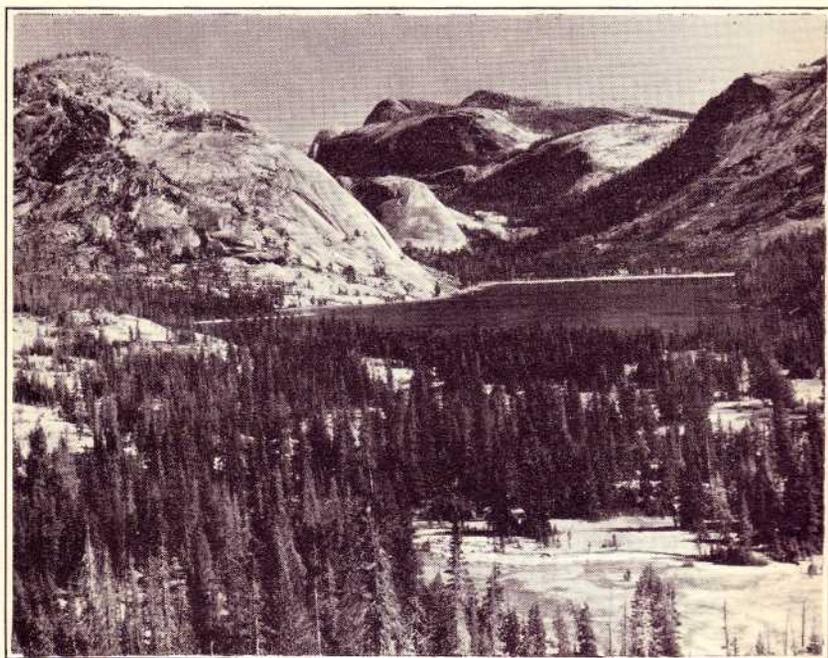


YOSEMITE NATURE NOTES



Yosemite Nature Notes

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THE NATIVE FISH FAUNA OF YOSEMITE NATIONAL PARK AND ITS PRESERVATION¹

By Carl L. Hubbs, Scripps Institution of Oceanography and
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Except for some studies and stories on the trout, the fish fauna of Yosemite National Park has been made known in only four publications. The first, a book by J. M. Hutchings, "In the Heart of the Sierras" (1886), contained a very brief statement on the fish life of the Merced River. The second was a chapter on "The Fishes of Yosemite National Park," by Barton Warren Evermann, in Ansel F. Hall's "Handbook of Yosemite National Park" (1921). The third was a brief treatise on "Fish and Fishing in Yosemite National Park," written by H. C. Bryant and

included in "Yosemite Ranger Naturalist Manual" (1929). The fourth and most important was a pamphlet entitled "Fishes of Yosemite National Park." It was prepared by Willis A. Evans, as a result of observations that he made while serving as Ranger Naturalist in 1941, and it was issued as Volume XXIII, Number 1, of **Yosemite Nature Notes** (1944). The paucity of reports on the fishes of Yosemite contrasts glaringly with the thorough treatment of the terrestrial vertebrates and reflects the limited study that has been made of the underwater life in this and other National Parks.

PRESERVATION OF THE NATIVE FISH FAUNA

The aquatic life of the National Parks has been much neglected, not only in research but also in the nature-preservation program (Madsen, 1937, pp. 395-397; Hubbs, 1940, pp. 3-4; Cahalane, 1947, pp. 69-70; Hubbs and Lager, 1949, pp. 98-99). The animal life above the water surfaces in the Parks has traditionally been treated as a sacred trust, to be preserved in strictly natural condition. That which lives below the water surfaces, in contrast, has commonly been managed as a recreational asset. Hunting of course is strictly prohibited, but fishing is gen-

erally allowed and is frequently encouraged. Only indigenous species are regarded as proper in the terrestrial communities, and exotics are eradicated wherever possible. In contrast, exotic fishes, especially trouts, have frequently been stocked and maintained to provide sport in Park waters. The introduced species no doubt greatly disturb natural conditions in several ways: disease organisms may be introduced, to infect native species as well as the exotics; some introduced forms hybridize with the indigenous ones; through competition or predation, the

¹Contribution from the Scripps Institution Oceanography, New Series, No. 394.

native fishes and invertebrates may be depleted or even exterminated. Fishing in itself disturbs the balance of nature.

Consistency would seem to demand the strict preservation of all the native aquatic life as well as all the native terrestrial life of the Parks, but such a policy could hardly be established now. Sport fishing has become a vested right of the Park visitors and is one of the outstanding recreational assets. Furthermore, legislation is involved. After considering this conflict in policy and practice, the Park Service has reached a realistic compromise policy, which calls for the preservation of the native aquatic life where it still exists, but which permits stocking of fish and allows fishing for sport where the natural balance has already been greatly disturbed (see statement of policy in the current edition of "Fishes of Yosemite National Park"). We urge a trend toward a more preservationist policy wherever this is practicable.

So far as the native fish life is concerned, there seems to be little fear that sport fishing will further greatly modify the natural conditions in Yosemite National Park. The native stock of rainbow trout has no doubt been modified by hybridization with introduced stocks, representing different races of the same species, or has been more or less completely replaced by the exotic races; the original characteristics of the local form of the Merced River can probably never be learned. The only other native species now of wide occurrence in the Park, the Sacramento sucker, is maintaining itself, despite the predation that must be exerted against it by trout. Such predation may be effected chiefly by the brown trout, which is usually more piscivorous than the other trouts. Ex-

cept on the floor of Yosemite Valley, the rainbow trout is maintaining its abundance in competition with the brown trout. Even if all stocking of brown trout should be abandoned, this European species, which is particularly resistant to depletion, might continue to exist indefinitely in the Valley. The other native fishes, three minnows and one sculpin, appear to occur naturally in the Park only in the lower stretches of the Merced River. They may ascend to the power dam in the Merced Canyon but if so, they are blocked by this obstacle from reaching the seemingly more habitable waters of Yosemite Valley. They may originally have transgressed the turbulent waters of the Canyon at favorable times, to populate the relatively quiet waters of the Valley, but if so, they were probably eliminated there by the brown trout or by the floods. Re-entry into the Valley would have been prevented by the dam.

More natural conditions for fish life in the Merced River and other Yosemite waters might be restored, but only by such measures as: (1) cessation of all further stocking of the exotic brown trout (in line with the present policy and program of the State Division of Fish and Game, which has restricted the propagation of this species, regarded as generally objectionable, almost entirely to National Park waters); (2) increased stocking of rainbow trout on the Valley floor, perhaps using larger fingerlings, or even yearlings or adults; (3) propagation of the rainbow trout of Yosemite Park waters or of other nearby Sierra Nevada waters, rather than those of distant regions, in order to maintain a stock as nearly like the original as would now be possible; (4) lessening or removal of fishing restrictions on the brown trout, or its depletion in the

Valley by other means; (5) protecting the rainbow trout, particularly in the Valley; (6) removal of the power dam, to permit the natural movement of rainbow trout and other native species from the Canyon into the Valley. These measures could be invoked in any combination. The

first two to four would seem to be the least objectionable and the most practicable. We urge the consideration of these suggested measures by the Park authorities and recommend that the stocking of brown trout be stopped and that at least one of the other measures be adopted.

PREVIOUS REPORTS OF NATIVE FISHES

The first published notice of the fish life of Yosemite National Park that has come to our notice was a brief statement by J. M. Hutchings (1886, p. 363), one of the pioneer hotel managers. He wrote: "There are but two kinds of fish in this river [the Merced], or in any of its tributaries, speckled (rainbow) trout and [Sacramento] suckers."

In the second report cited above, Evermann (1921, p. 200) stated that "the fish fauna of Yosemite National Park is not a rich one," adding that "of native species there are two suckers, three minnows, and one trout; and of these only the trout is at all common." This general statement is true, but the species list as given was hypothetical and in part incorrect. When the report was written none of the putative native species other than the rainbow trout was known by Evermann to occur within Yosemite boundaries. He stated, "there remain but two suckers and three minnows that might be found within the park." Of the five kinds mentioned, one sucker, *Catostomus occidentalis*, and two minnows, *Mylopharodon conocephalus* and *Ptychocheilus grandis*, have since been taken in the Park. One of the others, "*Pantosteus araeopus*," is currently treated as a synonym of *Catostomus occidentalis*. The fifth, *Siphateles formosus*, was

either a lowland type, now probably extinct, or was incorrectly ascribed to the Merced River and to the Sacramento River system.

Bryant in 1929 (p. 143) definitely indicated that the sucker (*Catostomus occidentalis*) is an inhabitant of the Park and noted that the "Sacramento Pike or Squawfish" (referring to *Ptychocheilus grandis*) had "been taken in the Merced River close to the park line." He mentioned also: "Split tail. Native. Occasionally caught in Moss Creek near El Portal. Not known to have been taken within the park boundary." But the split-tail is *Pogonichthys macrolepidotus* (Ayres), an inhabitant of the lower, main rivers in the Sacramento Valley. It probably never ascends to such high elevations. Since Bryant gave no scientific name for this species and since no specimens have been found to support the record, we have assumed that no authoritative identification was made. Word just received from him confirms this assumption. The record was based on the report of fishermen who had caught some fish, probably *Mylopharodon conocephalus* or *Ptychocheilus grandis* that they called "splittail."

In the fourth report on Yosemite fishes, Evans (1944, pp. 10-11; 1947 ed., pp. 8-9) listed, in addition to trout, one sucker, *Catostomus occi-*

dentalis, and two minnows, **Mylopharodon conocephalus** and **Hesperoleucus symmetricus**. All were

recorded from within the Park, but the species last named was regarded as introduced.

NEW DATA ON THE NATIVE FISHES

We now add two species, both native, to the known fish fauna of Yosemite National Park, namely the Sacramento squawfish, **Ptychocheilus grandis**, and a sculpin, the riffle muddler, **Cottus bairdii gulosus**. We further show that the minnow **Hesperoleucus symmetricus**, previously thought to be introduced only, is really native in the Park. We thus add three species to the recognized native fish fauna of Yosemite National Park, doubling the list. The total fauna comprises the six species listed below: one trout, one sucker,

three minnows and one sculpin. Of the six only the trout and the sucker are known to be of native occurrence in any of the Park waters, other than the Merced River in the Canyon, at the lowest elevations within the Park boundaries. Probably only the trout and the sucker are native to the Tuolumne River within the Park. The Tuolumne leaves the Park at a somewhat higher elevation (about 3,150 feet) than does the Merced (about 2,200 feet). These are the only rivers whose headwaters drain Yosemite National Park as at present delimited.

COMMON RAINBOW TROUT

Salmo gairdnerii irideus Gibbons

Despite all the attention that has been given the rainbow trout (including the steelhead), by ichthyologists, fishery biologists and fish-culturists, not to mention myriads of anglers, much doubt and confusion persists regarding the systematic status and scientific nomenclature of its several subspecies. There is rather general agreement only on the species name, **Salmo gairdnerii** (Richardson). Our tentative opinion is that the Yosemite trout of this species should be referred to **S. g. irideus**, which name we use for the wide-spread, generally nonmigratory, moderately coarse-scaled, relatively deep-bodied, big-headed and big-finned types. The Yosemite form has been referred to "**Salmo shasta**," the Shasta rainbow trout of fish-culturists, but a recent examination at Stanford University of the type specimens of **Salmo gairdnerii shasta** Jor-

dan, by Hubbs and Follett, failed to disclose any valid reason for even the subspecific recognition of **shasta**.

It is possible that the Yosemite waters were originally populated by a slightly differentiated race of rainbow trout, but, as noted earlier (p. 132), it will probably never be possible to determine what were the characteristics of the indigenous stock or stocks. Here as elsewhere the local forms have been much contaminated and confused by the almost indiscriminate mixing indulged in by fish-culturists. Such interference with the natural order is especially to be decried in the National Parks, which are supposedly consecrated to the strict preservation of nature and of all native life within the park boundaries.

Rainbow trout were presumably native in Yosemite Park in most of the waters at moderate elevations,

in both the Merced and Tuolumne river systems. The species is treated in the four reports on Yosemite fishes cited earlier, and in several angling books, notably that of McDermand (1941). Lee-mee, one of the surviving Indians of the Yosemite region, who has interpreted the life of the local aborigines for the Park Service, states that trout occurred in Yosemite Valley prior to the occupation of the valley by white men, but that the Indians held them in lesser esteem than the suckers. Obviously this view was not shared by the early white settlers, for Hutchings (1886, p. 363) wrote that the "trout, you will find, are a delicious table fish; but no one except Indians, will think of eating suckers."

There is no reason to believe that rainbow trout or any other kind of fish ever occurred in any of the Park waters above the free-leaping waterfalls of Yosemite and Little Yosemite valleys. This view is verified by a letter written to Mr. Chester Versteeg on July 12, 1924, by Colonel H. C. Benson, one of the early Park Superintendents. Colonel Benson stated: "When we went into the Yosemite Park there were no fish in the Park except those which were enabled to come directly up the Merced River to the Yosemite Valley and up the south fork of the Merced to within a mile or two east of Wawona and up the Tuolumne to the falls of the Hetch Hetchy except the fish that were found in Lake Eleanor and its immediate tributaries which fish had been brought in by old man Kibbe in 1877. He had put fish in Lake Eleanor and Lake Vernon but they were unable to get back into the country behind the falls of Lake Eleanor."

Since the early years of Park history rainbow trout and other exotic

species have been stocked in many of the higher waters. They have spread from points of stocking upstream as far as they could go. Downstream they may not have been stopped even by the high falls. Trout have been caught between the successive leaps of Yosemite Falls and there are no records of stocking that part of Yosemite Creek. Experiments by the senior author showed that small fish may be dropped until they attain the maximum velocity of fall, without harm if they land in water or even on hard wet surfaces.

Rainbows are caught more commonly in the Merced Canyon than in Yosemite Valley. They were seen in marked abundance in pools below the power dam. On the morning of July 31, 1948, 28 adults were counted in a single pool and on the upper part of the riffle below. There is some natural reproduction of rainbows.

The differential abundance of the rainbow and brown trout of Merced River in the Canyon and in the Valley apparently reflects the recent stocking practice as well as natural habitat selection. Alan C. Taft, Chief of the Bureau of Fish Conservation of the State Division of Fish and Game, which operates the fish hatchery in the Park, writes under date of October 19, 1948, that: "During the last few years we have planted the Merced River in the floor of Yosemite Valley with approximately 100,000 brown trout fingerlings each year. About the same number of rainbow have been planted but they have been largely concentrated in the swifter water between the power house and El Portal. Only the larger of our rainbow fingerlings have been planted in the floor of the Valley."

SACRAMENTO SUCKER

Catostomus occidentalis Ayres

This species, the common sucker of the Central Valley, probably occurs throughout the Merced and Tuolumne river systems from low elevations in the San Joaquin Valley to moderate elevations in Yosemite National Park. Hutchings (1886, p. 363), wrote of its occurrence, habits and utilization by the Indians in Yosemite Valley. As noted above, one of the surviving Indians of the Valley states that his people preferred suckers to trout. Rutter (1908, p. 124) reported it from the Merced at Benton Mill and Livingston, from the Tuolumne at Baker Ford and from the South Fork of the Tuolumne near the mouth. It was found to be common in the Merced at Indian Flats (1,550 feet elevation) by Taft, Shapovalov, Needham and Sumner in July, 1933, and by Hubbs and Miller on July 24, 1938. Evermann (1921, p. 200) indicated that it might be found within Yosemite Park. Bryant (1929, p. 143) reported it as native in the larger streams, adding that it had supposedly been introduced into Tenaya Lake. Evans (1944, p. 10; 1947 ed., p. 8) wrote that it is common in the Merced and Tuolumne rivers at the lower elevations within the Park, but that it is seldom at home above the lower valley levels. In the summer of 1948 we found the species common in the quieter pools and margins of the Merced River from the west boundary (about 2,200 feet) through the Canyon and Valley at least to Mirror Lake (about 4100 feet). None were seen by us in Tenaya Lake (8,141 feet), but our observations there were brief and we heard several reports of the occurrence of suckers and also of "chubs." Leo Shapovalov tells us that large suckers were found by the 1933 survey to be common in

Tenaya Lake. Because of its high elevation, it is extremely improbable that such species are native to this lake.

Adult and half-grown suckers are more or less solitary inhabitants of the deeper, quieter pools of the Merced River. They may be seen from early morning until night, leisurely mouthing their way over the rock surfaces in search of food. Using their very fleshy papillose lips, they work like a vacuum cleaner.

The very young, in contrast, swim in loose to dense schools at various water levels, near the quiet margins and in small side channels. On July 31, 1948, such young-of-the-year abounded at the margins of the Merced River near the west boundary of the Park and at various points between there and the Valley. They were still very small and extremely slender (such fry can be recognized as suckers by their slenderness and by the extension of the intestine to near the caudal fin). A sample of 82 specimens dip-netted from several of the small schools ranged in standard length from 12 to 21 mm. and averaged 15.0 mm. (slightly more than one-half inch). Until disturbed most of the fry swam near the surface, but the largest ones were beginning to live on the bottom, forsaking their early plankton-feeding habits.

Growth of suckers in the Merced River must be very slow, for 54 yearlings seined on July 31 (50 about one-half mile below Cascade Creek and 4 in the Valley) ranged in standard length from 33 to 64 mm., with an average of only 47.3 mm. (less than 2 inches). Large numbers of yearlings of this size range were observed in the quieter side chan-

nels and on quiet sandy shallows. Like the adults, they were feeding on the bottom. The first winter annulus is close to the center of the scales and is indistinct. One two-year-old sucker in the July 31 collection, 107 mm. (slightly over 4 inches) in standard length, has a definite winter annulus near the margin of each scale.

The very slow growth of suckers in Merced River is attributable to the purity of the snow-fed water and to the scouring of the bottom by

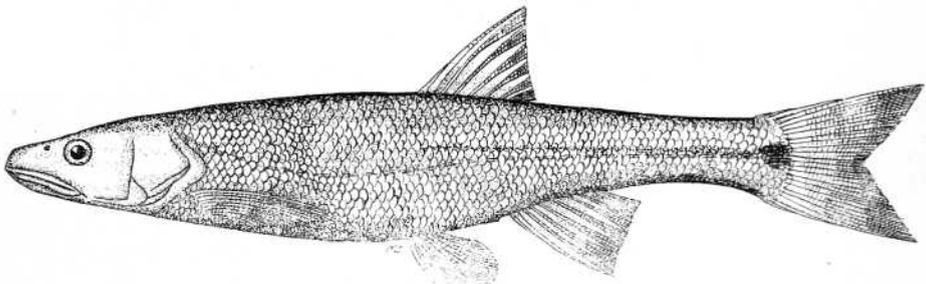
high water in the spring. By the end of July (when our collection was made) young-of-the-year suckers in a Michigan lake are as large as the yearlings in Merced River (Hubbs and Creaser, 1924). Growth is also much less rapid than in a lake in northern Wisconsin (Spoor, 1938), but more in accord with that reported by Stewart (1926) for certain streams in New York. The eastern suckers are referred to a different though very similar species, *Catostomus c. commersonii*.

SACRAMENTO SQUAWFISH

Ptychocheilus grandis (Ayres)

Published reports have indicated the occurrence of this species in the Merced River, but only at elevations lower than the western boundary of Yosemite National Park (about 2,200 feet). It is wide-spread in the Central Valley of California (Evermann and Clark, 1931, pp. 52-53). Rutter (1908, p. 133) listed it from the Merced at Livingston and Benton Mill. Evermann (1921, p. 200) wrote that it might occur within the Park and Bryant (1929, p. 141) indicated that it had been taken in the Merced close to the Park line.

Anglers have reported for several years the capture of "pike"—a common misnomer for this very large and voracious minnow—about El Portal and in pools in the Merced Canyon above the Park boundary. On July 31, 1948, we verified these claims by finding right at the boundary a half-grown specimen 230 mm. in standard length; obviously it had been caught in the river and had been thrown out by a disappointed trout angler. Later we learned that a specimen had been taken in the Park by the fish survey of 1933, con-



Sacramento squawfish, *Ptychocheilus grandis*, drawn by Ranger Naturalist Martin R. Brittan from a 6½-inch specimen from Merced River.

ducted by Taft, Shapovalov, Needham and Sumner. It was caught on August 18 in the Merced River 1.5 miles above El Portal and 0.2 mile within the Park boundary. No evidence was obtained to indicate that this species occurs above the power dam in the Merced Canyon and it must be rare between the dam and the boundary.

The fact that the specimen taken in 1933 was a yearling suggests that the species spawns within the Park, for the river in the Canyon is apparently too swift to be ascended by small minnows. It reproduces freely

in the Merced River at Indian Flats, at an elevation of about 1,550 feet. Numerous young to half-grown specimens were taken there during the 1933 survey and yearlings were seined at the same place by Hubbs and Miller on July 24, 1938.

This large-mouthed minnow reaches a length of over three feet and is reputed to be very destructive to trout and salmon. Its predatory habits, however, should not be taken as an excuse for its destruction within the Park. Since it is of such rare though natural occurrence, it should be protected by the Park regulations.

HARDHEAD

Mylopharodon conocephalus (Baird and Girard)

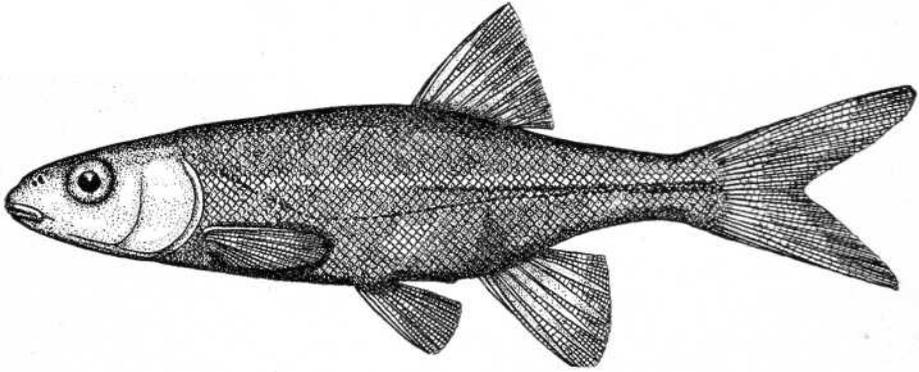
The inclusion of this large minnow in the Yosemite National Park list rests on the statement by Evermann (1921, p. 200) that it might occur and on the definite record by Evans (1944, p. 10; 1947 ed., p. 8), of a specimen collected on July 26, 1934, in the Merced River one-half mile below Arch Rock Entrance Station, at an elevation of about 2,800 feet. It was caught by Mrs. F. M. Watson and was received and accessioned by A. E. Borell. The identification was confirmed on July 31, 1948, by a re-examination of the specimen in the Yosemite Museum (No. 139).

This species is somewhat smaller than the squawfish, seldom reaching the length of two feet. It has a smaller mouth and a less slender head. It differs sharply in having the upper lip nonprotractile (bound to the forehead by a bridge of skin, the frenum) and in having a much shorter bony

pharyngeal arch (in the throat), with molar rather than slender, hooked teeth. These differences in structure indicate that the hardhead is much less predacious than the squawfish. (Follett, 1928.)

The hardhead is probably uncommon within the Park and is almost certainly confined there to the lower elevations of the Merced Canyon. The few that ascend the stream beyond the Park boundary (at about 2,200 feet) are perhaps strays from Indian Flats (about 1,550 feet), where many young and yearling specimens and some older ones were taken during the survey of July-August, 1933. At the same place Hubbs and Miller took yearlings on July 24, 1938. Rutter (1908, p. 129) got specimens farther down the Merced River, at Livingston and Benton Mill. The species is widely spread through the Central Valley (Evermann and Clark, 1931, p. 52), particularly in the foothill region.





Chub-roach, *Hesperoleucus symmetricus*, drawn by Ranger Naturalist Martin R. Brittan from a 3½ inch specimen collected by Rutter in Merced River at Livingston.

SIERRA CHUB-ROACH

***Hesperoleucus symmetricus* (Baird and Girard), subspecies**

This somewhat speckled, finger-length minnow was reported from Yosemite National Park by Evans (1944, pp. 10-11; 1947 ed., pp. 8-9). In the Park it has been known only in Hetch Hetchy Reservoir and it is said to have first appeared there in 1930. Apparently on circumstantial evidence it has been assumed that it was introduced by the dumping of live bait. That may well be true, but it is also wholly possible that it existed in small numbers in the Tuolumne River in Hetch Hetchy Valley (elevation 3,680 feet), prior to the impoundment, and that it did not build up a conspicuous population in the lake until 1930. The possibility that the species naturally ascended the Tuolumne to populate Hetch Hetchy Valley finds support in our discovery of its occurrence and breeding in the Merced River at the western boundary of Yosemite National Park, at an elevation of about 2,200 feet.

The discovery of this minnow in the Merced River at the park boundary came about in an unexpected way. It was not recognized during the examination of the river on July

31, 1948. On sorting the collection of fry dip-netted on that day in the quiet margins of the river, it was noticed that the six smallest specimens, each 9 mm. ($\frac{3}{8}$ inch) in standard length, were minnows, not suckers. The expectation that these larvae might represent ***Hesperoleucus symmetricus*** was verified by comparing the specimens with Fry's (1936) excellent figures and descriptions of the developmental stages of the Baystream chub-roach, ***H. s. venustus*** Snyder. In all details of form and proportions, position and development of fins, and pigmentation, our 9 mm. postlarvae are just intermediate between the 8.5 and 9.5 mm. stages figured by Fry. There seems to be no doubt about the specific identification.

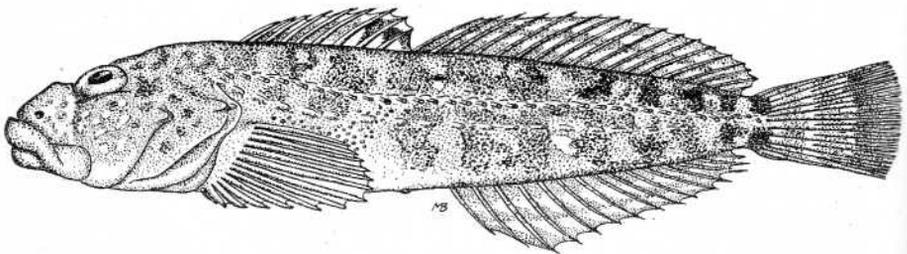
In all probability ***Hesperoleucus symmetricus*** is native in the Merced River within the Park, though it is undoubtedly scarce at elevations above 2,000 feet. It is probably very inconspicuous there, for in the swift water it would tend to seek retreat under boulders. Those that do occur so far upstream (and at least occasionally breed there) presumably

stem from a rather large population in the river at Indian Flats (about 1,550 feet). Many young to adult specimens were taken there during the 1933 survey and yearlings plus two adults were seined at the same place by Hubbs and Miller on July 24, 1938.

The species **Hesperoleucus symmetricus** is of wide occurrence through the Central Valley of California and in the contiguous coastal streams (Snyder, 1913, pp. 63-70). In the Merced and Tuolumne river systems it is probably common at many places below the localities already mentioned. Rutter (1908, p. 139) had it from the Merced at Benton Mill and Livingston, from the North Fork of the Merced at Bower Cave, from the Tuolumne at Baker Ford, and from the South Fork of the Tuolumne near its mouth.

The subspecies that occurs in and near Yosemite National Park appears to be one of the several local forms that are still unnamed. Snyder named a number (giving them full species rank), but, overimpressed with the importance of geographical

segregation in separate stream systems, he did not distinguish subspecies within the Sacramento-San Joaquin system. Rutter (1908, pp. 137-139) had already pointed out marked local variations, even within the Merced River system. Much of the differentiation appears to be ecotypic. The typical subspecies, **H. s. symmetricus**, inhabiting the main rivers with a strong and constant current, has a very slender caudal peduncle and long, expansive and falcate fins, the dorsal usually with 10 and the anal ordinarily with 9 rays. The unnamed foothill form, inhabiting the quieter spots of the smaller pool-and-riffle streams, has a chunkier build with deeper caudal peduncle and smaller, more rounded fins, the dorsal usually with 9 and the anal ordinarily with 8 rays. These contrasting but intergrading types are paralleled by ecotypic subspecies in many species of western fresh-water fishes (Hubbs, 1940a, pp. 199-200; 1941, pp. 186-187). The character gradients are repeated again and again in close correlation with the biological gradients.



Riffle muddler, *Cottus bairdii gulosus*, drawn by Ranger Naturalist Martin R. Brittan from a 5-inch specimen from Merced River in Yosemite National Park.

RIFFLE MUDDLER

Cottus bairdii gulosus (Girard)

This fresh-water sculpin is another addition to the known fish fauna of Yosemite National Park. It was reported by Rutter (1908, p. 146) southward only to Stanislaus River, the first main stream north of the Tuolumne. Dill (1946, pp. 54-55) reported a species of **Cottus** from the San Joaquin River, the first main mountain stream of the Merced, but a specimen from Millerton Lake, submitted by him, proves to be **Cottus asper** Richardson. We find no published records of any **Cottus** for either the Tuolumne or the Merced system. The occurrence of the species in Merced River is substantiated by four collections, each of a single specimen and all from within the Park. The first three specimens are in the Yosemite Museum, the fourth, in the University of Michigan Museum of Zoology. The data follow:

One adult from Merced River below the dam and above Arch Rock Entrance Station, at an elevation of about 3,700 feet; caught by Mrs. Lucy Cleveland on July 14, 1934, and received by A. E. Borell.

One adult from Merced River near the Incline; caught by a woman angler on July 10, 1938.

One adult from Merced River at Steamboat Bay (a large stream pool), at an elevation of about 3,600 feet; caught on a worm by Erwin Brocker on August 22, 1938.

One half-grown specimen 52 mm. in standard length, from the Merced River at the west boundary of the Park (about 2,200 feet); taken by us in a small seine by overturning boulders, on July 31, 1948.

The species must be rare in the Merced River. The lower courses of the river in San Joaquin Valley do not provide suitable habitats. No

specimens were found among the many fishes collected during the 1933 survey, either at Indian Flats (about 1,550 feet) or in the Park. None was obtained at Indian Flats by Hubbs and Miller on July 24, 1938, though special effort was made to collect sculpins by methods that are usually productive—overturning boulders and stones and kicking in vegetation, in such a way that the fish are swept into a small seine set below and partly around the operation. Such methods employed on July 31, 1948, yielded only the one specimen at the park boundary and none in the river below Cascade Creek or on the Valley floor.

According to L. C. Nixon, foreman of the local State fish hatchery, the "bullheads" that occur in Merced River near the western Park boundary reach a length of six inches.

The muddlers or fresh-water sculpins (miller's thumb and bull-head are other names) are small scaleless (sometimes prickly) fishes with expanded pectoral fins, the pelvic (ventral) fin below the pectoral base, two dorsal fins (the first with low, threadlike spines), a broad and rather flat head, a small eye on the upper part of the head, one or more small preopercular spines (on the side of the head), and rather dark, usually mottled color.

The systematics of the American species of **Cottus** is in a state of uncertainty. The far-western form that has generally been named **C. gulosus** should apparently be treated as a subspecies of **Cottus bairdii**, for **gulosus** and **C. b. bairdii** (of eastern North America) seem to belong to the same wide-spread and variable species complex. The form **gulosus** as currently recognized is

perhaps in itself a complex of subspecies and it is not certain that the Merced River form should be identified as **C. b. gulosus**. Several of the local forms in the Sacramento system, including the one named **Cottus shasta**, seem to be worthy of subspecific separation.

In view of the confusion that exists, we give some of the salient

features of the four specimens from the Merced River. The lateral line is complete. Palatine teeth are well developed. Prickles are confined to the axil. The dorsal fins are only slightly connected. The fin rays number: dorsal spines, 9; dorsal soft-rays, 18 (in 3) or 19 (1); anal rays, 13 (1) or 14 (3); pectoral rays, 15 (6 fins) or 16 (2 fins); pelvic rays I, 4; principal caudal rays, 10 (1) or 11 (2).

OTHER SPECIES OF POSSIBLE NATIVE OCCURRENCE

It seems doubtful to us that there will be any further increases in the list of fishes known to be native in the waters of Yosemite National Park. Even a considerable extension of the boundaries (or a considerable trip beyond the present limits) would probably add none. The Mono Lake drainage basin across the Sierra rim to the eastward seems to be devoid of native fish life (Hubbs and Miller, 1948, pp. 78-79). It is unlikely that the Park area will be extended far enough to the northeastward to include waters in the Walker River system that contain native Lahontan species. An extension of the boundary in the mountains northward or southeastward or southward would presumably bring in no additional species. An extension to much lower elevations to the westward would probably be required to add other species.

There are now known from within the Park all species that have been obtained during extensive collecting in the Merced River at Indian Flats at an elevation of about 1,550 feet. Collections were made there in July and August, 1933, during the fish survey conducted by Alan C. Taft, Leo Shapovalov, Paul R. Needham and Francis H. Sumner, and on July 24, 1938, by Carl L. Hubbs and Robert R. Miller. Both parties collected only **Catostomus occidentalis**,

Ptychocheilus grandis, **Hesperoleucus conocephalus** and **Hesperoleucus symmetricus**. We are greatly indebted to Mr. Shapovalov, now with the California State Division of Fish and Game, for permission to examine and to list fishes taken during the 1933 survey.

Since none of the other, more lowland species of the Central Valley were obtained at 1,550 feet in Indian Flats, it is extremely doubtful that any of them have ever reached the Park boundaries, or will likely do so by natural dispersal. Exclusive of the anadromous forms which with even greater assurance can be regarded as unable to reach the Park at present, these lowland forms may be listed as follows:

Lampreys, family Petromyzonidae: European brook lamprey, **Lampetra planeri** (Bloch).

Minnnows, family Cyprinidae: blackchub, **Orthodon microlepidotus** (Ayres); splittail, **Pogonichthys macrolepidotus** (Ayres); thicktail, **Gila crassicauda** (Baird and Girard); Sacramento hitch, **Lavinia e. exilicauda** Baird and Girard; Sacramento tui, **Siphateles obesus formosus** (Girard).

Sunfishes, family Centrarchidae: Sacramento-perch, **Archoplites interruptus** (Girard).

Surfperches and seaperches, fam-

ily Embiotocidae: valleyperch, **Hysterocarpus traskii** Gibbons.

One other minnow species listed by Rutter (1908, pp. 139-140) as **Agosia robusta** but now called **Rhinichthys osculus**, occurs at various elevations in the Sacramento-San Joaquin system, but oddly seems to skip the Yosemite region in its distribution. The subspecies of this river system are undetermined.

The fish fauna of Yosemite National Park is limited and restricted by the steep gradient of the streams and by the torrential rush of water during the rapid melting of the deep snowfall on the Sierra Nevada. Many species of the Sacramento fauna fail to ascend either the Merced or the Tuolumne River to the western boundary of the Park (at elevations of about 2,200 and 3,150 feet, respectively). Four of the

six kinds that are known to have extended their range beyond the boundary appear to be confined to the lower elevations of the Merced River Canyon. It is possible that they originally occurred as high as Yosemite Valley (3,900 to 4,100 feet elevation), but, if so, they have probably been extirpated there by high water, by the power dam that prevents reinvasion and by the predation of trout, particularly brown trout. Among the native fishes only the rainbow trout and the Sacramento sucker are definitely known to occur either in Yosemite Valley or in the Tuolumne River system within the Park boundaries. Suckers and trout are particularly adept in surmounting torrential waters. As would be expected, no native fish occur above the high plunging falls of Yosemite National Park.

SUMMARY AND CONCLUSIONS

The National Parks have been consecrated to the strict protection of that part of the native animal and plant life which lives above the water surface, but the Park Service has commonly treated the aquatic life as a recreational asset. Hunting is prohibited but fishing is often encouraged. Exotic terrestrial animals are rigidly excluded but exotic fishes have often been stocked. A compromise policy has been adopted. It calls for the preservation of aquatic life in the Parks where conditions are yet unspoiled and otherwise to some degree restricts the recreational developments. The trend toward a preservationist policy for the aquatic life might well be extended when and where it would be practicable to do so. In Yosemite National Park, however, fishing under present regulations will probably have relatively little further effect on the native aquatic life. Drastic measures

would be needed to improve very markedly the natural biotic conditions in the streams. It is recommended, however, that the stocking of the exotic brown be discontinued.

Hitherto only three fish species have been reported as native in Yosemite waters—rainbow trout, **Salmo gairdnerii irideus**; Sacramento sucker, **Catostomus occidentalis**; and a large minnow, the hardhead, **Mylopharodon conocephalus**. We now double the list, adding two minnows (the squawfish, **Ptychocheilus grandis**, and a chub-roach, **Hesperoleucus symmetricus**) and also one fresh-water sculpin, the riffle muddler, **Cottus bairdii gulosus**. Notes are included on the biology of the six native species, including a brief study of the slow growth of the sucker. It is unlikely that any additional native species will be discovered in the Park waters.

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