ADDITIONAL FISH REMAINS, MOSTLY OTOLITHS, FROM A PLEISTOCENE DEPOSIT AT PLAYA DEL REY, CALIFORNIA

By JOHN E. FITCH[1]

ABSTRACT: When the washed screenings from a 200-pound field sample of fossiliferous "dirt" from the Playa del Rey locality (LACMIP 59) were examined a spoonful at a time with the aid of a microscope, 1,174 identifiable otoliths (representing 34 "species") were recovered. Twelve of these species were new to the deposit, as were two of the elasmobranchs from which teeth were found. The yield of fish remains from this "resampling experiment" emphasizes the necessity for using a microscope or similar viewing aid for obtaining accurate information on the fauna contained in a fossil deposit.

Fish otoliths, teeth, and other remains routinely are picked from washed fossiliferous screenings by numerous volunteers (unpaid) and a few salaried employees at the Los Angeles County Museum of Natural History. Most of the sorting has been done by volunteer personnel working in the Invertebrate Paleontology section of the Museum, and their primary concern has been fossil mollusks. Fortunately, most of these student workers were trained by George P. Kanakoff, formerly Curator of Invertebrate Paleontology, who subsequently supervised their activities. Thus, recognizable vertebrate remains, as well as mollusks and other invertebrates, have been saved whenever encountered.

The search-and-removal technique employed at the Museum (Invertebrate Paleontology) involves spreading a thin layer of washed screenings in front of the searcher, and picking from this residue all identifiable vertebrate and invertebrate remains that are observed. Most of the time this work is accomplished without the help of any device that will aid in detection (*e.g.*, magnifying glass, hand lens, microscope, etc.).

Over the years I have found that when I am searching through fossiliferous material for otoliths, I often fail to "see" the numerous mollusks and other invertebrate remains that pass before my vision. Conversely, when I have been looking for and removing mollusks, I often passed up otoliths that I did not see. Because of this, and because many fish otoliths are minute, or odd-shaped, or both, I decided to test the efficiency of the Museum's "perusal-by-eye" technique by examining under a microscope some of the fine material they were discarding after having finished sorting through it.

For finding fossil otoliths, I spread a tablespoonful of washed fossiliferous screenings evenly in a flat plastic dish with slightly raised margins, and systematically search through this material with a pair of forceps while using

[1]Research Associate, Los Angeles County Museum of Natural History; Marine Biologist, California Department of Fish and Game, Terminal Island, California.

a binocular microscope at six magnifications. Almost every spoonful of the Museum's discard yielded one or more otoliths when this technique was used.

Since it appeared that many otoliths were escaping detection, I decided to resample a number of the Museum's fossil localities while they were still accessible. (Each month in southern California fossil deposits of long standing are lost because of freeway construction, housing developments, cut-and-fill projects, and a multitude of other "progressive" activities of modern man.)

Since the fish fauna of the Playa del Rey (Lincoln Avenue) locality already had been reported upon (Fitch, 1964), it seemed an appropriate place to start resampling. The 1,376 identified otoliths from this site (Table 1) had been gleaned by Museum personnel from several tons (at least) of fossil-

TABLE 1. Percentages of otoliths sorted from Playa del Rey screenings by eye (Fitch, 1964) and with the aid of a microscope
(Relative size of otolith: large, medium, small, indicated to left of name)*

Species	How sorted: By eye	How sorted: With scope	Species	How sorted: By eye	How sorted: With scope
s. *Anchoa compressa*		0.3	l. *Micropogon ectenes*	0.1	
l. *Anisotremus davidsoni*	0.1		s. *Occa verrucosa*		0.1
s. *Argentina sialis*		0.1	l. *Otophidium* spp.	16.3	9.7
s. *Atherinops affinis*	0.1	0.9	m. *Paralabrax* sp.		0.3
m. *Atherinopsis californiensis*	0.2	0.1	m. *Paralichthys californicus*	0.1	0.4
s. *Chitonotus pugetensis*	0.1	0.6	m. *Parophrys vetulus*	0.1	0.3
m. *Citharichthys* spp.	21.2	19.0	m. *Phanerodon furcatus*	0.6	
l. *Coelorhynchus scaphopsis*		0.1	s. *Pleuronichthys ritteri*	0.1	
m. *Cymatogaster aggregata*	0.4	0.8	l. *Porichthys* spp.	12.8	24.0
l. *Cynoscion nobilis*	0.4		m. *Prionotus stephanophrys*		0.2
l. *Cynoscion reticulatus*	0.3	0.1	l. *Roncador stearnsi*	0.7	
s. *Engraulis mordax*	4.9	16.5	l. *Sebastodes* spp.	1.8	0.7
l. *Genyonemus lineatus*	15.8	9.9	l. *Seriphus politus*	20.1	9.9
s. *Icelinus quadriseriatus*		0.8	l. *Sphyraena argentea*	0.1	
s. *Lepidogobius lepidus*	0.1	0.7	s. *Stenobrachius leucopsarus*		0.1
l. *Lepophidium negropinna*	0.1		s. *Symbolophorus californiense*		0.1
s. *Leuresthes tenuis*	0.4	0.3	s. *Symphurus atricauda*		1.1
m. *Lyopsetta jordani*	0.1		m. *Trachurus symmetricus*		0.3
m. *Menticirrhus undulatus*	0.1	0.4	l. *Umbrina roncador*	1.0	0.3
l. *Merluccius productus*	1.8	0.9	s. *Zaniolepis latipinnis*		0.1
			Total otoliths	1,376	1,174
			Percent	99.9	99.1

*large = > ⅓ inch; medium = ¼ to ⅓ inch; small = < ¼ inch

iferous material gathered during a period of three decades or more. In fact, this lens-shaped deposit has been so thoroughly sampled in the past that it took some rather diligent searching to obtain a 200-pound field sample.

I routinely screen field samples through three sieves (2, 1, and 0.5 mm, U.S. Standard Sieve Series) that fit one into the other "piggy-back" style. After soaking my field sample in a tub of water, I place several handfuls of the saturated dirt into the top (largest mesh) sieve, submerge all three in a second tub of water to within one-half inch of the top of the upper sieve, and filter the mixture by gently rotating and shaking the submerged screens. When the residue in each screen is clean (a running hose played over the top of each one as it is removed will guarantee best results) I "dump" the contents onto several thicknesses of newspaper and allow it to dry in the sun.

When the sample is dry, I screen the coarsest material through ¼-inch mesh to remove "large" shells, rocks, bone fragments, and similar items. The residue retained by the ¼-inch mesh can be checked by eye for the rare shark tooth or very large otolith it might contain. All remaining material is examined through a binocular microscope at six magnifications. By having washed the samples through three screens, the particles are graded by size and the task of examining the material under the microscope is greatly simplified.

Using these techniques of washing, screening, and sorting, I gleaned 1,174 identifiable otoliths from the 200-pound Playa del Rey field sample (Table 1). Interestingly, while 19 of the 40 "species" were encountered in both samplings, 9 kinds were found only in the earlier diggings, and 12 only in the resampling. The same six "species" (*Citharichthys* spp., *Engraulis mordax, Genyonemus lineatus, Otophidium* spp., *Porichthys* spp., and *Seriphus politus*) were important in both samplings, but the proportions generally were markedly different. *Genyonemus lineatus, Otophidium* spp., and *Seriphus politus* comprised 15.8, 16.3, and 20.1 percent of the 1,376 otoliths sorted by eye, but only 9.9, 9.7, and 9.9 percent of the 1,174 obtained with the aid of the microscope. Obviously, because of their large maximum sizes, otoliths of these three species were "found" with fair frequency by eye. On the other hand, the small otoliths of *Engraulis mordax* comprised only 4.9 percent of the earlier sample, but made up 16.5 percent of the yield from resampling–their small maximum size unquestionably contributed to the low numbers found with the naked eye. The 24.0 percent recovery rate for *Porichthys* spp. otoliths with the microscope, compared to 12.8 percent by eye, was a result of two factors: failure of earlier sorters to recognize them because of their odd shape, and the difficulty of discerning with the naked eye the great numbers of small midshipman otoliths present in this deposit (many of the *Porichthys* otoliths recovered by use of the microscope were 2 mm or less in greatest dimension).

Otoliths of six of the nine species found by Museum personnel, but not encountered in my resampling, were large, two were medium sized, and one was small. For only three of these nine species, were more than two otoliths found. Thus, it may be assumed that the otoliths of most of these species,

TABLE 2. Fish remains found during resampling of the Playa del Rey Pleistocene

Scientific name	Common name	Type and number of remains			
		otoliths	teeth	vertebrae	other
	ELASMOBRANCHS				
Alopias vulpinus	thresher		1		
Carcharhinus sp.	requiem shark		7		
Dasyatis dipterurus	diamond stingray		2		
Galeorhinus zyopterus	soupfin shark		1		
Heterodontus francisci	horn shark		1		
Isurus oxyrinchus	mako		2		
Myliobatis californicus	bat stingray		32		
Raja spp.	skates				4*
Squatina californica	Pacific angel shark		6		
Sphyrna sp.	hammerhead shark		6		
Urolophus halleri	round stingray				5**
	unidentified elasmobranchs			15	
	TELEOSTS				
Anchoa compressa	deepbody anchovy	4			
Argentina sialis	Pacific argentine	1			
Atherinopsis californiensis	jacksmelt	1			
atherinids	atherinids	10			
Chitonotus pugetensis	roughback sculpin	7			
Citharichthys sordidus	Pacific sanddab	7			
Citharichthys stigmaeus	speckled sanddab	181			
Citharichthys spp.	sanddabs	47			
Coelorhynchus scaphopsis	Gulf rattail	1			
Cymatogaster aggregata	shiner perch	10			
Cynoscion reticulatus	striped corvina	1			
Engraulis mordax	northern anchovy	194			
Genyonemus lineatus	white croaker	116			
Icelinus quadriseriatus	yellowchin sculpin	10			
Lepidogobius lepidus	bay goby	8			
Leuresthes tenuis	grunion	4			
Menticirrhus undulatus	California corbina	5			
Merluccius productus	Pacific hake	11			
Occa verrucosa	warty poacher	1			
Otophidium scrippsae	basketweave cusk-eel	49			
Otophidium taylori	spotted cusk-eel	65			
Paralabrax sp.	bass	3			
Paralichthys californicus	California halibut	5			
Parophrys vetulus	English sole	3			
Porichthys myriaster	specklefin midshipman	3			
Porichthys notatus	plainfin midshipman	278			
Prionotus stephanophrys	lumptail searobin	2			
Sebastodes spp.	rockfish	8			
Seriphus politus	queenfish	116			
Stenobrachius leucopsarus	northern lampfish	1			
Symbolophorus californiense	California lanternfish	1			
Symphurus atricauda	California tonguefish	13			
Trachurus symmetricus	Pacific jackmackerel	3			
Umbrina roncador	yellowfin croaker	4			
Zaniolepis latipinnis	longspine combfish	1			
	unidentified teleosts	8	18	32	3†
		1,182			

*skate "wing" spines
**caudal "stings"
†2 fin spines, 1 jaw fragment

although rare in the deposit, were recovered efficiently because of their large size.

On the other hand, otoliths of 8 of the 12 species found in the resampling, but not found previously, were small, three were medium sized, and only one was large. Six of the 12 (*Argentina sialis, Coelorhynchus scaphopsis, Occa verrucosa, Stenobrachius leucopsarus, Symbolophorus californiense,* and *Zaniolepis latipinnis*) were represented by only one otolith each, but one species (*Icelinus quadriseriatus*) yielded 10 (Table 2). Thus, although sorting by eye seems to be productive of large otoliths, it is not an efficient method for recovering the small ones.

Elasmobranch remains in the resampling consisted primarily of teeth, but some vertebrae, caudal stings, and dermal denticles also were found (Table 2). Only two of the 11 species (*Dasyatis dipterurus* and *Heterodontus francisci*) were not previously reported for this site (Fitch, 1964). The teeth of both of these are relatively small compared with the other shark and ray teeth found in this deposit, and the flattened laterals of *Heterodontus* could be easily overlooked by anyone not familiar with them. (The single *Heterodontus* tooth found with the aid of the microscope was a lateral.) Although finding the teeth of two additional elasmobranch species in my relatively small field sample is not conclusive proof that sorting for these remains without a microscope is inefficient, recent experiments have shown that a microscope (or some similar magnifying device) is an absolute necessity for finding the tiny teeth of seven of California's commonest inshore elasmobranchs. In these experiments, I found that all of the teeth of the swell shark, *Cephaloscyllium uter,* shovelnose guitarfish, *Rhinobatos productus,* banded guitarfish, *Zapteryx exasperata,* thornback, *Platyrhinoidis triseriata,* electric ray, *Torpedo californica,* butterfly ray, *Gymnura marmorata,* and round stingray, *Urolophus halleri,* will pass through an 18-mesh screen (1 mm, U.S. Standard Sieve Series), as will most of the teeth of the gray smoothhound, *Mustelus californicus.* These small teeth would be impossible to find with the naked eye, particularly when one considers they would comprise an infinitesimal part of the sample being searched.

SYSTEMATIC ACCOUNT

Heterodontidae–horn sharks

Heterodontus francisci–horn shark

Horn sharks are abundant in rocky subtidal areas between about Morro Bay, California, and Magdalena Bay, Baja California. They seldom move about during daylight hours, but at night they can be found foraging the bottom for food, primarily crustaceans. During their nocturnal feeding, they occasionally stray short distances away from their preferred rocky habitat, into areas of sandy or sandy-mud substrate.

Material: 1 lateral tooth.

Alopidae–thresher sharks

Alopias vulpinus–thresher shark

The thresher shark previously was reported from the Playa del Rey site based upon two teeth (Fitch, 1964).

Additional material: 1 tooth.

Isuridae–mako sharks

Isurus oxyrinchus–mako

The mako was previously reported from this site as *Isurus glaucus* based upon two teeth (Fitch, 1964).

Additional material: 2 teeth.

Carcharhinidae–requiem sharks

Carcharhinus sp.–carcharhinid shark, species undetermined

Unidentified requiem sharks were previously reported from this site based upon 26 teeth (Fitch, 1964). The additional teeth found in the resampling probably came from one of the same unidentified species.

Additional material: 7 teeth.

Galeorhinus zyopterus–soupfin shark

Soupfin shark teeth (15) previously were reported from this site (Fitch, 1964).

Additional material: 1 tooth.

Sphyrnidae–hammerhead sharks

Sphyrna sp.–hammerhead shark, species undetermined

The 3 hammerhead shark teeth and 17 vertebrae previously reported from this site were not identified to species (Fitch, 1964), nor are the teeth from my resampling.

Additional material: 6 teeth.

Squatinidae–angel sharks

Squatina californica–Pacific angel shark

The Pacific angel shark previously was reported from this deposit based upon 10 teeth and 8 vertebrae (Fitch, 1964).

Additional material: 6 teeth.

Rajidae–skates

Raja spp.–skates, species undetermined

Unidentified skate remains (8 vertebrae and 3 "wing" spines) have been reported from this site (Fitch, 1964).

Additional material: 4 "wing" spines.

Dasyatidae–stingrays

Dasyatis dipterurus–diamond stingray

Diamond stingrays have been reported from as far north as British Columbia, but their occurrence north of Point Conception can be considered unusual. They range south at least to Central America and possibly to Peru. A large female caught in Los Angeles Harbor in 1963 was about 5 feet 2 inches long (34 inches across the disk) and weighed 113½ pounds.

Material: 2 teeth.

Urolophus halleri–round stingray

Although it is difficult, if not impossible, to distinguish broken and worn fragments of the caudal "sting" of round stingrays from those of bat stingrays or juvenile diamond stingrays, the 164 stings previously reported from this deposit were assigned to *U. halleri* (Fitch, 1964). The teeth of the round stingray are extremely small (they will pass through an 18-mesh screen) so even if they occur in a deposit, they would not be found unless residue retained by a 30- or 32-mesh screen was carefully examined under a microscope.

Additional material: 5 stings.

Myliobatidae–eagle rays

Myliobatis californicus–bat stingray

The bat stingray previously has been reported from this deposit based upon 205 teeth (Fitch, 1964).

Additional material: 32 teeth.

Unidentified elasmobranchs

Material: No attempt was made to assign to species the 15 elasmobranch vertebrae found during resampling.

Engraulidae–anchovies

Engraulis mordax–northern anchovy

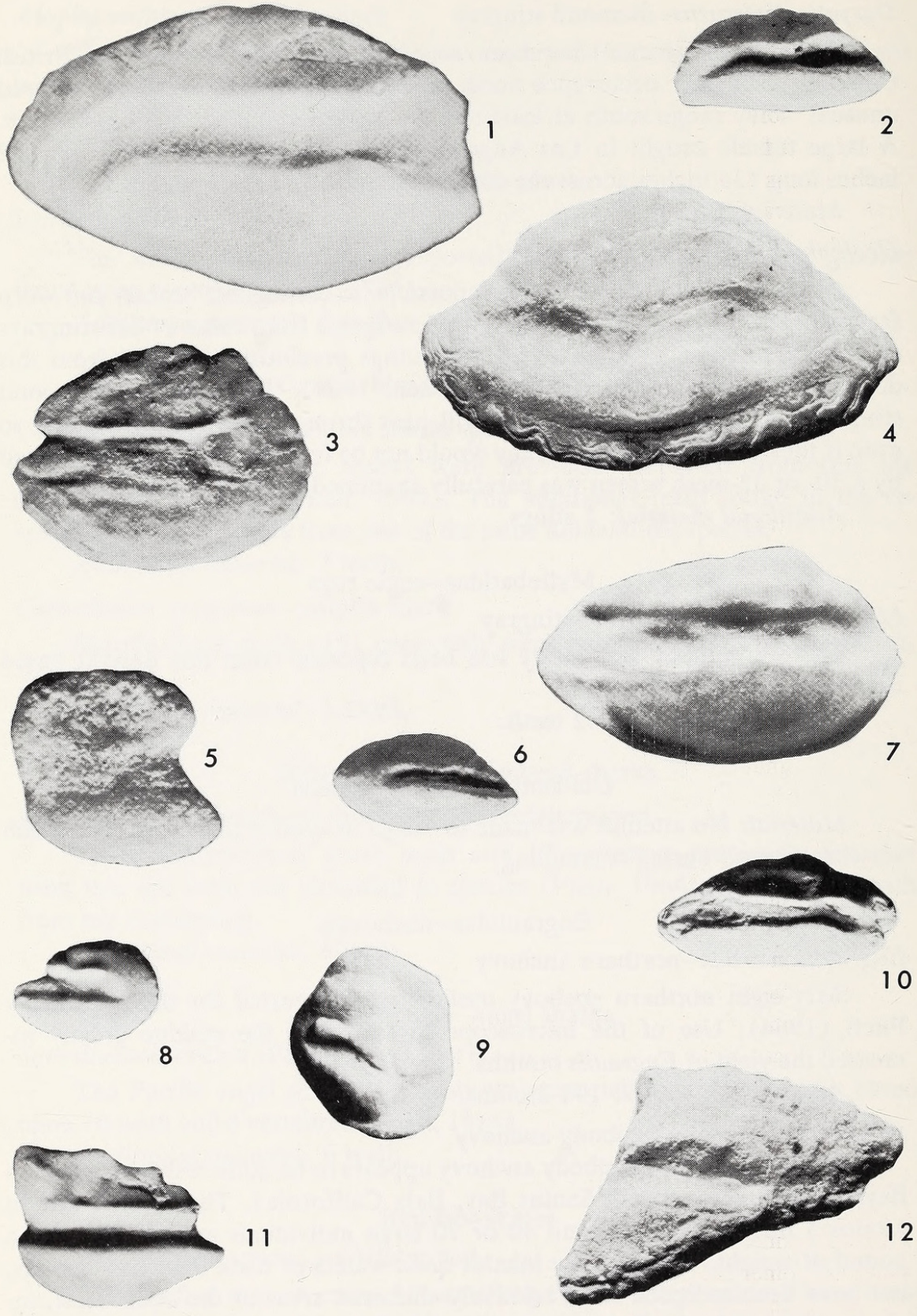
Sixty-eight northern anchovy otoliths were reported for this deposit by Fitch (1964). Use of the microscope in searching the residue greatly increased the yield of *Engraulis* otoliths.

Additional material: 194 otoliths.

Anchoa compressa–deepbody anchovy

The range of the deepbody anchovy appears to be quite restricted (Morro Bay, California, to Todos Santos Bay, Baja California). The species seldom attains 5 inches in length, and 40 or 50 large individuals are required for a pound of weight. They usually inhabit quiet waters of back bays and sloughs, but have been recorded from relatively sheltered areas of the open coast, including Santa Monica Bay.

Material: 4 otoliths (Fig. 8).


1
2
3
4
5
6
7
8
9
10
11
12

Argentinidae–argentines

Argentina sialis–Pacific argentine

The Pacific argentine ranges from off San Francisco south into the Gulf of California. Although they have been considered a bathypelagic species, they probably are most abundant just above the bottom in water shallower than 1,000 feet. Small schools of *Argentina sialis* have been photographed in these depths from a diving saucer, and the stomachs of occasional large individuals trawled from 600 to 800 feet of water contain bottom-living organisms. An 8¼-inch female weighed slightly less than 2 ounces (53 grams).

Material: 1 otolith (Fig. 11) showing signs of having been in the stomach of some predatory species (*i.e.*, general erosion of all surfaces including concave).

Myctophidae–lanternfishes

Symbolophorus californiense–California lanternfish

S. californiense is a bathypelagic species that ranges throughout the north Pacific Ocean–from British Columbia to below Ensenada in the eastern Pacific. A large individual might be 5 inches long and weigh about one-half ounce.

Material: 1 otolith (Fig. 3) in good condition.

Stenobrachius leucopsarus–northern lampfish

S. leucopsarus is one of the most abundant bathypelagic fishes in the eastern Pacific, where it ranges from the Bering Sea to about Cedros Island, Baja California. A large individual might be 5 inches long and weigh about one-half ounce.

Material: 1 otolith (Fig. 5), somewhat eroded, as if from the stomach of a predator.

Figure 1. Inner face, left sagitta (badly worn, rostrum missing) of *Trachurus symmetricus* 6.7 mm long.

Figure 2. Inner face, left sagitta (badly worn) of *Zaniolepis latipinnis* 3.3 mm long.

Figure 3. Inner face, right sagitta of *Symbolophorus californiense* 4.4 mm long.

Figure 4. Inner face, right sagitta of *Prionotus stephanophrys* 6.8 mm long.

Figure 5. Inner face, left sagitta (badly worn) of *Stenobrachius leucopsarus* 2.0 mm long.

Figure 6. Inner face, left sagitta of *Icelinus quadriseriatus* 2.8 mm long.

Figure 7. Inner face, left sagitta of *Coelorhynchus scaphopsis* 7.9 mm long.

Figure 8. Inner face, right sagitta of *Anchoa compressa* 1.9 mm long.

Figure 9. Inner face, right sagitta of *Symphurus atricauda* 2.5 mm long.

Figure 10. Inner face, right sagitta of *Occa verrucosa* 3.8 mm long.

Figure 11. Inner face, left sagitta (badly worn) of *Argentina sialis* 3.0 mm long.

Figure 12. Inner face, right sagitta (posterior portion) of *Paralabrax* sp. 7.8 mm long.

Photographs by Jack W. Schott.

Macrouridae (=Coryphaenoididae)–rattails

Coelorhynchus scaphopsis–Gulf rattail

This species is one of the commonest rattails in the northern Gulf of California, where it can be trawled on the bottom in depths greater than 100 fathoms. During recent years, a single individual was caught off Santa Barbara, California, in an otter trawl. No measurements are available for the Gulf rattail, but none of several dozen observed during the past 10 years exceeded 15 inches total length.

Material: 1 otolith (Fig. 7) in good condition.

Merlucciidae–hakes

Merluccius productus–Pacific hake

Pacific hake otoliths (24) previously were reported from the Playa del Rey deposit (Fitch, 1964).

Additional material: 11 otoliths.

Bothidae–lefteyed flounders

Paralichthys californicus–California halibut

A single broken California halibut otolith was reported from this site by Fitch (1964).

Additional material: 5 otoliths.

Citharichthys spp.–sanddabs, species as listed below.

The otoliths of all three sanddabs known to Californian waters are easily distinguished if they are in good condition. Those of *C. stigmaeus* have straight margins and never attain large sizes. *C. sordidus* and *C. xanthostigma* otoliths have rounded margins, and at maximum size are two to three times larger than *C. stigmaeus* otoliths. The antero-dorsal margin of the otolith of *C. sordidus* is sharply notched, distinguishing it from *C. xanthostigma*. Otoliths (290) of *C. sordidus* and *C. stigmaeus* were reported from this deposit by Fitch (1964).

Additional material: 235 otoliths–7 from *C. sordidus*, 181 from *C. stigmaeus*, and 47 undeterminable.

Pleuronectidae–righteyed flounders

Parophrys vetulus–English sole

A single English sole otolith previously was reported from this deposit (Fitch, 1964).

Additional material: 3 otoliths.

Cynoglossidae–tonguefishes

Symphurus atricauda–California tonguefish

The California tonguefish lives on sandy or sandy-mud bottoms at moderate depths between Big Lagoon, northern California and about Magdalena Bay, Baja California. Greatest concentrations seem to be in water shallower than 150 feet. A very large individual was 7⅛ inches long; its weight was not recorded but probably was not in excess of 3 ounces. Because of their small size and odd shape, *Symphurus* otoliths probably would not be found without using a microscope.

Material: 13 otoliths (Fig. 9).

Serranidae–basses

Paralabrax spp.–kelp and sand basses

Three species of *Paralabrax* are abundant in shallow waters along the southern California coast. The kelp bass, *P. clathratus*, prefers rocky habitat, especially where kelp beds are prolific. Of the other two, *P. nebulifer* (sand bass) and *P. maculatofasciatus* (spotted sand bass), *P. nebulifer* is the most likely to be found in quiet offshore waters where the bottom is sandy or sandy-mud. *P. maculatofasciatus* seems to prefer the habitats found in bays and estuaries. *Paralabrax* otoliths are difficult, if not impossible, to distinguish to species even when they are in perfect condition. None of the *Paralabrax* otoliths found in resampling was complete.

Material: 3 otoliths, all with anterior ends missing (Fig. 12).

Atherinidae–silversides

Leuresthes tenuis–grunion

Grunion otoliths (6) previously were reported from the Playa del Rey deposit by Fitch (1964).

Additional material: 4 otoliths.

Atherinopsis californiensis–jacksmelt

Three jacksmelt otoliths previously were reported from this locality (Fitch, 1964).

Additional material: 1 otolith.

Atherinids–species undetermined

The only other silverside known to California is the topsmelt, *Atherinops affinis*. A single topsmelt otolith previously was reported from this deposit (Fitch, 1964). Several broken atherinid otoliths found during resampling probably were from *A. affinis*, but were not sufficiently entire to make a positive identification.

Additional material: 10 broken otoliths.

Carangidae–jacks

Trachurus symmetricus–Pacific jackmackerel

The Pacific jackmackerel is a schooling species that ranges from British Columbia to Cape San Lucas and offshore for several hundred miles. A large individual might be 30 inches long and weigh 5 or 6 pounds, but the commercial catch, comprising thousands of tons each year, consists mostly of 15-inch and smaller fish.

Material: 3 otoliths (Fig. 1) in poor condition, possibly from having been partially digested in the stomachs of predators.

Sciaenidae–croakers

Cynoscion reticulatus–striped corvina

The otoliths (4) of this southern species previously were reported for this site (Fitch, 1964).

Additional material: 1 otolith.

Genyonemus lineatus–white croaker

White croaker otoliths were abundant in the original sampling of the Playa del Rey deposit, 217 having been reported (Fitch, 1964).

Additional material: 116 otoliths.

Menticirrhus undulatus–California corbina

The California corbina previously was reported from this locality based upon the broken posterior half of a single otolith (Fitch, 1964).

Additional material: 5 otoliths.

Seriphus politus–queenfish

The 275 queenfish otoliths reported from this site (Fitch, 1964) represented over 20 percent of the total otoliths on hand at that time.

Additional material: 116 otoliths.

Umbrina roncador–yellowfin croaker

Yellowfin croaker otoliths (13) previously were reported from this deposit (Fitch, 1964).

Additional material: 4 otoliths.

Embiotocidae–surfperches

Cymatogaster aggregata–shiner perch

Shiner perch otoliths (6) previously were reported from the Playa del Rey locality (Fitch, 1964).

Additional material: 10 otoliths.

Scorpaenidae–rockfishes

Sebastodes spp.–rockfishes, species undetermined

The otoliths of most of the 52 species of *Sebastodes* inhabiting the waters of California can be distinguished from each other if they are in perfect or near-perfect condition. Such characters as length and shape of rostrum, configuration of posterior end, angle of posterior taper, depth of sulcus, and number of growth zones (annuli) for otolith size are helpful for determining species or species-complex. Although five species were identified from among the 25 *Sebastodes* otoliths previously reported upon (Fitch, 1964), the rockfish otoliths obtained from resampling the deposit were in such poor condition it was impossible to determine the species involved.

Additional material: 8 otoliths.

Zaniolepidae–combfishes

Zaniolepis latipinnis–longspine combfish

The longspine combfish is fairly abundant in moderate depths (50 to 400 feet) on sandy-mud bottoms between Puget Sound and San Martin Island, Baja California (at least). A large individual may exceed 10 inches in length, but weights for a combfish that size are unavailable. An 8½-inch specimen weighed nearly 3 ounces (72 grams).

Material: 1 otolith (Fig. 2).

Cottidae–sculpins

Chitonotus pugetensis–roughback sculpin

One roughback sculpin otolith previously was reported from this site (Fitch, 1964).

Additional material: 7 otoliths.

Icelinus quadriseriatus–yellowchin sculpin

The yellowchin sculpin is one of the most abundant members of the family in moderate depths (50 to 250 feet) between about Pt. Reyes, California, and Cape San Lucas, Baja California. They never attain very large sizes, about 3½ inches being maximum, and their otoliths are small enough that a microscope is needed to recover them. Three other species of *Icelinus* are fairly common in the same general areas as *I. quadriseriatus,* but only the otoliths of *I. tenuis* are difficult to distinguish from those of the yellowchin sculpin. Some of the *Icelinus* otoliths found during resampling could have been from *I. tenuis,* but *I. tenuis* is less abundant in our area and typically inhabits somewhat deeper water, so I assigned all of the present material to *I. quadriseriatus.*

Material: 10 otoliths (Fig. 6), some in rather poor condition.

Triglidae–gurnards

Prionotus stephanophrys–lumptail searobin

Although the lumptail searobin has been reported from as far north as San Francisco, its occurrence in California is sporadic and usually during years when water temperatures are higher than normal. It is relatively abundant in Mexican waters, and occurs in the Gulf of California with several other members of the genus. A very large individual from southern California was 15½ inches long and weighed just over 2 pounds.

Material: 2 otoliths (Fig. 4).

Agonidae–poachers

Occa verrucosa–warty poacher

The warty poacher ranges from about Vancouver Island to Point Conception, where it is found on sandy-mud bottoms in moderate depths (30 to 150 feet or so). A large individual might be 8 inches long and weigh 2 ounces, but most are much smaller. This appears to be the only species from the Playa del Rey deposit that has not been reported south to the same latitude during recent times. The lack of recent records from south of Point Conception may be a reflection of inadequate sampling with small-mesh trawl nets in the right depths, but several hundred tows with small-mesh otter trawls in Santa Monica Bay during the past decade failed to yield a single warty poacher.

Material: 1 otolith (Fig. 10).

Gobiidae–gobies

Lepidogobius lepidus–bay goby

One otolith from a bay goby previously was found in this deposit (Fitch, 1964).

Additional material: 8 otoliths.

Batrachoididae–toadfishes

Porichthys myriaster–specklefin midshipman

Specklefin midshipman otoliths (15) previously have been reported from this locality (Fitch, 1964).

Additional material: 3 otoliths.

Porichthys notatus–plainfin midshipman

Plainfin midshipman otoliths (161) previously were reported from this deposit (Fitch, 1964).

Additional material: 278 otoliths.

Ophidiidae—cusk-eels

Otophidium scrippsae—basketweave cusk-eel

O. scrippsae otoliths were nearly twice as abundant as the otoliths of *O. taylori* in the earlier samples from this site, 140 having been reported as *O. scrippsae* by Fitch (1964). This ratio did not hold up during resampling.

Additional material: 49 otoliths.

Otophidium taylori—spotted cusk-eel

Eighty-three otoliths of *O. taylori* were reported from this site by Fitch (1964).

Additional material: 65 otoliths.

DISCUSSION

The fish remains found during resampling of the Playa del Rey deposit represent 11 species (at least) of sharks, skates, and rays belonging to nine families, and 34 or more species of bony fishes belonging to 21 families. Two of the elasmobranchs and 12 of the bony fishes had not previously been found at this locality, and brought the known number of species from this deposit to 62 (at least). The elasmobranch remains consisted of 58 teeth, 15 vertebrae, 5 caudal "stings," and 4 "wing" spines, whereas the teleost remains consisted of 1,182 otoliths, 32 vertebrae, 18 teeth, 2 fin spines, and 1 jaw fragment.

These remains do not detract from the contention that the habitat (at the time and place of deposition) was an area of fine grained silty sand, typical of a quiet-water embayment 10 to 12 fathoms deep (Valentine, 1961), even though two of the species (*Stenobrachius leucopsarus* and *Symbolophorus californiense*) are bathypelagic forms that almost never are captured where the water is shallower than 1,000 feet. Two other species (*Coelorhynchus scaphopsis* and *Argentina sialis*) usually are taken at or near the bottom in 600 feet or more of water. The otoliths of these four species are quite rare in the deposit (only one of each was found), and possibly all were carried there in the stomachs of predators or scavengers. Dead fish, including deep-sea species, that float to the surface usually are picked up by gulls and other scavenging birds which are capable of traveling great distances in a short time after eating such a meal. Otoliths that pass through gulls, terns, and other fish-eating birds, often are scarcely altered by digestive action (Martini, 1964).

The finding of *Coelorhynchus scaphopsis* and *Prionotus stephanophrys* otoliths during the resampling brought to six the number of southern fish species in this deposit that seldom, if ever, are taken north of Mexico. Previously, a tooth from *Rhizoprionodon* (formerly *Scoliodon*) *longurio*, and otoliths of *Micropogon ectenes, Cynoscion reticulatus*, and *Lepophidium negropinna* had been reported from this site (Fitch, 1964). An otolith of *Cynoscion reticulatus* also was found during resampling. These southern species lend additional support to the contention that this deposit was laid down at a time