U.S. Nat. Mus. 20(1131):487–499.

Gold, J. R., G. A. E. Call. and S. J. Nicola. 1978. Taxonomy of the Colorado cutthroat trout (*Salmo clarki pleuriticus*) of the Williamson Lakes, California. Calif. Fish Game 64(2):98–103.

Goodson, L. F., Jr. 1966. Redeye bass. Pages 371-373 *in* A. Calhoun, ed., Inland Fisheries Management. Calif. Dep. Fish and Game.

Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. Cooper Ornith. Club, Pac. Coast Avifauna, no. 27, 608 p.

Hart, J. S. 1952. Geographic variations *of* some physiological and morphological characters in certain freshwater fish. Univ. Toronto Pr., Univ. Toronto Biol. Ser. no. 60, Publ. Ontario Fish Res. Lab. no. 72, 79 p.

Henry, F. D., Jr. 1979. The introduction of southeastern bluegill, *Lepomis macrochirus purpurescens,* into Lake Penis, California, with notes on the growth of the initial year class. Calif. Fish Game 65 (4): 279-281. (The identical article was published in 1980 Calif. Fish Game 66(1) :62–64).

Hoopaugh, D. A. 1974. Status of the redband trout (*Salmo* sp.) in California. Calif. Dep. Fish and Game, Inland Fish. Admin. Rep. 74-7, 11 p.

Hoover, F. G., and J. A. St. Amant. 1970. Establishment of *Tilapia mossambica* Peters in Bard Valley, Imperial County, California Calif. Fish Game 56(1):70–71.

Hopkirk, J. D. 1973.[5] Endemism in fishes of the Clear Lake region of central California. Univ. Calif. Publ. Zool. 96, 135 p.

Hubbs, C. L. 1953. *Eleotris picta* added to the fish fauna of California. Calif. Fish Game 39(1) :69-76.

———. 1967. Occurrence of the Pacific lamprey, *Entosphenus tridentatus,* off Baja California and in streams of southern California; with remarks on its nomenclature. Trans. San Diego Soc. Nat. Hist. 14(21):301–312.

———. 1971. *Lampetra (Entosphenus) lethophaga,* new species, the nonparasitic derivative of the Pacific lamprey. Trans. San Diego Soc. Nat. Hist. 16(6):125–163.

Hubbs, C. L., W. I. Follett, and L. J. Dempster. 1979. List of the fishes of California. Calif. Acad. Sci. Occ. Papers "0. 133, 51 p.

Hubbs, C. L., and L. C. Hubbs. 1932. Experimental verification of natural hybridization between distinct genera of sunfishes, Papers Mich. Acad. Sci. Arts and Letters 1931(15):427–437.

Hubbs, C. L., and R. R. Miller. 1943. Mass hybridization between two genera of cyprinid fishes in the Mohave Desert, California Papers Mich. Acad. Sci. Arts and Letters 1942(28) :343–378.

———. 1948. The zoological evidence: correlation between fish distribution and hydrographic history in the desert basins of western United States. Pages 17-166 in The Great Basin, with emphasis on glacial and postglacial times. Bull. Univ. Utah 38(20), Biol Ser. 10(7):191.

[5] Actually published March 28, 1974.

_____ 1965. Studies of cyprinodont fishes XXII. Variation in *Lucania parva,* its establishment in western United States, and description of a new species from an interior basin in Coahuila, *Mexico.* Misc. Publ. Mus. Zool. Univ. Mich. no 127, 104 p.

Kimsey, J. B. 1954. The introduction of the redeye black bass and the threadfin shad into California. Calif. Fish Game 40(2):203–204.

_____. 1957. The status of the redeye bass in California. Calif. Fish Came 43 (1):99–100.

Kimsey, J. B., and L. 0. Fisk. 1960. Keys to the freshwater and anadromous fishes of California. Calif. Fish Game 46(4):453–479.

Kljukanov, V. A. 1970. Classification of smelts (Osmeridae) with respect to pecularities of skeleton structure in the genus Thaleichthys. Zool. J. 49(3):399–417. (in Russian with English summary).

Knaggs, E. H. 1977. Status of the genus *Tilapia* in California's estuarine and marine waters. Cal-Neva Wildl. (1977):60–67.

LaBounty, J. F., and J. E. Deacon. 1972. *Cyprinodon milleri,* a new species of pupfish (family Cyprinodontidae) from Death Valley, California. Copeia 1972 (4) :769–780.

Lambert, T. R. 1980. Status of Redeye bass, *Micropterus coosae,* in the South Fork Staoislaus River, California. Calif. Fish Game 66(4): 240–242.

La Rivers, I. 1962. Fishes and fisheries of Nevada. Nev. St. Fish and Game Comm., Carson City, 782 p.

Lindberg, G. U., and M. I. Legeza. 1965. Fishes of the Sea of Japan and the adjacent areas of the Sea of Okhotsk and the Yellow Sea. Part 2, Telepstomi, XII. Acipenseriformes-XXVIII. Polynemiformes. Keys to Fauna USSR, Zool. Inst. Acad. Sci. USSR, no. 84. 391 p. Israel translation, 1969. viii+389 p.

Mearns, A. J. 1975. *Poeciliopsis gracilis* (Heckel), a newly introduced poeciliid fish in California. Calif. Fish Game 61(4):251–253.

Meinz, M., and W. L. Mecum. 1977. A range extension for Mississippi silversides in California. Calif. Fish Game 63(4):277–278.

McAllister, D. E. 1963. A revision of the smelt family, Osmeridae. Nat. Mus. Can. gull. 191, 53 p.

McCoid, M. J., and J. A. St. Amant. 1980. Notes on the establishment of the rainwater killifish, *Lucania parva,* in California. Calif. Fish Game 66(2):125–126.

Miller, D. J., and R. N Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dept. Fish Game, Fish Bull. 157, 235 p.

Miller, L. W. 1967. The introduction, growth, diet, and depth distribution of walleye, *Stizostedion vitreum* (Mitchill), in El Capitan Reservoir, San Diego County. Calif. Dep. Fish and Game, Inland Fish. Admin. Rep. 67-10, 14 p.

Miller, R. R. 1952. gait fishes of the lower Colorado River from Lake Mead, Nevada, to Yuma, Arizona, with a key for their identification. Calif. Fish Game 38(1): 7–42.

_____. 1958. Origin and affinities of the freshwater fish fauna of western North America. Pages 187-222 *in* C. L. Hubbs ed., Zoogeography. Amer. Assoc. Adv. Sci. Publ. 51.

_____. 1963. Synonymy, characters, and variation of *Gila crassicauda,* a rare Californian minnow, with an account of its hybridization with *Lavinia exilicauda.* Calif. Fish Game 49 (1) :20–29.

_____. 1973. Two new fishes, *Gila bicolor snyderi* and *Catostomus fumeiventris,* from the Owens River basin, California. Univ. Mich. Mus. Zool. Occ. Papers no. 667, 19 p.

Miller, R. R., and C. L Hubbs. 1960. The spiny-rayed cyprinid fishes (Plagopterini) of the Colorado River system. Misc. Publ. Mus. Zool. Univ. Mich. no. 115, 39 p.

Miller, R. R., and C. H. Lowe. 1964. An annotated check list of the fishes of Arizona. Pages 133-151 *in* C. H. Lowe, ed., The vertebrates of Arizona. Annotated check lists of the vertebrates of the state: the species and where they live. Tuscon, Univ. of Adz. Press.

Minckley, W. L. 1973. Fishes of Arizona. Ariz. Game and Fish Dep., xv+293 p.

Minckley, W. L., and J. E. Deacon. 1966. Southwestern fishes and the enigma of "endangered species". Science 159(3822):1424–1432.

Morton, W. M. 1970. On the validity of all subspecific descriptions of North American *Salvelinus malma* (Walbaum). Copeia 1970(3):581–587.

Moyle, P. B. 1976. Inland Fishes of California. Univ. Calif. Press, Berkeley, viii+405 p.

Moyle, P. B., F. W. Fisher, and H. W. Li. 1974. Mississippi silversides and logperch in the Sacramento-San Joaquin River system. Calif. Fish Game 60(3):144–149.

Naiman, R. J., and E. P. Pister. 1974. Occurrence of the tiger barb, *Barbus tetrazona,* in the Owens Valley, California. Calif. Fish Came 60(2):100–101.

Neale, G. 1931. The spiny-rayed game fishes of the California inland waters. Calif. Fish Game 17(1):1–17.

Norden, C. R. 1961. Comparative osteology of representative salmonid fishes, with particular reference to the grayling *(Thymallus arcticus)* and its phylogeny. Can., Fish. Res. Ed., J. 18(5):679–791.

Richardson, W. M., J. A. St. Amant, L. J. Bottroff, and W. L. Parker. 1970. Introduction of blue catfish into California. Calif. Fish Game 56(4):311–312.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada (Fourth edition). Amer. Fish. SOC., Spec. Publ. no. 12, 174 p.

Rosen, D. E., and R. M. Bailey. 1963. The poeciliid fishes (Cyprinodontiformes), their structure, zoogeographyand systematics. Bull. Amer. Mus. Nat. Hist. 126(1):1–176.

Ross, S. T. 1973. The systematics of *Gasterosteus aculeatus* (Pisces: Gasterosteidae) in central and southern California. Los Angeles County Nat. Hist. Mus. Contrib. Sci. no. 243, 20 p.

St. Amant, J. A. 1966. Addition of *Tilapia mossambica* Peters to the California fauna. Calif. Fish Game 52 (1):54-55.

_____. 1970. Addition of Hart's rivulus, *Rivulus harti* (Boulenger), to the Californian fauna. Calif. Fish Game 56(2):138.

St. Amant, J. A,, and F. C. Hoover. 1969. Addition of *Misgurnus anguillicaudatus* (Cantor) to the Californian fauna. Calif. Fish Game 55(4):330–331.

St. Amant, J. A., and I. Sharp. 1971. Addition of *Xiphophorus variatus (Meek),* to the California fauna. Calif. Fish Game 57(2):128–129.

Sasaki, S. 1961. Introduction of Florida largemouth bass into San Diego County. Calif. Dep. Fish and Game, Inland Fish. Admin. Rep. 61-11, 6 p.

Schultz, L. P. 1957. The frogfishes of the family Antennariidae. Proc. U. S. Nat. Mus. 107(3383):47–105.

Seale, A. 1930. List of twenty fresh water fishes found in California that may be used in small aquariums or garden pools. Aquarium J. 3(7):38–39.

Shapovalov, L., and W. A. Dill. 1950. A check list of the fresh-water and anadromous fishes of California. Calif. fish Came 36(4):382–391.

Shapovalov, L., *W.* A. Dill, and A. J. Cordone. 1959. A revised check list of the freshwater and anadromous fishes of California. Calif. Fish Game 45(3):159–180.

Skinner, J. E. 1971. *Anguilla* recorded from California. Calif. Fish Game 57(1):76–79.

Smith, G. R. 1966. Distribution and evolution of the North American catostomid fishes of the subgenus *Pantosteus, genus Catostomus. Misc.* Publ. Mus. Zool. Univ. Mich. *no,* 129, 132 p.

Snyder, J. 0. 1914. A new species of trout from Lake Tahoe. Bull. U. S. Bur. Fish. Dep. Comm. 32(1912):23–28. (issued as Document 768 on December 31, 1912)

_____. 1918. The fishes of the Lahontan system of Nevada and northeastern California. Bull. U. S. Bur. Fish. Dep. Commerce 35(1915–1916):31–86. (issued as Document 843 on September 28, 1917)

_____. 1935. California fresh water fish. Aquarium J. 8(9):146.

Stevenson, *M. M.* 1971. *Percina macrolepida* (Pisces, Percidae, Etheostomatinea), a new percid fish of the subgenus *Percina* from Texas. Southwestern Nat. 16(1):65–83.

Sturgess, J. A. 1976. Taxonomic status of Percina *in* California. Calif. Fish Game 62(1):79–81.

Svetovidov, A. N. 1952. Fishes: Clupeidae, 2(1):1–428 *in* Fauna of USSR, Zool. Inst. Akad. Nauk. USSR *ms* 48 (English translation, 1963. Nat. Sci. Found., Wash., D. C.).

Taylor, T. L. 1988. A blue catfish from the Sacramento-San Joaquin Delta. Calif. Fish Game 66(2):120–121.

Taylor, W. R. 1954. Records of fishes in the John N. Lowe collection from the upper Peninsula *of* Michigan, Misc. Publ. Mus. Zool. Univ. Mich. no. 87, 50 p.

Vandermeer, J. H. 1966. Statistical analysis of geographic variation of the fathead minnow, *Pimephales promelas,* Copeia 1966(3):457–466.

Vladykov, V. D. *1973 Lampetra pacifica, a* new nonparasitic species of lamprey (Petromyzontidae) from Oregon and California. Can., Fish. Res. Bd., J. 30(2):205–213.

Vladykov, V. D., and W. I. Follett. 1965. *Lampetra richardsoni,* a new nonparasitic species of lamprey (Petromyzonidae) from western North America. Can., Fish. Res. Bd., J. 22 (1):139–158.

Vladykov, V. 0, and E. Kott. 1976*a.* A new nonparasitic species of lamprey of the genus *Entosphenus* Gill, 1862, (Petromyzonidae) from south central California. Bull. So. Calif. Acad. Sci. 75(2):60–67.

_____. 1976*b.* A second nonparasitic species of *Entosphenus* Gill, 1862 (Petromyzonidae) from Klamath River system, California. Can. J. Zool. 54(6):974–989.

von Geldern, C. E., Jr. 1966. The introduction of white bass *(Roccus chrysops)* into California. Calif. Fish Game 52(4):305.

Wales, J. H. 1962. Introduction of pond smelt from Japan into California. Calif. Fish Game 48(2):141–142.

Walker, B. W., R. R. Whitney, and G. W. Barlow. 1961. The fishes of the Salton Sea. Pages 77-92 in B. W. Walker ed., The ecology of the Salton Sea, California, in relation to the sportfishery. Calif. Dept. Fish Game, Fish Bull. 113, 204 p.