FISHES OF THE SANTA CLARA RIVER SYSTEM, SOUTHERN CALIFORNIA[1]

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ABSTRACT: The distribution of fishes within the Santa Clara River and most of its tributaries in which fishes were found is described from field observations and 46 fish collections. Fifteen species of fishes were collected, of which five probably are native to the system. All native species are peripheral freshwater fishes so there is no evidence of faunal exchange with adjacent river systems. *Gasterosteus aculeatus* and *Gila orcutti* occurred at almost all collecting stations while five species occurred at only one. This river system contains a high diversity of freshwater fishes for southern California streams. The Santa Clara River system is vulnerable to habitat destruction by urbanization, and potential threats to fishes of the system are discussed.

INTRODUCTION

Although many papers have discussed individual fish species from the Santa Clara River system (Girard 1854; Hubbs 1967; Hubbs, Hubbs and Johnson 1943; Miller 1960, 1968, 1972, 1973; Ross 1973; Smith 1966), its fish fauna has not been described previously. By virtue of its proximity to Los Angeles, this drainage currently is subject to rapid urbanization with the attendant dangers of habitat destruction and pollution. The only known native population of the endangered unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni* (Girard), still survives in this drainage. This drainage also harbors some introduced fishes endemic to southern California and some species of game fishes. Thus, it is desirable to describe the fish fauna before disturbance of the ecosystem causes the elimination of some species. This description will serve in the future as a base line to assess the impact of urbanization on the fish fauna.

MATERIALS AND METHODS

Forty-six fish collections were made at varying intervals from the mouth of the Santa Clara River system to as far upstream as water existed except in Piru and Santa Paula creeks primarily between September 4 and November 9, 1975 (Fig. 1). Collections were made in the Santa Clara River, Todd Barranca, Sespe Creek, Piru Creek

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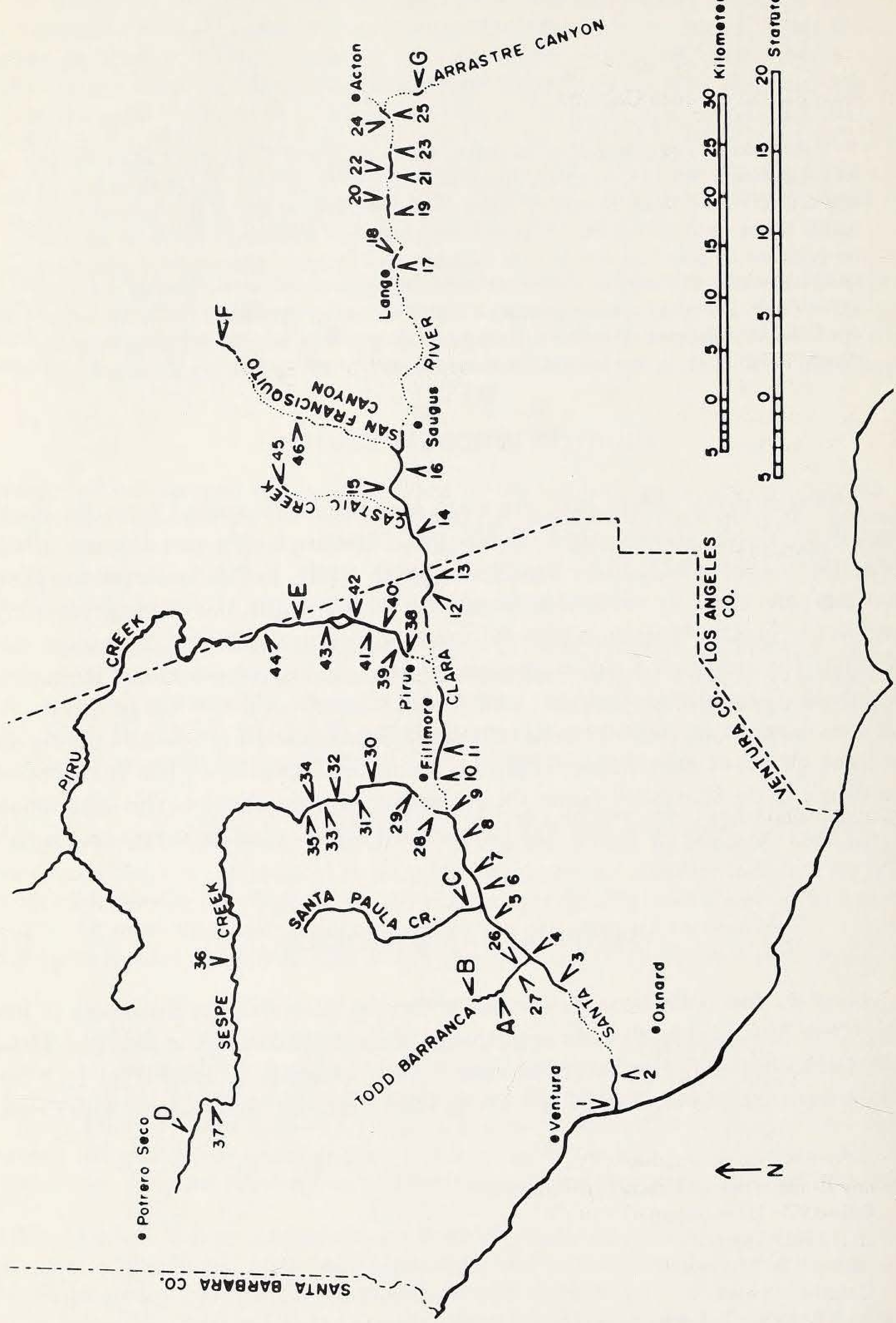

FIGURE 1. Map of the Santa Clara River system showing the location of collections (numbers) and observations (letters).

and San Francisquito Canyon. Arrastre Canyon and Santa Paula Creek were examined briefly, but no collections were made. The original purpose of the sampling program was to determine the distribution of threespine stickleback (*Gasterosteus aculeatus*) phenotypes. This species favors areas of low velocity flow so most collections were made in backwaters, side streams, pools and mainstream margins. Samples are thus biased against those species preferring rapidly flowing water. For this reason, estimates of abundance, which may be misleading were not made, and the absence of a species from a sample should be interpreted with caution.

Collecting stations were selected for accessability and the presence of suitable habitat for *Gasterosteus*. The position of stations was determined in the field using local landmarks, and they were recorded on U.S.G.S. 7.5 minute series (topographic) maps. The distance of collection stations from the mouth in the Santa Clara River and from the confluence with the Santa Clara River in tributaries was determined by stepping off that distance on the topographic maps using dividers set at 0.1 km. Stream gradient was determined by stepping off the distance between one or two contour lines up and downstream of the station with dividers set for 500 or 200 feet. Because of irregularities in stream course, the distance from the mouth or confluence tends to be a slight underestimate and the gradient a slight overestimate using this method.

Surface temperature and velocity were measured where the majority of fishes was collected at each station. Thermometers were calibrated to within 0.5 C of the freezing and boiling point of distilled water. Water temperature tended to vary with the air temperature. Water velocity was determined by measuring the time required for a vial partially filled with water (so only a corner protruded above the surface) to drift 5 m. Water depth, stream width, amount of vegetation, bottom composition and water color were typical of the habitat, but collecting frequently extended across a heterogeneous segment of stream.

Fishes were collected with a 10 foot (3.048 m), ⅛ inch (3.175 mm) mesh knitted nylon seine. The collecting effort usually varied inversely with the abundance of *Gasterosteus*. Specimens were fixed in 10% formalin and transferred to 50% isopropyl alcohol 4 to 10 days after collection. Eddy (1957), Kimsey and Fisk (1960), Robins and Miller (1957) and Smith (1966) were useful for identification. The current scientific and common names were verified in Baily (1970). All collections were deposited in the fish collection of the Natural History Museum of Los Angeles County (LACM). These are station 1, LACM 34071, station 2 to 44, LACM 34198 to 34240 respectively, station 45, LACM 35228, and station 46, LACM 34241. LACM 35227 also came from station 31 and LACM 35648 was collected near station 30. Additional specimens from the California Academy of Sciences Fish Collection (CAS) were examined to verify early collection records (CAS 20283, CAS 20284 and CAS Acc. No. X:30).

I attempted to determine whether species presently occuring in or previously reported from the Santa Clara River system were native or introduced. This is a relatively simple task for species known to be introduced from distant sources, but those native to southern California present a problem. One must depend on historical records, distribution patterns, the original presence of appropriate habitats and the existence of dispersal routes for entry into the system. Only negative historical data can be brought forth to support the hypothesis that a species is introduced. The failure of a species to be observed or collected (negative data) until recent times may be a result of recent introduction or from erroneous observation, identification or incomplete collection in the past. Even if there is a record of introduction, the species may already have been present before the introduction. The confidence placed in the conclusion based on historical data that a species is introduced depends on the quality of the original observation. Reasoning based on distribution patterns, the presence of appropriate habitats and dispersal routes is inferential. Fishes do not always occur in habitats that they can disperse into and that appear to be appropriate for them. Thus, as much evidence as possible must be brought to bear on the question of whether a fish species is native, and the answer obtained may never be satisfactory.

RESULTS

DESCRIPTION OF STREAMS

The Santa Clara River system is composed of the Santa Clara River and a large number of tributaries primarily draining from the north (Fig. 1). The drainage is bounded on the southwest by the Santa Susana Mountains and on the southeast by the San Gabriel Mountains. No substantial tributaries of the Santa Clara River drain these mountain ranges. The Santa Susana Mountains are drained to the south by Calleguas Creek and its tributaries. The southern slope of the San Gabriel Mountains is drained by tributaries of the Los Angeles and San Gabriel Rivers.

In the west, the headwaters of Sespe and Piru creeks are interdigitated with those of the Cuyama River, a tributary of the Santa Marie River and tributaries of the small Ventura River system.

Drainage north of the Santa Clara River system is by creeks which eventually disappear into the southern San Joaquin Valley. The eastern corner of the Santa Clara River system is bounded by these creeks as well as those of the Los Angeles River system and some draining into the Mojave desert.

The Santa Clara River, Santa Paula, Sespe, Piru and Castaic creeks, San Francisquito and Arrastre canyons and Todd Barranca were studied. Other tributaries east of Saugus were not studied because J. N. Baskin (personal communication) reported no fishes there. Some tributaries in the western portion of the drainage could not be studied or received cursory examination because of limitations of time, funds or access.

The Santa Clara River was examined from its headwaters to its mouth. Flow is intermittent over substantial lengths of the stream (dotted lines, Fig. 1) and the geographic extent and duration of desiccation varies yearly. The section between Lang and Saugus is dry except during heavy downpours, a condition that apparently has existed since at least the middle of the last century (Miller 1960). The Santa Clara River and its tributaries are subject to flooding some winters. The river flows through a broad, primarily sandy-bottomed valley. In most places, the flood plain is lined by earth and rock or wire and debris barriers. The Southern Pacific Railroad runs the length of the Santa Clara River, built across the flood plain on elevated grades in places. Upstream of Saugus the flood plain is occupied by gravel pits, small recreational parks or is undeveloped. The Saugus area presently is undergoing rapid urbanization. The flood plain, beginning just upstream of Piru Creek, is occupied by citrus orchards, which bound most of the river on both sides except for small gaps at the cities of Fillmore, Santa Paula, Satacoy and Oxnard. The Oxnard-Satacoy region also is an area of rapid urban growth.

The first tributary studied was Todd Barranca, a small stream that drains Wheeler Canyon and flows across the flood plain of the Santa Clara River, entering it at Santa Paula. Fishes were present in the lower portion.

Only the lower kilometer of Santa Paula Creek, which is enclosed in a rock and earth levee was examined (stat. C). No fishes were seen.

Sespe Creek is a large tributary of the Santa Clara River. Numerous small waterfalls a few centimeters to more than 3 m high occur from 12 to 17 km (and probably farther) upstream of the confluence with the Santa Clara River (stats. 32-35). Much of the stream flows through deep, narrow canyons over rocky substratum. Practically the whole Sespe Creek drainage is contained in Los Padres National Forest (including the Sespe Condor Sanctuary, where no samples could be collected) and is protected as recreational land or wildlife sanctuary.

Piru Creek is the largest tributary to the Santa Clara River. Flow volume fluctuates according to the amount of water released from Lake Piru through Santa Felicia Dam, and the creek receives imported water from Pyramid Reservoir. The canyon through which Piru creek flows in that portion studied is broad and sandy-bottomed. Piru Creek is primarily within the Los Padres National Forest.

Castaic Creek is located in a dry, broad, sandy-bottomed valley. Castaic Lake is a reservoir that receives imported water from Pyramid Reservoir. The only flowing water seen in this creek during the summer was water being released from a small impoundment below Castaic Lake at station 45.

San Francisquito Canyon contains three areas of continuous flow: where it joins the Santa Clara River, and at two points upstream. One point upstream is where water released from Drinkwater Reservoir tumbles out of Drinkwater Canyon and flows for about 200 m along the bottom of San Francisquito Canyon before sinking into the sand. On February 1, 1976 this stream segment had increased to 1400 m long. Such extensions are characteristic of the Santa Clara River system in the winter. The second point upstream where the stream flows is for a few kilometers below San Francisquito Powerhouse No. 1. The canyon bottom varies in width and generally is dry and sandy.

Arrastre Canyon is one of several canyons that converge to form the headwaters of the Santa Clara River. A small flow descends the steep sandy bottom of this shallow canyon, sinking into the sand and forming small pools. Like San Francisquito Canyon, this is a remote and little disturbed canyon.

FISH DISTRIBUTIONS

Fifteen fish species were collected from 46 collecting stations. The characteristics of these stations are indicated in Table 1. Fishes collected are listed below (numbers in parentheses indicate the number of stations at which the species was collected):

Gasterosteus aculeatus Linnaeus Threespine stickleback (42)

Gila orcutti (Eigenmann and Eigenmann) Arroyo Chub (37)

TABLE 1

Physical characteristics of collecting stations. The values under Distance Upstream column opposite tributaries indicate the distance of the confluence of the tributary with the Santa Clara River from the mouth. Numbers in the Bottom column indicate: 1, detritus and/or mud; 2, sand; 3, gravel; 4, cobble; and 5, rock.

STREAM and STATION	DISTANCE UPSTREAM (Km)	WATER TEMP. (C)	WATER DEPTH (cm)	STREAM WIDTH (m)	WATER VELOCITY (cm/sec)	PLANT COVER	BOTTOM	WATER COLOR	GRADIENT (%)
St. Clra									
1	1.1	24	12	6	35.7	+	1,2	clear	0.24
2	3.9	25	5	3-4	25.0	+	1,2	"	0.21
3	14.2	22	50	96	none	+	2	"	0.36
4	18.0	21	30	14	negligible	+	1,2	"	0.40
5	23.3	23	25	12	55.5	+	2	"	0.42
6	25.6	25	20	5	negligible	+	1,2,4	"	0.57
7	27.7	24	15	13	50.5	+	2,3	"	0.30
8	32.0	19	12	3.5	20.0	+	1,2	"	0.27
9	35.3	21	15	5-6	20.0	–	2	"	0.42
10	39.3	21	70	3	35.7	+	2,3	"	0.56
11	42.3	17	40	11	21.7	+	1,2	"	0.59
12	58.8	26	20	3	35.7	+	2	green	0.56
13	60.4	28	40	8	rapid	+	2,3	brown	0.67
14	64.7	18	35	20	variable	+	2	"	0.59
15	71.8	23	15	2.5	negligible	+	2	clear	0.76
16	74.5	20	15	3.5	20.0	+	2	brown	0.69
17	97.6	19	70	30	none	+	2	clear	0.89
18	98.1	18	15	25	negligible	+	2,3,4	"	0.89
19	103.7	27	30	4.5	55.5	–	2,3	"	1.08
20	105.3	21	30	4	83.3	+	2,3	"	1.25
21	107.4	20	45	16	negligible	+	2	"	1.26

22	108.2	20	70	13	negligible	+	2,4	"	1.90
23	110.5	20	30	4-5	negligible	+	2	"	1.25
24	114.2	21	50	18	negligible	+	1,2,4	"	1.54
25	114.6	19	15	3-4	45.5	+	2	"	2.08
Todd	17.3								
26	1.1	20	13	4	29.4	+	2	"	.95
27	2.6	19	40	2	16.1	+	2	"	1.21
Sespe	35.3								
28	1.6	21	10	5	12.5	+	2,3,4	"	0.67
29	4.3	20	60	1	negligible	+	2,3,4	"	0.59
30	8.0	19	50	3	negligible	+	2,4	"	0.80
31	11.7	?	100	?	negligible	–	2,4,5	"	2.05
32	13.1	?	100	4.5	none	+	2,4,5	"	9.41
33	14.2	23	100	7	negligible	+	4,5	"	2.58
34	15.2	24	150	?	negligible	+	2,3,4,5	green	3.64
35	16.5	23	130	7.2	negligible	+	2,4	clear	4.00
36	49.0	12	40	4	15.2	+	1,4	"	0.46
37	70.9	10	65	3	negligible	–	1,4	"	1.56
Piru	51.8								
38	2.0	27	50	2	negligible	+	1	brown	0.89
39	3.5	27	50	9	33.3	+	1,2,4	green	0.73
40	5.9	24	40	3	35.7	+	1	brown	0.89
41	7.5	25	30	9	55.6	+	1,2,4	"	0.77
42	9.1	23	30	9.5	23.3	+	1,4	green	0.89
43	12.0	27	20	?	none	–	1	brown	0.80
44	18.7	19	50	6	variable	–	1,2,4	clear	0.71
Castaic Cr	69.8								
45	8.1	25	30	10	variable	+	2	"	0.80
S. Frqto	75.4								
46	13.9	24	25	5	29.4	–	2,4	"	1.08

Gambusia affinis (Baird and Girard) Mosquitofish (24)
Catostomus (*Pantosteus*) *santaanae* (Snyder) Santa Ana sucker (20)
Pimephales promelas Rafinesque Fathead minnow (15)
Salmo gairdneri Richardson Rainbow trout (5)
Lepomis cyanellus Rafinesque Green sunfish (6)
Micropterus salmoides (Lacépède) Largemouth bass (4)
Ictalurus punctatus (Rafinesque) Channel Catfish (1)
Cottus asper Richardson Prickly sculpin (3)
Notemigonus crysoleucas (Mitchill) Golden shiner (1)
Dorosoma petenense (Günther) Threadfin shad (1)
Eucyclogobius newberryi (Girard) Tidewater goby (1)
Leptocottus armatus Girard Pacific staghorn sculpin (1)
Lampertra tridenteta (Gairdner) Pacific lamprey (2)

Fish collection records are summarized in Table 2 and the locations of collection stations are shown in figure 1.

Gasterosteus acculeatus occurred in every stream where fishes were found except in Arrastre Canyon and Castaic Creek. It was abundant at all stations where it occurred except in the Santa Clara River between Saugus and Piru and in the headwaters of some tributaries. This species was collected by J. N. Baskin (personal communication) at my station F, farther upstream in San Francisquito Canyon than I was able to find it.

Gila orcutti penetrates farther into headwaters than *Gasterosteus*. In addition to being widespread in the Santa Clara River and all tributaries in which fishes were found, it was observed in Arrastre Canyon (stat. G) and farther up San Francisquito Canyon (stat. F), Sespe Creek (stat. D) and Piru Creek (stats. 43, 44, E) than *Gasterosteus*.

Gambusia affinis, *Catostomus santaanae* and *Pimephales promelas* are all widespread in the Santa Clara River but are restricted in some tributaries. *Gambusia affinis* apparently is absent above station 22 in the upper Santa Clara River and was not found above station 30 in Sespe Creek or station 39 in Piru Creek. Generally the absence of *Gambusia* is associated with an increase in stream gradient (Table 1). *Catostomus santaanae* was absent from small tributaries like Todd Barranca, San Francisquito Canyon and Arrastre Canyon and also from the headwaters of Sespe Creek (above stat. 32). However, J. N. Baskin (personal communication) found it and *Gila orcutti* in isolated pools in Mill Canyon, which joins the Santa Clara River near station 23. *Pimephales promelas* has a more restricted distribution. In the Santa Clara River, it occurred below station 14 and has only entered the lower gradient portions of Sespe Creek, below station 30. However, fathead minnows were seen above Lake Piru and were collected in the lake, in two stations downstream in Piru Creek and below Castaic Lake.

The only other widespread species is *Lepomis cyanellus,* which was taken at six disjunct stations in the Santa Clara River, Todd Barranca, Castaic Creek and seen in Sespe Creek. It probably occurs elsewhere, but may be rare and difficult to collect.

Other species found in the system are either locally abundant or associated with unusual conditions. *Salmo gairdneri* lives in the discharge of Fillmore Fish Hatchery

TABLE 2
Distribution of fishes in the Santa Clara River systems. Symbols: +, species collected; S, species seen, but not collected.

STREAM and STATION	*Gasterosteus aculeatus*	*Gila Orcutti*	*Gambusia affinis*	*Catostomus santaanae*	*Pimephales promelas*	*Salmo gairdneri*	*Lepomis cyanellus*	*Micropterus salmoides*	*Ictalurus punctatus*	*Cottus asper*	*Notemigonus crysoleucas*	*Dorosoma petenense*	*Eucyclogobius newberryi*	*Leptocottus armatus*	*Lampetra tridentata*	STAT.
St. Clra																
1	+	+	+	•	+	•	•	•	•	•	•	•	+	+	•	1
2	+	+	+	•	•	•	•	•	•	•	•	•	•	•	•	2
3	+	•	+	•	+	•	•	•	•	•	•	•	•	•	•	3
4	+	+	+	•	+	•	+	•	•	•	•	•	•	•	•	4
5	+	+	+	+	+	•	+	•	+	•	•	•	•	•	•	5
6	+	+	+	•	+	•	•	•	•	•	•	•	•	•	•	6
7	+	+	+	+	+	•	•	•	•	•	•	•	•	•	•	7
8	+	+	•	•	•	•	•	•	•	•	•	•	•	•	•	8
9	+	+	•	+	+	•	•	•	•	•	•	•	•	•	•	9
10	+	+	+	+	•	•	•	•	•	•	•	•	•	•	•	10
11	+	S	•	+	•	S	•	•	•	•	•	•	•	•	•	11
12	+	+	+	+	+	•	+	•	•	•	•	•	•	•	•	12
13	•	+	+	•	+	•	•	•	•	•	•	•	•	•	•	13
14	+	+	+	+	•	•	•	+	•	•	•	•	•	•	•	14
15	+	•	+	•	•	•	•	•	•	•	•	•	•	•	•	15
16	+	+	+	+	•	•	•	•	•	•	•	•	•	•	•	16
17	+	•	+	+	•	•	•	•	•	•	•	•	•	•	•	17
18	+	•	+	+	•	•	•	•	•	•	•	•	•	•	•	18

TABLE 2 (continued)

Distribution of fishes in the Santa Clara River systems. Symbols: +, species collected; S, species seen, but not collected.

STREAM and STATION	*Gasterosteus aculeatus*	*Gila Orcutti*	*Gambusia affinis*	*Catostomus santaanae*	*Pimephales promelas*	*Salmo gairdneri*	*Lepomis cyanellus*	*Micropterus salmoides*	*Ictalurus punctatus*	*Cottus asper*	*Notemigonus crysoleucas*	*Dorosoma petenense*	*Eucyclogobius newberryi*	*Leptocottus armatus*	*Lampetra tridentata*	STAT.
19	+	+	+	+	•	•	+	•	•	•	•	•	•	•	•	19
20	+	+	+	+	•	•	•	•	•	•	•	•	•	•	•	20
21	+	•	+	+	•	•	•	•	•	•	•	•	•	•	•	21
22	+	+	+	+	•	•	•	•	•	•	•	•	•	•	•	22
23	+	+	•	+	•	•	•	•	•	•	•	•	•	•	•	23
24	+	+	•	+	•	•	•	•	•	•	•	•	•	•	•	24
25	+	+	•	•	•	•	•	•	•	•	•	•	•	•	•	25
Todd																
26	+	+	+	•	•	•	+	•	•	•	•	•	•	•	•	26
27	+	+	+	•	•	•	•	•	•	•	•	•	•	•	•	27
Sespe																
28	+	+	•	+	•	•	•	•	•	•	•	•	•	•	•	28
29	+	+	•	+	+	•	•	•	•	•	•	•	•	•	•	29
30	+	+	+	•	+	•	•	•	•	•	•	•	•	•	+	30
31	+	+	•	+	S	•	S	•	•	•	•	•	•	•	+	31
32	+	+	•	S	•	+	•	•	•	•	•	•	•	•	S	32
33	+	+	•	•	•	+	•	•	•	•	•	•	•	•	•	33
34	+	+	•	•	•	+	•	•	•	•	•	•	•	•	•	34

35	+	+	•	•	•	+	•	•	•	•	•	•	•	•	•	35
36	+	+	•	•	•	+	•	•	•	•	•	•	•	•	•	36
37	+	+	•	•	•	S	•	•	•	•	•	•	•	•	•	37
Piru																
38	+	•	+	•	+	•	•	•	•	•	•	•	•	•	•	38
39	+	+	+	•	+	•	•	•	•	•	•	•	•	•	•	39
40	+	+	•	•	•	•	•	•	•	•	•	•	•	•	•	40
41	+	+	•	•	•	•	•	•	•	•	•	•	•	•	•	41
42	+	+	•	•	•	•	•	+	•	+	•	•	•	•	•	42
43	•	•	•	•	+	•	•	+	•	•	+	+	•	•	•	43
44	•	+	•	+	•	•	•	+	•	+	•	•	•	•	•	44
Castaic Cr.																
45	•	•	•	•	+	•	+	•	•	+	•	•	•	•	•	45
S. Frqto																
46	+	+	•	•	•	•	•	•	•	•	•	•	•	•	•	46

(trout) and in favorable riffle and pool habitats of Sespe Creek. It was observed but not collected above Lake Piru (stat. E). *Lampetra tridentata* is restricted to Sespe Creek. One dead adult specimen was collected at station 31, one badly decomposed adult was observed at station 32 and D. L. Soltz (personal communication) collected several adults from near station 29 in June 1975. I also obtained two ammocetes (LACM 35648) at station 30. *Notemigonus crysoleucas, Dorosoma petenense, Cottus asper* and *Micropterus salmoides* were found mainly in the vicinity of Lake Piru. *Micropterus* also was collected below Castaic Lake and in the Santa Clara River, 5 km downstream of the juncture with Castaic Creek (stat. 14). It also was observed in private ponds along the upper reaches of the Santa Clara River (near stat. 19) but not in the river. *Cottus asper* was found at stations 42, 44 and below Castaic Lake at station 45 and was observed at station E, near Lake Piru. *Dorosoma petenense* and *Notemigonus crysoleucas* were collected only in Lake Piru.

Eucyclogobius newberryi and *Leptocottus armatus* are species that frequently occupy the mouths of rivers but fail to penetrate far inland. They were taken only at station 1. Other marine fishes that enter stream mouths might have been collected if it had been possible to collect closer to the mouth of the river.

CONCLUSIONS AND DISCUSSION

Limitations of Data

To collect fishes by seining is at best an incomplete sampling method, although it is the most practical one considering the large number of samples and the limited resources available to make collections. The distributions here presented are based on a series of collections made mostly during a short time span, obtained from a varying number of seine hauls, generally from slow moving to still water because sampling of sticklebacks was the primary objective. Seining is not ideal to obtain a complete representation of the distribution of diverse fishes. Some species may have been overlooked because special collecting techniques are required for capture. For instance, *Lampetra tridentata* was found in Sespe Creek only by making a special trip to look for adults during the spawning season. Rarer species, such as *Lepomis cyanellus*, might have been collected at more stations if collecting had been more intense. Abundance or distribution of some species varies seasonally and these species would have occurred at more stations had they been sampled year round. Thus, the results of these collections are minimal measures of species diversity and distribution in the Santa Clara River.

Native Fishes

Of the 15 fishes collected, *Gasterosteus aculeatus, Eucyclogobius newberryi, Leptocottus armatus, Salmo gairdneri* and *Lampetra tridentata* are native. *Gasterosteus acculeatus* was found in the headwaters of the Santa Clara River near Acton during surveys for a Pacific railroad route in the middle 1800's (Miller 1960). This form was described as *Gasterosteus williamsoni* by Girard (1854) from "Williamson's Pass," now known as Soledad Canyon (Miller 1960). Sticklebacks were present in the area now occupied by the Santa Clara River system as early as the Pliocene (David 1945; Bell 1973). Miller (1968) stated that *Gasterosteus aculeatus* was the only fish originally present in the Santa Clara River system. It appears to be native to most of the system and in 1947 was collected in San Francisquito Canyon (CAS 20284) where it may or may not be native. Two subspecies of *G. aculeatus* have been recognized from this drainage (Miller and Hubbs 1969): *G. A. williamsoni*, mostly upstream of Saugus, and *G. a. microcephalus* from the headwaters of Sespe Creek. Intergrades between these two subspecies occupy much of the remainder of the drainage (Bell 1976).

Hubbs (1946) reported large and consistent runs of *Salmo gairdneri* into the Santa Clara River. Sespe Creek between stations 31 and 35 is high gradient and consists of riffles and pools. Although water temperauture is near the upper limits for *Salmo* during the summer, they still are abundant. Thus, *Salmo* almost certainly is native to Sespe Creek. Piru Creek and the Santa Clara River are much less suitable for *S. gairdneri*. Rainbow trout are restricted to a few deep spots in the generally shallow Piru Creek. California Department of Fish and Game records indicate that *S. gairdneri* has been planted in Piru Creek since at least 1931, and these may be the original source of trout observed at station E. Those observed at station 11 in the Santa Clara River certainly had escaped from the Fillmore Hatchery just upstream of the station. Although they were very abundant in the artificially cooled water flowing out of the hatchery, they were absent 3 km downstream at station 10.

Eucyclogobius newberryi and *Leptocottus armatus* are euryhaline species that have entered the Santa Clara River from the sea. There is no reason to believe that they are introduced.

A fifth native species is *Lampetra tridentata* (placed in this genus by Hubbs 1971), the Pacific lamprey. Hubbs (1967) reported on three specimens from Sespe Creek about 3 miles north of Fillmore (near stats. 30 and 31).

The native fishes of the Santa Clara River system have one thing in common, they all are either anadromous or peripheral freshwater fishes. Peripheral freshwater fishes are those restricted to freshwater immediately adjacent to the sea and the distributions of which are the result of dispersal through the sea (Darlington 1957), whereas anadromous fishes spend a portion of their life cycle in marine water but enter fresh water to spawn. Thus, all native fishes could have entered the Santa Clara River system from the sea and there is no evidence that there has been any exchange between the ichthyofauna of the Santa Clara River system and those of adjacent river systems.

CALIFORNIA FISHES INTRODUCED TO THE SANTA CLARA RIVER SYSTEM

Miller (1968) listed three fish species from California which have been introduced to the Santa Clara River system. *Rhinichthys osculus* (Girard), the speckled dace, is native to Santa Ana River system (Culver and Hubbs 1917), San Luis Obispo Creek (based on Jordan 1894) and other coastal streams north of the latter. Miller (1968) commented on the disjunct distribution of this species but concluded that it was introduced to the Santa Clara River system. I did not collect this species there. Another native to the Santa Ana River system, *Catostomus* (*Pantosteus*) *santaanae* (Snyder 1908), apparently is introduced to the Santa Clara River system. Miller (1968:175) concluded that the Santa Ana sucker is introduced based on the testimony of "An old resident of that drainage. . . " that a fish (i.e., *Gasterosteus aculeatus)* ". . . about 2 or 3 inches long, that swam in a jerky fashion and curled its tail when at rest." was the only species originally present. *Catostomus santaanae* had been introduced to the Santa Clara River by 1934, when it also was found in Piru Creek (R. R. Miller personal communication). It was abundant in the Santa Clara River between Piru and Fillmore, and in the lower reaches of Sespe Creek by 1940 (Hubbs et al. 1943). Hubbs et al. (1943) reported another unidentified *Catostomus* of the subgenus *Catostomus* and numerous hybrids between it and *Catostomus santaanae* collected between 1939 and 1942. Smith (1966) stated that *C. santaanae* from the Santa Clara River drainage has features indicating introgression by a sucker of the subgenus *Catostomus* (i.e., papillae on the anterior face of the upper lip). The source of the second species of *Catostomus* was unknown to Hubbs el al. (1943), but it is referred to the Owens sucker, *Catostomus fumeiventris* Miller (1973) in his synonomy of that species. It apparently was introduced by a release of Owens River water from the Los Angeles Aqueduct. Owens suckers are endemic to the Owens River basin but have been introduced to June Lake in Mono basin and the Santa Clara River drainage (Miller, 1973). I detected neither *C. fumeiventris* nor its hybrids and backcrosses with *Catostomus santaanae* in my samples, but other recent surveys have reported them to be present (A. W. Wells and J. S. Diana personal communication).

Gila orcutti is the third California species that has been introduced to the Santa Clara River system. Miller (1968) also concluded that this species was introduced because of the report that *Gasterosteus aculeatus* was the only native fish. *Gila orcutti* is native to many streams from San Luis Rey River (Riverside County) north to Malibu Creek (Los Angeles County) (Miller 1968). This species was first collected in the Santa Clara River in 1934 (Miller 1968) when it also was found in Piru Creek (R. R. Miller personal communication). Arroyo chubs were collected in San Francisquito Canyon in 1947 (CAS 20253), and they are now the most widespread fish in the system.

Cottus asper ranges south to Ventura County (Eddy 1957), and it has been collected in the Ventura River (R. R. Miller personal communication) which enters the Pacific Ocean just north of the Santa Clara River. Prickly sculpins were found only in the vicinity of Lake Piru (stats. 42, 44, E) and Castaic Lake (stat. 45) but nowhere else. R. R. Miller sampled Piru Creek several times since 1934 without collecting *C. asper* (R. R. Miller personal communication). Both Lake Piru and Castaic Lake receive water from Pyramid Reservoir which receives its water from the Sacramento and San Joaquin River drainages. *C. asper* occurs in the Sacramento River (Evermann and Clark 1931) and this is probably the original source of all *Cottus* in the Santa Clara River system.

OTHER FISHES INTRODUCED TO THE SANTA CLARA RIVER SYSTEM

Other fishes found in the Santa Clara River system are not native to California. *Pimephales promelas* first was collected in California in 1950 and since has been introduced to many waters (Shapovalov, Dill and Cordone 1959). *Gambusia affinis* was introduced to California in 1922 and has become widespread for mosquito control (Miller 1961). *Lepomis cyanellus* probably was introduced with bluegill (*Lepomis macrochirus* Rafinesque) which it resembles when it is small (Evermann and Clark 1931). *Ictalurus punctatus* was first introduced to California in 1895 (Evermann and Clark 1931) and has been introduced widely. *Ictalurus melas* (Rafinesque), the black bullhead, was reported from near station 17 by J. N. Baskin (personal communication), but I did not collect it anywhere in the system.

Two fishes associated with Lake Piru probably were introduced there as forage species for *Micropterus salmoides,* which was introduced for sport fishing. One, *Dorosoma petenense,* was introduced to California in 1953 because it is suited to the warm fluctuating waters of reservoirs (Kimsey 1954). The other, *Notemigonus crysoleucas,* was reported in small creeks near San Diego by Evermann and Clark (1931) and since has been introduced to many reservoirs.

DISTRIBUTION PATTERNS

Threespine sticklebacks and Arroyo chubs are the most widespread fishes in the Santa Clara River system. Native *Gasterosteus aculeatus* are found throughout the drainage wherever there is slowly moving water, except in the smallest headwaters. However, introduced *Gila orcutti* is more widespread, occurring farther upstream than the native stickleback. *Gila orcutti* has dispersed well probably because it is native to small coastal streams similar to the Santa Clara River system and can withstand a stronger current than can *Gasterosteus* (J. N. Baskin personal communication). But another coastal stream fish, *Catostomus* (*Pantosteus*) *santaanae,* apparently is not sustained by the smaller flows (i.e., Arrastre Canyon, San Francisquito Canyon and Todd Barranca) and has not penetrated above the low falls in Sespe Creek (stat. 32).

Three other introduced fishes, though widespread, have not penetrated higher gradient tributaries. *Gambusia affinis* is present in the stream margins and pools of low gradient areas but apparently has not become established in some of the steeper tributaries. Mosquitofish have entered the upper Santa Clara River but have not spread to its higher reaches. *Pimephales promelas* is restricted to low gradient portions of the system except Piru Creek and below Castaic Lake. In Piru Creek, it was found in Lake Piru and upstream (stat. E) and downstream (stats. 38, 39) of the lake. Fathead minnows also occur at most stations in the Santa Clara River downstream of station 14 and only have penetrated a short distance up Sespe Creek (stat. 31). The distribution of *P. promelas* indicates that it may have been introduced in imported water, but unlike *Cottus asper,* successfully has dispersed. R. R. Miller (personal communication) over several years of collecting never obtained fathead minnows from Piru Creek, supporting the view that it was introduced recently.

Native species such as *Salmo gairdneri, Lampetra tridentata, Eucyclogobius newberryi* and *Leptocottus armatus* only are found in geographically restricted habitats. *Salmo gairdneri* was found in cooler (stat. 11) and higher gradient (stats. 32 to 37) water (Table 1). *Lampetra tridentata* is restricted to the unique riffle and pool habitat of Sespe Creek. *Eucyclogobius newberryi* and *Leptocottus armatus* were found only at station 1, near the sea.

Notemigonus crysoleucas, Dorosoma petenense and *Micropterus salmoides* apparently were introduced to Lake Piru and with the exception of the latter, are found only there. *Dorosoma petenense* is a fragile fish (Kimsey 1954), which probably could not survive in the small streams of the Santa Clara River system. *Notemigonus crysoleucas* also frequents quiet waters (Hubbs and Lagler 1952). *Micropterus salmoides* favors sluggish waters also (Hubbs and Lagler 1952). Specimens at station 14 in the Santa Clara River, which is typical stream habitat, may have been washed down from Castaic Lake.

The distribution of *Cottus asper* can be easily explained. It was found just above and below Lake Piru and below Castaic Lake and apparently was introduced in imported water (see above). It may be such a recent arrival in the drainage that it has not dispersed. High water temperature and other adverse habitat characteristics may retard or limit its ultimate distribution.

VULNERABILITY OF THE ICHTHYOFAUNA

The Santa Clara River system includes diverse aquatic habitats ranging from high gradient streams to sluggish, meandering streams with ponds and swampy areas. These diverse habitats support at least 15 species of fishes which are threatened by human activities. One problem is the increase of the human population centering around Saugus. Human population growth probably will increase habitat destruction, stream pollution, introduction of aquatic species, ground water exploitation and public pressure to channelize streams in the drainage. Another problem is the storage of imported water within the drainage.

Salmo gaireneri is probably immune to human disturbance because it is practically restricted to Los Padres National Forest. However, other fishes are more vulnerable because they are either found primarily in the Santa Clara River and lower portions of tributaries that are, for the most part, outside of the national forest or pass through this part of the drainage during spawning runs (i.e., *Lampetra tridentata*). This part of the drainage, from about the town of Piru to the sea, is occupied by citrus groves that seem to be compatible with the survival of fish populations. However, in some places, water draining from the citrus orchards has left a residue of silt. It is possible that fertilizers and pesticides also are being washed out of the orchards, though there is no evidence.

While the citrus orchards along much of the Santa Clara River afford some protection for the fish fauna, urbanization rapidly is spreading near Saugus (between stats. 16 and 17) and in the Oxnard-Satacoy area (near stats. 1 and 2). Urban growth in the vicinity of Saugus already has produced some pressure to channelize parts of the Santa Clara River drainage. On December 11, 1972, a hearing was held in Newhall, California where the U.S. Army Corps of Engineers proposed channelization of about 46 km (26.5 miles) of the Santa Clara River system. This proposal included channelization of about 18 km of river between Saugus and Lang, a generally dry stretch of river. This proposed project would not result in the direct destruction of fish habitats, but resultant increased runoff would have unpredictable consequences for habitats downstream. If the proposed concrete-lined channel were constructed, continuous water flow between the upper and lower portions of the Santa Clara River might result. Continuous flow might allow movement of fishes across this area, allowing increased introgression of the endangered subspecies, *Gasterosteus aculeatus williamsoni* (Miller 1972; California Fish and Game Code Sec. 2050 to 2055), by *G. a. microcephalus* (unpublished data). *G. a. williamsoni* is a distinct subspecies divergent from other *Gasterosteus* (Ross 1973; Bell 1976) and its introgression would constitute destruction of an unusual subspecies that is protected by federal and state laws. Channelization also might allow other fishes to invade the upper Santa Clara River.

Extension of channelization into the range of *Gasterosteus aculeatus williamsoni* probably would result in its extinction in the Santa Clara River (J. N. Baskin personal communication). An example of the effect of channelization can be seen in the lower part of Santa Paula Creek. Santa Paula Creek at station C is comparable in gradient (1.54%) to Todd Barranca at stations 26 and 27. Yet three or four species of fishes (including *Gasterosteus aculeatus*) live in the habitat of the latter two stations whereas in the channelized portion of Santa Paula Creek there are no fishes.

Another threat to the fishes of the Santa Clara River is the introduction of organisms that adversely affect fishes. The probability of such introductions is increased by greater human population density through release of bait and aquarium pets. *Xenopus laevis,* the African clawed frog, discovered by J. N. Baskin (personal communication) within the Santa Clara River drainage, probably was introduced by the release of pets and is considered to be a threat to fishes (St. Amant, Hoover and Stewart 1973). Aquatic organisms also may be introduced to the drainage with imported water. Introgression of *Catostomus santaanae* by *Catostomus fumeiventris* apparently resulted from the release of imported Owens River water. The storage of imported water recently has increased within the Santa Clara River basin. Pyramid Reservoir began to fill on January 6, 1972 and water immediately was released from it into Piru Creek. Any fishes that have survived passage through pumping and power plants en route to Pyramid Reservoir may colonize the Santa Clara River. I suggested above that *Cottus asper* and *Pimephales promelas* may have been introduced by this means. Colonization by other species may result in the introgression of *Gasterosteus aculeatus, Gila orcutti* and *Catostomus santaanae,* which are known to hybridize with confamilial species in nature (Hagen 1967; Greenfield and Greenfield 1972; Hubbs et al. 1943). New introductions also may compete with fishes already present in the drainage.

An estimate of the impact of urban growth and channelization may be obtained by examining the ichthyofauna of the Los Angeles Basin. Culver and Hubbs (1917) reported the presence of *Lampetra tridentata, Gasterosteus aculeatus williamsoni, Salmo gairdneri, Gila orcutti, Rhinichthys osculus* and *Catostomus santaanae* in the basin. Since 1917, most low gradient portions of the drainage have been urbanized, most of the streams have been channelized and several fishes have been introduced. Between 1929 and 1942 *Gasterosteus aculeatus williamsoni,* which previously was abundant throughout the system (Culver and Hubbs 1971), became extinct in the basin (Miller 1961). Miller (1961) attributed this extinction to the introduction of *Gambusia affinis*. However, mosquitofish coexist with *G. a. williamsoni* in the Santa Clara River, so its disappearance from the Los Angeles Basin probably was not caused solely by the introduction of *Gambusia*. Miller (1961) also cited the deterioration of surface flow as a contributory factor in the disappearance of *G. a. williamsoni,* and this may have been critical. Recent efforts to collect *Lampetra tridentata* in the Los Angeles Basin also have failed, and this species probably is extinct there (C. C. Swift personal communication). The other four species listed by Culver and Hubbs (1917) have persisted with much reduced ranges, although the presence of *Catostomus santaanae* is questionable. Thus, the condition of the fish fauna of the Los Angeles Basin does not inspire optimism for the future of the fishes of the Santa Clara River system.

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