

Californian Maritime and Interior Marshlands

Marshlands of this climatic zone are represented by tidal marsh as well as a number of interior marsh biomes. In estuaries and in some protected lagoons and sheltered bays, a *Californian maritime marshland* occurs intermittently southward along the Pacific Coast to the Vizcaino Peninsula (Fig. 171). Even as far south as Scammon's Lagoon, mangroves and other tropic-subtropical species are lacking or poorly represented, and both the marshland flora and fauna have a decidedly temperate aspect.

Occurring just inland from the intertidal zone (=strand) of mud flats, sand, or (rarely) rock, these marshes are maintained and flushed by tidal action; the emergent vegetation is at or just above the high water line. As is the case with tidal marsh ecosystems almost everywhere, most of these wetlands have been greatly reduced and disturbed by human activities. Figures showing reductions in areas of marshlands in Mission Bay, San Diego Bay, and Tijuana Estuary are especially impressive (MacDonald, 1977). Much of these and other coastal marshlands once found in southern California have been destroyed; small marshes, such as the one at Newport Bay, have been preserved only after considerable effort. The best examples of warm temperate maritime marshland remaining in the Southwest are in Baja California del Norte, the most extensive in the vicinity of Scammon's Lagoon.

Emergent vegetation in these marshes is most often consociations of either cordgrass (*Spartina foliosa*), or at slightly higher sites subject to less inundation, Pickleweed (*Allenrolfea occidentalis*), or Glasswort (*Salicornia virginica*). This latter species colors an otherwise sedate marsh, turning reddish orange in autumn and harboring the bright orange parasitic Dodder (*Cuscuta salina*) in spring and summer. Other beach and marsh plants as Batis (*Batis maritima*), Saltgrass (*Distichlis spicata*), Marsh-rosemary or Sea-lavender (*Limonium californicum*), Seep-weed (*Suaeda californica*), *Monanthochloë littoralis*, Arrowgrass (*Triglochin maritima*), *Salicornia subterminalis*, *Jaumea carnosa*, and *Anemopsis californica*, while widespread, are only rarely dominant. Although communities of Giant Bulrush (*Scirpus californicus*), rushes, and even cattail may be present in the brackish waters of some estuaries, such situations are uncommon in the Southwest. Saltbushes (*Atriplex patula* and others) and Alkali-heath (*Frankenia grandifolia*) may occupy mounds and other relatively xeric locales within the marsh. The only annual of consequence is *Salicornia bigelovii* (Macdonald, 1977).

Few birds nest in Californian maritime marshlands, the endangered Light-footed Clapper Rail (*Rallus longirostris levipes*) and Black Rail (*Laterallus jamaicensis*) being two important exceptions. Nonetheless, a great variety of migrating and wintering shore and marsh birds make these wetlands particularly attractive to bird watchers. Species especially found here or in adjacent strands include:

<i>Calidris melanotos</i>	Pectoral Sandpiper
<i>C. minutilla</i>	Least Sandpiper
<i>Catoptrophorus semipalmatus</i>	Willet
<i>Himantopus mexicanus</i>	Black-necked Stilt
<i>Limnodromus griseus</i>	Short-billed Dowitcher
<i>L. scolopaceus</i>	Long-billed Dowitcher
<i>Limosa fedoa</i>	Marbled Godwit
<i>Numenius americanus</i>	Long-billed Curlew
<i>N. phaeopus</i>	Whimbrel
<i>Nycticorax nycticorax</i>	Black-crowned Night Heron

<i>Recurvirostra americana</i>	American Avocet
<i>Totanus flavipes</i>	Lesser Yellowlegs
<i>T. melanoleucus</i>	Greater Yellowlegs
<i>Tringa solitaria</i>	Solitary Sandpiper

The larger marshes are (or were) also used by numerous wintering waterfowl, as for nighttime resting and feeding by wintering Black Brant (*Branta nigricans*).

Amphibians are understandably absent from saline maritime marshes, and reptiles are scarcely represented in brackish waters by Western Pond Turtle (*Clemmys marmorata*) and two garter snakes (*Thamnophis sirtalis* and *T. elegans*), near inflowing streams. Fishes are variously represented depending on salinity, water depth, and permanency. Marine species that characteristically move into brackish Californian marshes include Shiner Perch (*Cymatogaster aggregata*), Arrow and Tidewater Gobies (*Clevelandia ios* and *Eucyclogobius newberryi*), Longjaw Mudsucker (*Gillichthys mirabilis*), and Starry Flounder (*Platichthys stellatus*). Three-spine Stickleback and California Killifish also are characteristic of marshy areas along southern California coastlines, and the killifish successfully occupies hypersaline waters to 128 g/l (Miller and Lea, 1972).

Inland, other warm-temperate marshlands occur in old river oxbows, on poorly drained lands, at springs and other shallow water sites in the Californian, Mohavian, Madrean, and Chihuahuan biotic provinces (Figs. 172, 176). Many of these represent remnants of once large aquatic systems, the great Pluvial lakes and rivers of the west (Hubbs and Miller, 1948; Reeves, 1969; Strain, 1970; Hubbs et al., 1974), now scarcely perpetuated by far lower precipitation and meager outflows of groundwater. Many of these environments are saline, a result of evaporative concentration of salts in endorheic basins, and plant communities often are reminiscent of seaside marshes.

Remnant springs and marshes of pluvial Lake Manly in Death Valley are generally surrounded by saltgrass (Fig. 173) and scattered clumps of Common Reed. Small rushes (*Juncus cooperi*, *Nitrophila occidentalis*) are associated with saltgrass in wetter areas. The edges of open water are occupied by bulrushes, principally *Scirpus americanus* and with lesser frequency *S. maritimus* var. *macrostachyus*. Lizardtail (*Anemopsis californica*) is a characteristic species near seeps (Bradley, 1970). In other parts of the Death Valley system, as in Ash Meadows where salts are less concentrated, marshes in spring outflows are backed by extensive scrublands of mesquite and other woody plants (Beatley, 1971). These areas now are suffering invasion by Saltcedar in a pattern similar to that described for riparian wetlands.

Inland marshes are most extensive in the Chihuahuan biotic province, in the remarkable number of bolsones of that region (Figs. 174, 175, 176). These Chihuahuan interior marshlands are subject to great variation in the length and frequency of inundation, and some may be dry for periods of a year or more (Henrickson, 1978), with broad strands surrounding zones of permanent water.

Deeper and better watered locales and springs (e.g., the Cuatro Ciénegas Basin in Coahuila, Mexico), where salinities are not too high, support complex communities of cattail (*Typha angustifolia*), bulrushes, and Common Reed. Lesser sedges and grasses (*Eleocharis cellulosa*, *E. rostellata*, *E. caribaea*, *Carex pringlei*, *Spartina spartinae*, and *Setaria geniculata*) may develop as an understory or as monospecific stands. Drier

shorelines are covered by grasses and sedge including *Fimbristylis thermalis*, *Fuirena simplex*, and *Schoenus nigricans* (see e.g., Fig. 175).

Herbaceous plants of this assemblage include Heliotrope, Water Hyssop (*Bacopa monnieri*), Water Primrose (*Ludwigia octovalvis*), Lizard Tail, Water Parsnip (*Berula erecta*), and many others. In open water, Waterlily (*Nymphaea ampla*), Bladderwort (*Utricularia obtusa*), and charophytes often are common, as are species of pondweed (*Potamogeton nodosus*, *P. pectinatus*), Holly-leaf Naiad (*Najas marina*), Widgeon-grass (*Ruppia maritima*), and Common Pondmat (*Zannichellia palustris*) (Pinkava, 1978).

The few and, therefore, particularly valuable cattail and other marshlands within the Western warm-temperate provinces provide "oases" to widely separated populations of nesting and migrating marsh birds. Even the smallest of these seem to support a family of Red-winged Blackbirds, Coots, and Long-billed Marsh Wrens (*Cistothorus palustris*). Both the larger natural wetlands, such as those in Chihuahua (lagunas Bavicora, Santa María, Mexicanos, and Patos) and "managed" marshes such as at Bosque del Apache National Wildlife Refuge, Willcox Playa, Lake McMillan, and San Simón Ciénega in New Mexico and Arizona, may provide nesting habitat for the endemic Mexican Duck (*Anas platyrhynchos diazi*) (O'Brien, 1975). Other waterfowl, such as Snow Geese (*Chen caerulescens*), Pintails (*Anas acuta*), Green-winged Teal (*A. crecca*), American Widgeon (*Anas americana*), and Shovelers (*Spatula clypeata*), use these marshes during migration, and there is some nesting by Blue-winged Teal (*Anas discors*), Cinnamon Teal (*Anas cyanoptera*), Ruddy Ducks (*Oxyura jamaicensis*), and Avocets and other marsh birds. During winter months these marshlands and adjacent playa strands may provide roosting sites for large concentrations of Sandhill Cranes.

Marshlands sometimes support dense populations of aquatic amphibians, especially after heavy runoff expands available water and/or dilutes saline conditions. Included there are many desert and grassland species, spadefoot toads (*Scaphiopus* spp.), true toads (*Bufo cognatus*, *B. debilis*), and Tiger Salamander, which are preyed upon by the ever-present garter snakes.

Few mammals are restricted to these interior marshlands, but springfed pools and seeps should be as important to bats moving over arid lands as they are to migrating birds (O'Farrell and Bradley, 1970). In Death Valley, it has been demonstrated that the moister areas near marshes enhance populations of desert rodents, including Round-tailed Ground Squirrel (*Spermophilus tereticaudus*), Desert Kangaroo Rat (*Dipodomys deserti*), Harvest Mouse (*Reithrodontomys megalotis*), and Desert Woodrat (*Neotoma lepida*) (Bradley and Deacon, 1971; Sulley et al., 1972). Mesic marshlands also may allow northern or high-altitude mammalian species to persist in lowlands, e.g., Vagrant Shrew (*Sorex vagrans*) on isolated mountains in southern Arizona (Cockrum, 1960) and Meadow Vole (*Microtus pennsylvanicus*) in springfed marshes near Galeana, Chihuahua (Cockrum and Bradley, 1968).

Warm temperate wetlands support an inordinate number of fishes in the Southwest. This largely results from extreme isolation and substantial security, afforded by desert springs, and the presence of a remarkable family of fishes, the Cyprinodontidae, which has members adapted for survival in some of the most severe aquatic habitats yet described. Well-



Figure 171. Californian maritime marshland at Laguna Manuela, Baja California del Norte, Mexico. Emergent vegetation is a consociation of Cordgrass (*Spartina foliosa*).



Figure 172. Interior (Sonoran) marshland, woodland, and submergents at Arivaca Slough, Pima County, Arizona (winter aspect). Although there is often much integration, there also is often only one or two representative dominants in each formation-class—in this case cattail (*Typha domingensis*) marshland and willow (*Salix gooddingii*) woodland. Elevation ca. 1,100 m.



Figure 173. Interior (Mohavian) marshland along Salt Creek, Death Valley National Monument, San Bernardino County, California. Consociations of Salt Grass (*Distichlis stricta*; drier areas) and Bulrush (*Scirpus olneyi* in the water), with few associates, line this marsh-stream. Elevation ca. -25 m; photograph by Stuart G. Fisher, November 1979.

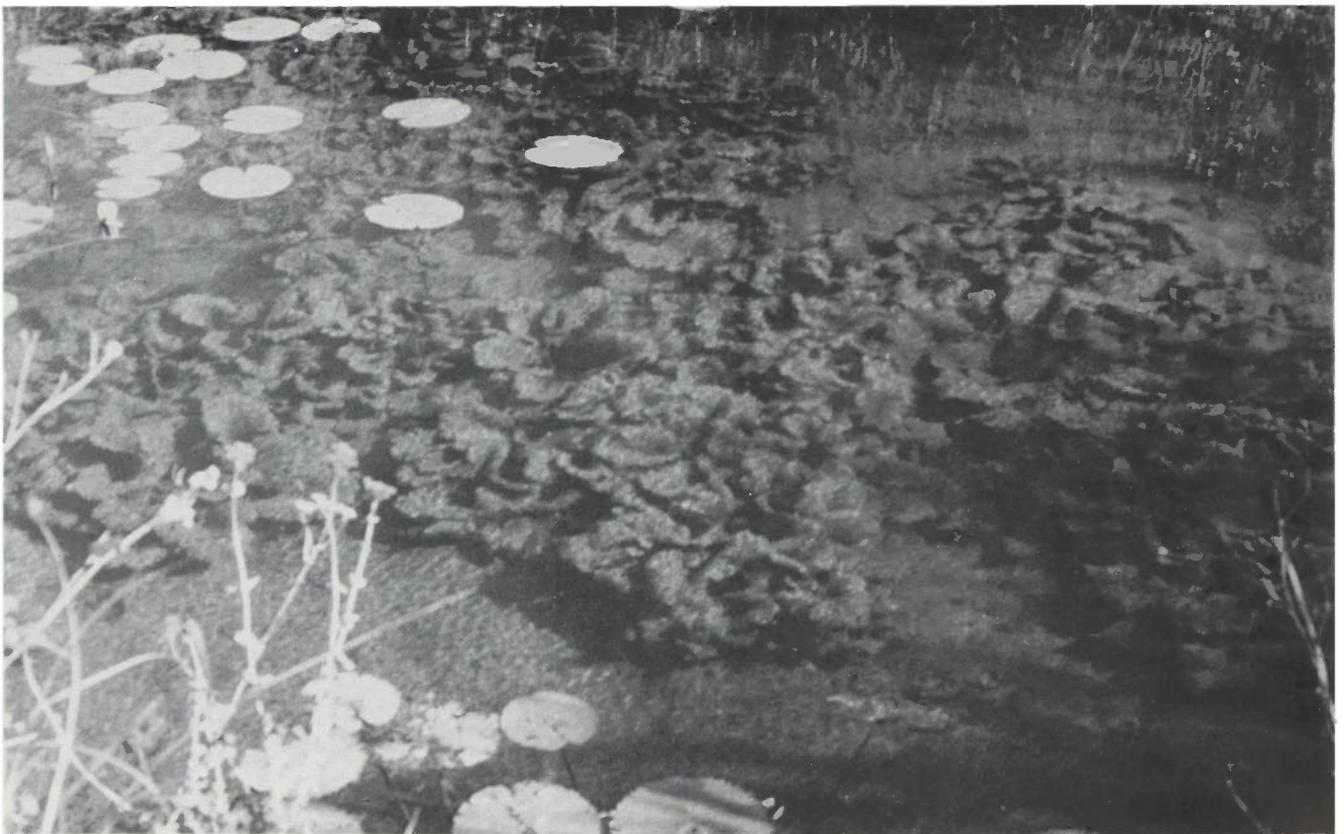


Figure 174. Sub- and emergent growth-forms of *Nymphaea ampla* in clear, 1.5-m-deep water of Laguna Tio Candido, Cuatro Ciénegas Basin, Coahuila, Mexico; Elevation ca. 750 m; photograph by W.L. Minckley, December 1979.



Figure 175. Laguna Tio Candido and associated marshes. A complex submergent and marshland community, including *Typha angustifolia*, *Scirpus olneyi*, and lesser aquatics, with drier shorelines vegetated by *Fimbristylis thermalis*, *Fuirena simplex*, *Schoenus nigricans*, and *Sporobolus* sp. Elevation ca. 750 m; photograph by W.L. Minckley, December 1979.

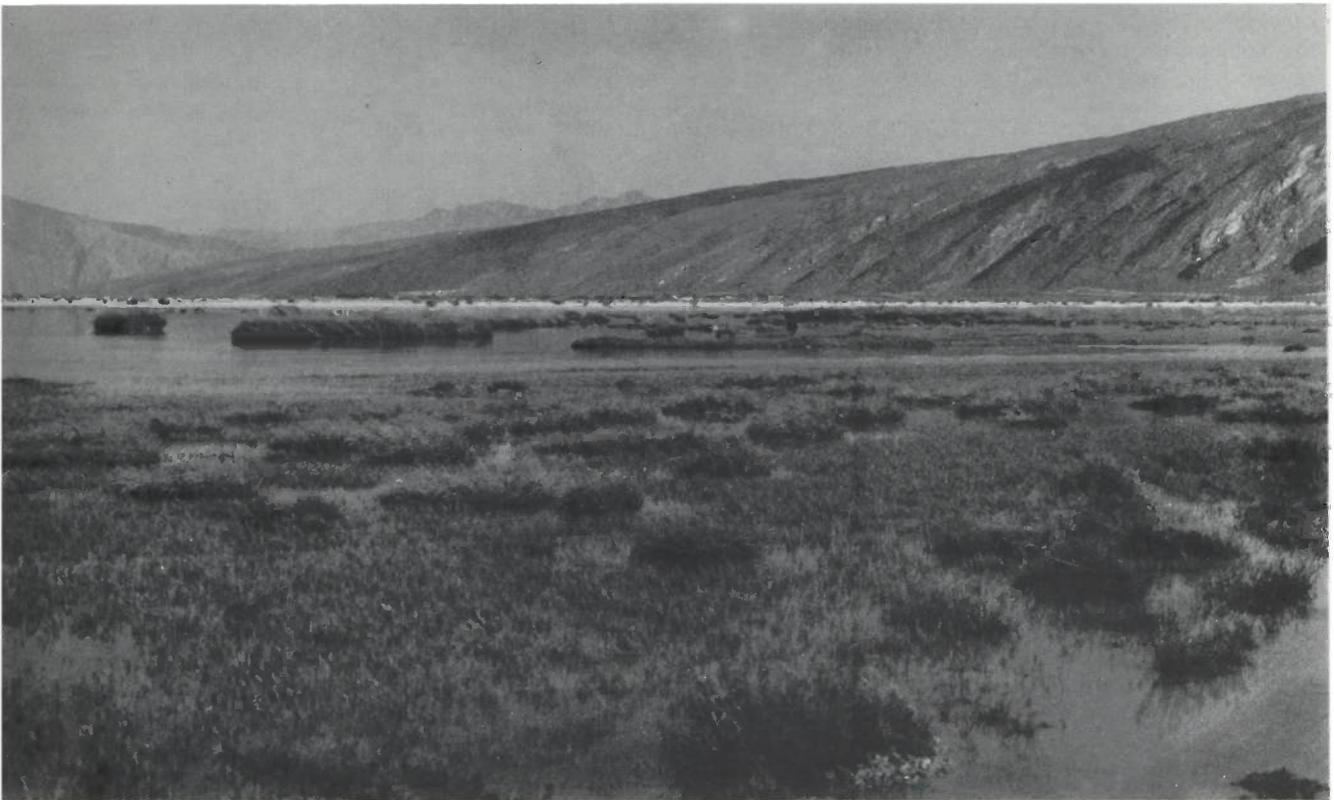


Figure 176. Interior (Chihuahuan) marshland near the inflow of Rio Churince to Laguna Grande, Cuatro Ciénegas Basin, Coahuila, Mexico; flooded Salt Grass (*Distichlis stricta*) dominates the saline flats surrounding this barrial lake, with clumps of sedges [*Scirpus olneyi* and others] occurring in less severe areas near the inflowing stream; dunes in background result from wind transport from the lake margin during drier periods (see also Fig. 179). Elevation ca. 750 m.

watered Pluvial environments allowed for dispersal of these fishes, along with a few other groups (coarse-scaled species of *Gila*, some *Catostomus*, and Speckled Dace), and when those rivers and lakes dried, the fishes remained to exploit meager remnants. If the riverine Pecos, Conchos, and Red River pupfishes are excluded, the other pupfish species listed in Table 32 from the Rio Grande-Pecos River systems are presently restricted to springs and spring-fed habitats, as are most of the mosquitofishes (excluding *Gambusia affinis* and *G. senilis*). Thus each of these genera is today prepared for natural desiccation with representatives positioned to survive all but human-caused catastrophe, such as pumpage resulting in lowering of water tables.

In the Death Valley system, the Mojave River has a single endemic—the Mohave Chub (*Gila bicolor mohavensis*). The higher-elevation Owens River has four: the Owens Tui Chub (*G. bicolor snyderi*), Owens Sucker (*Catostomus fumeiventris*), Owens Pupfish (*Cyprinodon radiosus*), and a distinctive Speckled Dace (Miller, 1973). The Amargosa River basin, including Death Valley itself and Ash Meadows, had a distinctive Speckled Dace and seven species of pup- and poolfishes: Amargosa Pupfish (*Cyprinodon nevadensis*), Salt Creek Pupfish (*C. salinus*), Cottonball Marsh Pupfish (*C. milleri*), Devil's Hole Pupfish (*C. diabolis*), Pahrump Poolfish (*Empetrichthys latos*), and the recently extirpated Ash Meadows Poolfish (*E. merriami*). These are separated into no fewer than 14 subspecies (Miller, 1948; Soltz and Naiman, 1978).

The remarkable Cuatro Ciénegas Basin in Coahuila, Mexico, is the only other desert bolsón to demonstrate a similar degree of endemism as Death Valley. Comparison of Tables 32 and 33 reveals the distinctiveness of the Cuatro Ciénegas fish fauna, which includes 15 of a total of 20 species that are known only from, or are differentiated within, that small area (Minckley, 1969, 1978). Endemism in invertebrates (Taylor, 1966; Minckley, 1978), other vertebrates as the aquatic Coahuilan Box Turtle (*Terrapene coahuilua*) (Brown, 1974), other endemic turtles (*Trionyx ater*, *Chrysemys scripta taylori*) (Conant, 1978), terrestrial forms such as *Gerrhonotus lugoi* (McCoy, 1970), and numerous vascular plants (Pinkava, 1978), plus a remarkable assemblage of relict species (Milstead, 1960), further attest to the antiquity of aquatic and terrestrial habitats of that area (Meyer, 1973). Most other basins of the Chihuahuan Desert have lesser, but nonetheless significant, levels of endemism: the basin of Lago de Guzmán in northern Chihuahua and southern New Mexico contains at least three pupfishes and the endemic Chihuahuan Chub (*Gila nigrescens*), and Laguna de Bavicora supports a species of *Gila*.

Some species of fishes in desert springs are stenotherms, adapted to narrow temperature ranges of their special environments. The most spectacular of these is perhaps the Moapa Dace (*Moapa coriacea*) and some populations of springfish (*Crenichthys baileyi*, *C. nevadae*) of the Pluvial White River of Nevada. These animals live within a few degrees of what is considered lethal maxima for many fishes, between 30.5° and 34° C for the dace and up to 35° for *C. baileyi*, and at least *M. coriacea* does not venture into cooler waters (Deacon and

Bradley, 1972). Indeed, certain populations of these animals are protected from depredations and competition from introduced fishes by high temperatures that only they can withstand; most introduced species simply cannot invade the thermal environments enjoyed by these natives.

Development of water resources adjacent to marshlands in the interior Southwest spells doom for many of the special habitats just discussed. Lowering of water tables obviously destroys surface waters of a permanent nature, and obligate aquatic communities disappear. If waters persist, non-native organisms provide other problems. Severity of this situation was recently pointed out by Pister (1974) as follows (brackets ours):

"During the past 35 years, man's activities apparently have caused the extinction of 4 species and 6 subspecies in 6 genera [of fishes] within California, Nevada and Arizona. In addition, at least 50 species and subspecies in 26 genera within 8 Great Basin States and northern Mexico are considered threatened. 19 of which are currently listed as endangered by the Secretary of the Interior... This situation has resulted primarily from agricultural pumping and diversion of watercourses and has been aggravated by the introduction of predaceous game fishes and other piscine competitors."

At this writing his statement stands true, and additional taxa may soon be added to Pister's ominous statistics.

Table 33. Fishes of the Cuatro Ciénegas basin, Coahuila, Mexico. Symbols: * = restricted to the basin; ** = differentiated to the subspecific level within the basin when compared to materials from the lower Rio Grande into which Cuatro Ciénegas water now flows as a result of canal connection via Rio Salado (from Minckley, 1978).

Characidae	Poeciliidae (cont'd)
<i>Astyanax mexicanus</i> (Mexican Tetra)	* <i>Xiphophorus gordonii</i> (Cuatro Ciénegas Platyfish)
Cyprinidae	Centrarchidae
* <i>Notropis xanthicara</i> (Cuatro Ciénegas Shiner)	** <i>Lepomis megalotis</i> (Longear Sunfish)
** <i>Dionda episcopa</i> (Roundnose Minnow)	** <i>Micropterus salmoides</i> (Largemouth Bass)
Ictaluridae	Percidae
** <i>Ictalurus lupus</i> (Headwater Channel Catfish)	* <i>Etheostoma</i> sp. (Cuatro Ciénegas Darter)
<i>Pylodictis olivaris</i> (Flathead Catfish)	Cichlidae
Cyprinodontidae	<i>Cichlasoma (Herichthys) cyanoguttatum</i> (Rio Grande Perch)
* <i>Lucania interioris</i> (Interior Killifish)	<i>Cichlasoma (Herichthys) sp.</i>
* <i>Cyprinodon bifasciatus</i> (Laguna Pupfish)	* <i>Cichlasoma (Parapetenia) sp.</i> "A" ("Lugo's Cichlid")
* <i>Cyprinodon atrorus</i> (Ciénegas Pupfish)	* <i>Cichlasoma (Parapetenia) sp.</i> "B" ("Caracole Cichlid")
Poeciliidae	* <i>Cichlasoma (Parapetenia) sp.</i> "C" ("Longhead Cichlid")
* <i>Gambusia longispinis</i> (Cuatro Ciénegas Mosquitofish)	* <i>Cichlasoma (Parapetenia) sp.</i> "D" ("Unexpected Cichlid")
<i>Gambusia marshi</i> (Rio Salado Mosquitofish)	