

OBSERVATIONS ON FISHES ASSOCIATED WITH THE 1997–98 EL NIÑO OFF CALIFORNIA

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ABSTRACT

From mid-1997 through 1998, anomalously warm water occurred off the California coast as part of the more global El Niño phenomenon of 1997–98. Warm-water periods of comparable magnitude were observed in 1957–59 and 1982–84; this most recent event may in fact be the strongest of the three. Biological evidence supporting the impact of this phenomenon was noted in a northern latitudinal shift in the range of a number of eastern tropical Pacific fishes into the warm-temperate waters of southern California. Families of fishes represented include Carcharhinidae, Sphyrnidae, Elopidae, Albulidae, Ophichthidae, Clupeidae, Synodontidae, Fistulariidae, Scorpaenidae, Triglidae, Serranidae, Apogonidae, Carangidae, Lobotidae, Mullidae, Chaetodontidae, Pomacanthidae, Pomacentridae, Sphyracidae, Polyneimidae, Labridae, Scaridae, Blenniidae, Callionymidae, Gobiidae, Trichiuridae, Bothidae, Tetraodontidae, and Diodontidae. Of particular significance are the following new California records of Panamic species: *Fistularia corneta*, deepwater cornetfish; *Diplectrum maximum*, greater sand perch; *Apogon pacificus*, pink cardinalfish; *Caranx vinctus*, cocinero; *Sphyracna ensis*, Mexican barracuda; *Decodon melasma*, blackspot wrasse; *Nicholsina denticulata*, loosetooth parrotfish; *Plagiotremus azaleus*, sabertooth blenny; *Synchiropus atrilabiatatus*, blacklip dragonet; and *Engyophrys sanctilaurentii*, speckled-tail flounder. Several species taken had not been reported since the Pacific Railroad Survey of the 1850s or the early 1900s (e.g., threebanded butterflyfish and longtail goby). Additionally, several species heretofore known from single or a few records were taken on multiple occasions and in some numbers. Differences between the 1997–98 and previous El Niño events and a measure of the intensity of this event are discussed. Changes in the ichthyofauna of California during the most recent El Niño were perhaps the most dramatic of the twentieth century.

INTRODUCTION

Periods of warm water off California have been observed by a number of ichthyologists since the early 1900s. Thompson (1918) noted the appearance of more

southern fishes off southern California in 1918, but did not mention temperature as a causative factor. Hubbs and Schultz (1929) reported on the occurrence of southern forms of marine life along the Pacific coast in 1926, and Walford (1931) reported more specifically on the northward occurrence of southern fishes off San Pedro in 1931. Hubbs (1948), in a seminal paper, discussed changes in the fish fauna of the eastern North Pacific correlated with changes in ocean temperature. At the seventh meeting of CalCOFI in Carlsbad, California, Radovich (1960) described the redistribution of fishes in the eastern Pacific Ocean during 1957 and 1958. He followed with a more detailed account further describing eastern Pacific tropical fishes and other organisms off California during the warm-water event of 1957–58 (Radovich 1961).

The next major warm-water period, which manifested itself off California in early 1983 and is now referred to as El Niño of 1982–84, was discussed generally by McGowan (1984) and Wooster and Fluharty (1985) and in specific articles by Swift (1986), Brooks (1987), Jones et al. (1988), Lea et al. (1989), Lea and Rosenblatt (1992), and others. Mearns (1988), in an overview, reviewed unusual occurrences of marine organisms as indicators of changing ocean conditions.

Sea-surface temperatures taken by the Scripps Institution of Oceanography and known as Scripps Pier temperatures represent a continuous data series from 1917 and serve as an indicator of general marine temperature conditions for southern California (fig. 1). This data set represents one of the longest series of ocean temperatures for the eastern North Pacific, and is the primary ocean temperature information considered in this report. We note that from 1992 to 1997 sea-surface temperatures were well above the long-term mean of approximately 17°C. Beginning in mid-1997 sea-surface temperatures rose dramatically and continued at a high level through 1998. In 1999, sea-surface temperatures cooled considerably, introducing a La Niña oceanographic condition.

In this paper we discuss a number of northward occurrences of eastern tropical Pacific (Panamic) fishes

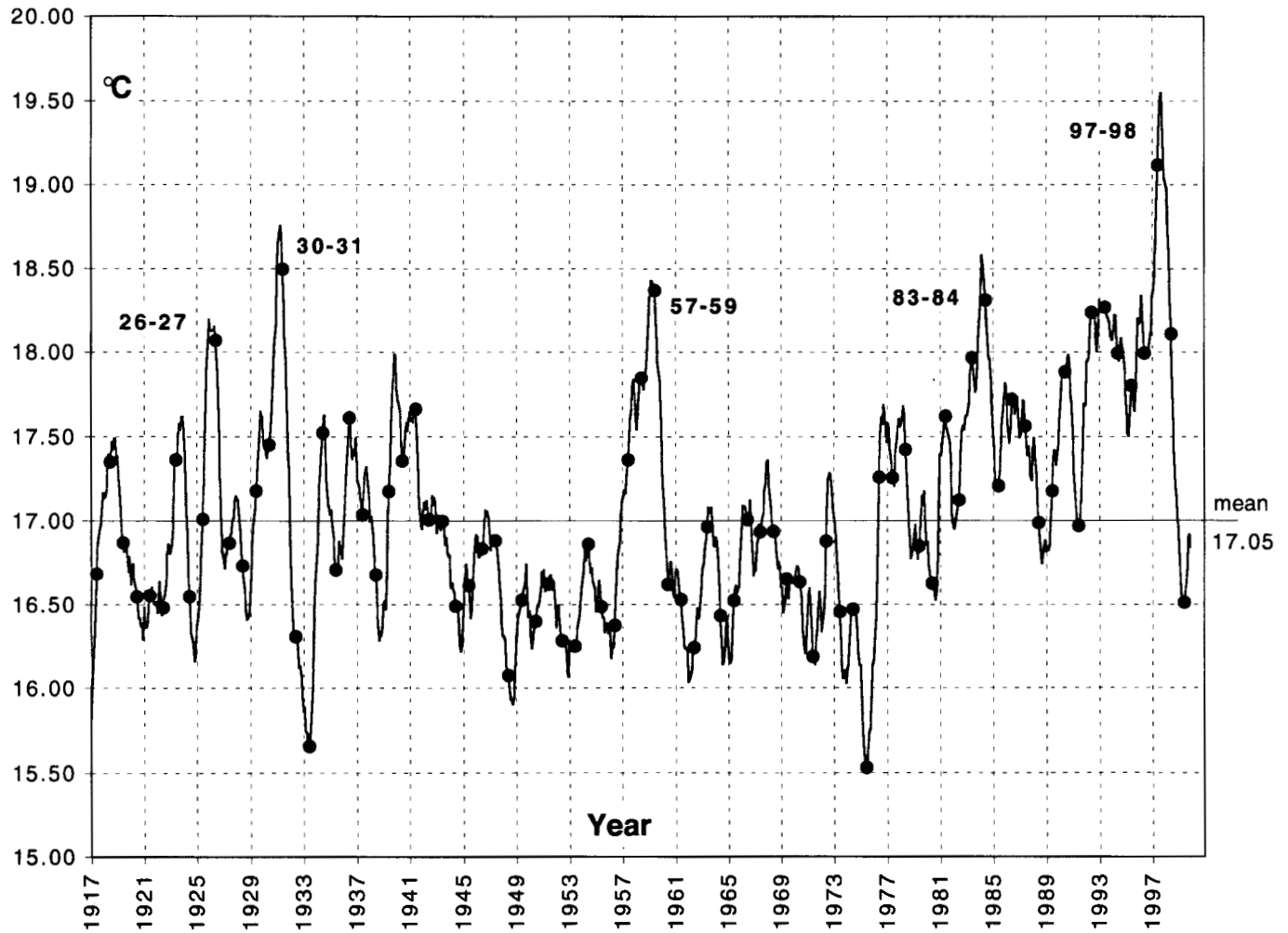


Figure 1. Sea-surface temperature at Scripps Pier, 1917–99. Line indicates 12-month moving mean; circles indicate annual means. Major warm-water periods are indicated. Compiled by Jerrold Norton, NOAA-NMFS, Pacific Grove.

that came to our attention during the 1997–98 El Niño and which we believe were a consequence of the oceanographic conditions relating to this event. We are aware that some of these observations may have been associated with the warm-water conditions persisting from 1992 to 1997. However, the majority of the records presented herein directly relate to the 1997–98 El Niño event.

DATA AND METHODS

The observations presented herein were obtained from a myriad of sources. Specimens came to our attention through the generosity of commercial and recreational fishers, state and federal research and assessment programs, environmental monitoring programs such as the Southern California Water Resources Project (SCWRP) and the City of San Diego, public aquaria, academic researchers, underwater photographers, and persons with simply a general interest in the marine environ-

ment. In most cases the relevant specimens have been accessioned into the ichthyological collections at the Scripps Institution of Oceanography, the Los Angeles County Museum of Natural History, and the California Academy of Sciences. In several instances we were given a photograph of a fish but not the specimen itself. As media coverage of El Niño became an almost daily topic in 1998, we received many anecdotal reports of unusual fishes as well as other organisms. We have not included these unless there was additional convincing and corroborative evidence as to the identity of the organism.

Our observations and discussion are presented in a phylogenetic sequence, listed by family. We follow (with minor exceptions) the arrangement presented by American Fisheries Society Special Publication 20, *Common and Scientific Names of Fishes from the United States and Canada* (Robins et al. 1991). Twenty-nine families of fishes are discussed; the majority are considered tropical in their zoogeographic affinities, and many exhibit

TABLE 1
 Panamic Species New to California Collected during 1997–98 El Niño, in Chronological Order

Species	Common name	Family	Location	Date ^a
<i>Caranx vinctus</i>	Cocinero	Carangidae	San Diego Bay	12 Aug. 1997
<i>Sphyrna ensis</i>	Mexican barracuda	Sphyrnidae	Oceanside	20 Oct. 1997
<i>Fistularia corneta</i>	Deepwater cornetfish	Fistulariidae	Huntington Beach	7 May 1998
<i>Apogon pacificus</i>	Pink cardinalfish	Apogonidae	La Jolla	12 May 1998
<i>Decodon melasma</i>	Blackspot wrasse	Labridae	Dana Point	2 June 1998
<i>Plagiotremus azaleus</i>	Sabertooth blenny	Blenniidae	King Harbor	18 Aug. 1998
<i>Engyophrys sanctilaurentii</i>	Speckled-tail flounder	Bothidae	San Diego	6 Sept. 1998
<i>Diplctrum maximum</i>	Greater sand perch ^b	Serranidae	Newport Beach	30 Nov. 1998
<i>Synchiropus atrilabiatus</i>	Blacklip dragonet ^c	Callionymidae	Santa Catalina Island	19 Jan. 1999
<i>Nicholsina denticulata</i>	Loosetooth parrotfish ^c	Scaridae	Santa Catalina Island	22 May 1999

^aDate of collection of specimen, except for the loosetooth parrotfish, which was photographed; we identify the species without question.

^bProposed common name.

^cNot collected or observed until 1999. However, we attribute the arrival of the species off California as occurring during the 1997–98 El Niño.

circumtropical distributions. Ten of the included species are reported from California for the first time (table 1).

RESULTS

Carcharhinidae

Requiem sharks of the genus *Carcharhinus* are represented primarily from warm seas by a large number of species from throughout the world (Rosenblatt and Baldwin 1958). On 14 July 1998, a dusky shark, *Carcharhinus obscurus*, was taken off Huntington Beach during a California Department of Fish and Game shark tagging cruise. The specimen was retained for documentation but inadvertently lost because of a freezer failure. However, a photograph of the specimen allows us to confirm the identification as a dusky shark.

Fitch and Schultz (1978) stated, regarding *C. obscurus*, “Californian records based upon actual specimens are extremely rare, although the species was at one time reported as being common in San Diego Bay.” Starks (1917) reported on a specimen of this species (as *C. lamiella*) taken at Santa Catalina Island that measured twelve feet in length. Carcharhinid sharks are notoriously difficult to distinguish, and the validity of this early record cannot be confirmed.

Sphyrnidae

Three species of hammerhead sharks are known from California waters; all are considered rare in our area. Starks (1917) first reported the smooth hammerhead, *Sphyrna zygaena*, as occasionally being taken off the southern California coast. Fusaro and Anderson (1980) reported on the scalloped hammerhead, *Sphyrna lewini*, from an adult specimen, 262 cm TL, taken west of Santa Barbara. Seigel (1985) reported on three additional scalloped hammerheads, including a juvenile (545 mm TL), taken off Pacific Palisades, Los Angeles County, during El Niño 1982–84.

Between April 1997 and mid-January 1998, at least 10 juvenile scalloped hammerheads were taken in San Diego Bay. All specimens were less than 1 m, which we consider to be neonates; no umbilical scars were noted on any of the specimens examined. The number of scalloped hammerhead taken during the 1997–98 El Niño, as well as their relative small size suggests that during extreme warm-water conditions San Diego Bay may serve as a nursery area for this species.

Elopidae

The elopids, tenpounders, are a group of five to six species, occurring worldwide in tropical and subtropical waters. The machete, *Elops affinis*, is a rare species in southern California waters (Fitch and Schultz 1978). On 30 December 1997, a machete measuring 458 mm SL was captured in south San Diego Bay.

Albulidae

Bonefish, *Albula vulpes*, are known historically from California (Starks 1918), but their occurrence has been sporadic; the family is considered circumtropical in distribution (Fitch and Lavenberg 1971). The taxonomy of the genus *Albula* is unresolved, and although we apply the name *Albula vulpes* herein, we realize that the eastern Pacific population undoubtedly represents a species separate from *A. vulpes* and in time will take on a different name.

From January 1998 throughout most of the year, bonefish were reported from bays and estuaries from San Diego County to Venice Canal, Los Angeles County. Leptocephalus larvae were collected in some locations, including San Diego Bay; transforming leptocephali and juveniles were taken more broadly. A juvenile bonefish was also taken in Morro Bay, San Luis Obispo County, in August 1998 (Robert Hardy, pers. comm.). The year 1998 appears to represent a unique recruitment event for bonefish off southern California.

Ophichthidae

Snake eels of the family Ophichthidae from the eastern Pacific constitute a rich and diverse assemblage of tropical species (McCosker and Rosenblatt 1998); four species have been recorded from California waters: *Myrichthys tigrinus*, tiger snake eel; *Myrophis vafer*, Pacific worm eel; *Ophichthus triserialis*, Pacific snake eel; and *O. zophochir*, yellow snake eel. Of these, two species were taken during the 1997–98 El Niño and are relevant to this discussion.

***Ophichthus zophochir*, yellow snake eel.** The genus *Ophichthus* was first reported from California by Hubbs in 1916, from a specimen taken off Long Beach. Since then, there have been a number of reports of the two species from California (Clark 1937; Hopkirk 1965; Quirolo and Dinnel 1975; McCosker and Rosenblatt 1998; and others). These snake eels have all been adults and most have been exceptionally large individuals (McCosker and Rosenblatt 1998).

Ophichthus have been collected in warm-water as well as cold-water years, and it is difficult to correlate captures with El Niño events. Because ophichthids are generally fossorial and difficult to collect, it is possible they may live for extended periods before being discovered. During 1997–98 a large *Ophichthus zophochir* was collected in April 1998 inside Newport Bay. When this fish arrived in California is not possible to determine, but warm oceanographic conditions have persisted since 1992. Of greater importance was the collection of a leptocephalus-stage *O. zophochir* from San Francisco Bay in January 1999. We believe this specimen most likely arrived sometime during the 1997–98 period. This example would seem to explain the mechanism of transport for tropical ophichthids to higher-latitude waters. It may be that ophichthid leptocephali arrive off our coast during conditions of northerly flow of ocean currents correlated with warm-water events, settle out, and then live an expatriated existence. Charter (1996) reported that *Ophichthus* larvae are unknown in the CalCOFI area north of the Cabo San Lucas region of Baja California. ***Myrophis vafer*, Pacific worm eel.** This eel was first reported from California as a new species of echelid eel, *Hesperomyrus fryi*, being taken under a night-light near the San Pedro breakwater in August 1930 (Myers and Storey 1939). It was later recognized that *H. fryi* was a junior synonym of *M. vafer* (Rosenblatt and McCosker 1970). We are aware of but one other collection of this species from California prior to the 1997–98 El Niño, a 455 mm SL specimen taken at the Los Angeles Harbor breakwater in July 1966.

In July and October 1998, two Pacific worm eels were collected from Batiquitos Lagoon, San Diego County. In January–February 1999, during La Niña conditions, four other Pacific worm eels were collected from

Mission Bay and Batiquitos Lagoon. We attribute these post-El Niño records as carryovers of worm eels that had arrived and settled out in southern California during the warmer-water period.

Clupeidae

Species of the genus *Opisthonema*, thread herring, are commercially important coastal pelagic fishes in the waters from Mexico to northern Peru. Three species are known from the eastern Pacific; two have been recorded from California: *Opisthonema libertate*, deepbody thread herring, and *O. medirastre*, middling thread herring. The species of thread herring are extremely difficult to distinguish morphologically, and the surest method requires the enumeration of ceratobranchial gill rakers, a tedious technique at best (Berry and Barrett 1963).

Three thread herring were taken by gill net set off Carlsbad in August 1997. From September through November 1997, thread herring were caught by anglers at Port Hueneme, Belmont Shore, and Balboa piers (Ventura, Los Angeles, and Orange counties). We have examined several of these fishes, and all have been attributable to *Opisthonema libertate*. It is impossible to say whether *Opisthonema medirastre*, the second species known from California, was a component of the thread herring occurring off southern California during this period.

Synodontidae

Lizardfishes occur worldwide, primarily in tropical seas. The California lizardfish, *Synodus lucioceps*, is a normal element of the southern California ichthyofauna. It is uncommonly taken north of Point Conception; however, during the 1982–84 El Niño California lizardfish were recorded as far north as Puget Sound, Washington (Gonyea and Burton 1985).

On 9 October 1998 a “calico lizardfish,” *Synodus lacertinus*, was collected off the United States–Mexico boundary by the City of San Diego Ocean Monitoring Program. The site of capture is approximately 6 kilometers south of California waters. The 145 mm SL specimen was taken by trawl on sand bottom at 27 m. This record is included because of its proximity to California and its occurrence in warm-temperate waters. We propose the common name calico lizardfish for this species in reference to its reddish-mottled color pattern. Most *Synodus* species are rather drab in color; this is an exceptionally beautiful member within the genus. Prior to the above record, the northernmost locality of this Panamic species of which we are aware was Islas San Benito, off the outer coast of central Baja California.

Fistulariidae

The cornetfishes are a small family of gasterosteiform fishes comprising four species and exhibiting a circum-

tropical distribution. Two cornetfishes occur in the eastern Pacific: *Fistulatia commersonii*, reef cornetfish, and *Fistularia corneta*, deepwater cornetfish (Fritzsche 1976). These highly specialized fishes are stalking predators most often associated with reef habitat.

In May 1998 two deepwater cornetfish, *F. corneta*, were collected at the Huntington Beach Generating Station, Orange County (Mike Curtis, pers. comm.). The deepwater cornetfish is a Panamic species previously known to Bahía San Hipólito, on the outer coast of Baja California (Thomson et al. 1987). This represents the first capture of the species and family in California.

Scorpaenidae

The rainbow scorpionfish, *Scorpaenodes xyris*, is a Panamic species with a known range from Santa Catalina Island, California, to Peru and the Galápagos Islands. This scorpionfish was first reported from California by Strachan et al. (1968) from a specimen collected at San Clemente Island, at 18 m by ichthyocide, in May 1966 (several other specimens were observed but not collected). A second rainbow scorpionfish was collected at Isthmus Reef, Santa Catalina Island, at 24 m, in March 1967.

We list four reports of rainbow scorpionfish that relate to the 1997–98 El Niño and are significant, two in 1998 and two in 1999. A rainbow scorpionfish was collected at Santa Catalina Island in June 1998 by Jeff Landesman of the Cabrillo Marine Aquarium. Additional sightings were made at Santa Catalina in October 1998 (Joe Wible, pers. comm.) and September 1999 (Paul Reilly and Chuck Kopezak, pers. comms.). All of the Santa Catalina reports were from Blue Cavern Point or Bird Rock.

Triglidae

The lumptail searobin, *Prionotus stephanophrys*, was originally described by William Lockington in 1881 from a San Francisco market specimen trawled off Point Reyes. Fitch and Lavenberg (1971) noted "... the species was not reported again until 1945, and even today fewer than two dozen individuals have been caught north of Mexico." Since Fitch and Lavenberg's account, additional specimens have been taken off California, including several during the 1982–84 El Niño. The species has also been reported as far north as the Columbia River, Oregon.

We comment on four captures relative to the 1997–98 El Niño. In October 1997 a lumptail searobin was taken by a commercial trawler off Humboldt County, California. In April 1998 an individual was trawled off Coos Bay, Oregon (Mike Hosie, pers. comm.), and in October 1998 and August 1999 lumptail searobins were taken in Monterey Bay.

Serranidae

Twelve species of serranid fishes are known from California (Robins et al. 1991). However, only three species would be considered as common: *Paralabrax clathratus*, kelp bass; *Paralabrax maculofasciatus*, spotted sand bass; and *Paralabrax nebulifer*, barred sand bass. Three species of serranids, one new and two rare for California, were taken during the 1997–98 El Niño.

A sport-caught *Diplectrum maximum*, a sand perch, was caught off Newport Beach and turned over to Stephen Crooke of the California Department of Fish and Game by an angler who initially thought he had an unusually colored barred sand bass. The 335 mm SL specimen was taken over sand bottom on 30 November 1998. The genus *Diplectrum* exhibits an Amphi-American distribution in primarily tropical waters. Rosenblatt and Johnson (1974) reviewed Pacific species, and the genus was revised by Bortone (1977). Eight species of *Diplectrum* are known from Baja California, the majority from Magdalena Bay and southward (nine species are known from the eastern Pacific). Of these, *D. maximum* is the largest species of the genus and perhaps the least common member. Only juveniles are known from off Baja California.

To our knowledge, the Newport Beach specimen is the first adult *D. maximum* collected north of Peru, the type locality. Our determination was based on the size of the specimen and the morphology of the preopercular spur. The specimen is deposited in the Los Angeles County Museum of Natural History, LACM 53932-1, and represents the first California record for the species. We apply the common name "greater sand perch" to *D. maximum* in reference to its size relative to other members of the genus, which are referred to as sand perches.

Epinephelus is primarily a tropical genus, although several species previously have been taken off California: *E. acanthistius*, gulf coney; *E. analogus*, spotted cabrilla; *E. dermatolepis*, leather bass; and *E. niphobles*, star-studded grouper (Lea and Fukuhara 1991). The spotted cabrilla is considered rare in California, and we are aware of but one California record prior to the 1997–98 El Niño. A photograph appeared in *Western Outdoor News* (20 Feb. 1998 issue) of a sport-caught, "14-pound," spotted cabrilla, taken off Port Hueneme, Ventura County, on 9 January 1998. The species is quite distinctive, and we are confident of the identification.

A juvenile *Serranus aequedens*, measuring 59 mm SL, was collected off San Diego in April 1998 by the City of San Diego Ocean Monitoring Program. The specimen was taken by trawl at 100 m on sand bottom. The first record of the species from California is of two specimens collected in April 1990 off Whites Point, Los Angeles County (Pondella 1999). The San Diego *Serranus* is the second record (third specimen) of the species from

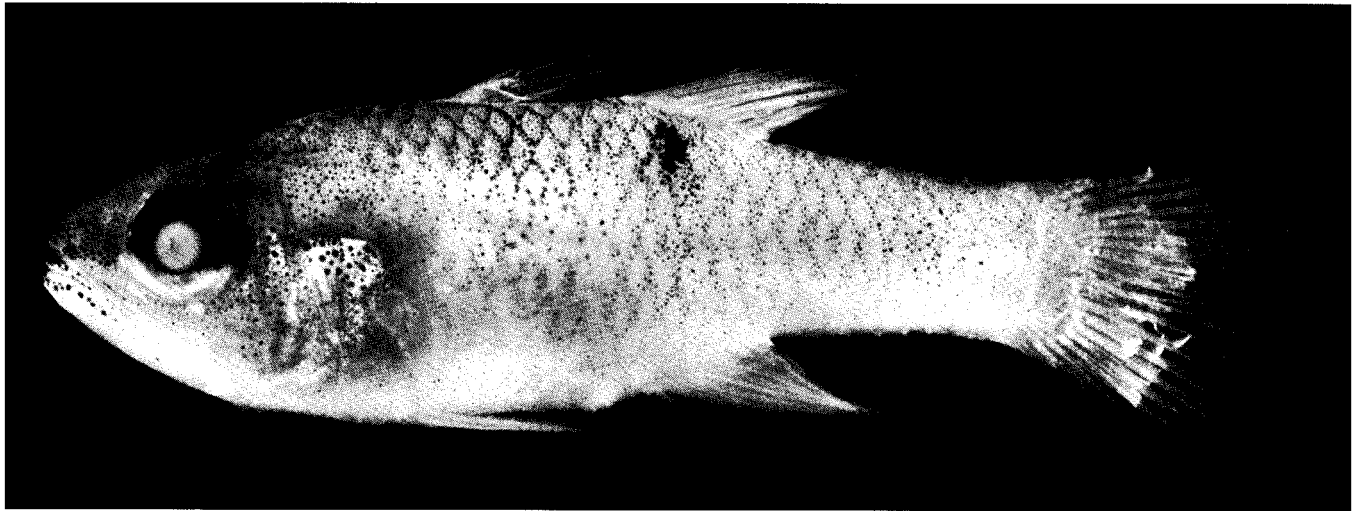


Figure 2. Pink cardinalfish, *Apogon pacificus*. Specimen from San Diego—La Jolla Ecological Reserve, 12 May 1998, 49.5 mm SL, SIO 98-49. Note bar under second dorsal fin.

California. The size of the fish would indicate relatively recent recruitment, likely within a year, to our area.

Apogonidae

The Apogonidae are a family of small tropical fishes with six species known from the eastern Pacific. The Guadalupe cardinalfish, *Apogon guadalupensis*, was first observed in California at San Clemente Island in November 1967 (Hobson 1969b). Specimens were later collected from this location to confirm their specific identification. Since the original observation, occasional sightings and collections have been made at San Clemente Island, mainly at the southern end in the vicinity of Pyramid Head.

During 1998 we received a number of reports of Guadalupe cardinalfish, with sightings not only at San Clemente Island, but also Santa Catalina Island, Santa Barbara Island, Anacapa Island, and La Jolla Cove. In late 1998 oral brooding by male cardinalfish was observed at San Clemente Island (Joe Wible, pers. comm.). This observation would indicate that water temperatures were warm enough for successful reproduction for the species at the southern Channel Islands.

On 25 April 1998 several cardinalfish with a distinctive bar under the second dorsal fin were observed in La Jolla Canyon by Robert Snodgrass and Hugh Khim. This color pattern is characteristic of the pink cardinalfish, *Apogon pacificus*; the Guadalupe cardinalfish is a uniformly colored species. Several weeks later, on 12 May, six pink cardinalfish, measuring 27 to 50 mm SL, were collected from this locality, at 12 m, by Ronald McConnaughey and Philip Zerofski (fig. 2). The above observation and collection represent the first California record for the species.

In September 1998, both species of cardinalfish were photographed at San Clemente Island. The pink cardinalfish was originally described as *Mionorus pacificus* from the Galápagos Islands (Herre 1936). The closest known locality for *A. pacificus* is Islas San Benito, off central Baja California.

Carangidae

The Carangidae, jacks, are a large family of primarily tropical fishes. Fourteen species have been attributed to the California ichthyofauna, of which only two species are considered temperate in distribution (Lea and Walker 1995). During the 1997–98 El Niño, four species of jacks of particular interest were taken off California: Pacific crevalle jack, *Caranx caninus*; bigeye trevally, *Caranx sexfasciatus*; cocinero, *Caranx vinctus*; and Mexican look-down, *Selene brevoortii*.

A Pacific crevalle jack was collected in San Diego Bay on 21 January 1998. This is the fourth record of the species from California. All four were from south San Diego Bay; the last previous Pacific crevalle jack was taken in 1984.

The bigeye trevally was first reported from California on the basis of three specimens taken during November 1990 in San Diego Bay. On 3 January 1998 a bigeye trevally was taken by Mike Irey while fishing for mullet and corvina in south San Diego Bay.

The cocinero, also referred to as barred jack, is a small jack that has not previously been reported from California. On 12 August 1997 a specimen measuring 245 mm FL was collected in south San Diego Bay by Mike Irey while commercial fishing with seine for mullet and corvina. The addition of this species now brings to 15 the known number of carangids from California, 13 of which have a tropical affinity.

The fourth jack, the Mexican lookdown, was previously known from a single specimen collected in February 1993 (Lea and Walker 1995). During the period from December 1997 through April 1998, several dozen Mexican lookdown were caught in south San Diego Bay, again by Mike Irey. Approximately 10 Mexican lookdown collected during this period were donated to the Scripps Aquarium by Mr. Irey; some were still on display in October 1999 (at the time of the CalCOFI conference).

Lobotidae

Lobotes pacificus, Pacific tripletail, was first reported from California (as *Lobotes surinamensis*) from a single specimen taken off the Cabrillo Breakwater, Los Angeles Harbor, on 5 April 1992 (Rounds and Feeney 1993). The tripletail was caught by a recreational angler and measured 533 mm TL. In the intervening period to the 1997–98 El Niño we are aware of no other captures of this species.

During the 1997–98 El Niño event, at least six Pacific tripletail were taken off southern California. On 23 August 1997 a Pacific tripletail was caught 22 km south of Dana Point, Orange County. The fish measured 384 mm TL and was caught by an angler fishing on drift kelp at the surface. On 2 September 1997 a tripletail was caught off Balboa Pier, Orange County, and on 6 September 1997 a third tripletail, measuring 461 mm TL, was caught from the beach at Belmont Shore, Los Angeles County. Additionally, three specimens were captured from south San Diego Bay between 5 November 1997 and 1 January 1998 by Mike Irey, a commercial fisherman targeting mullet and corvina.

All of the tripletail captured were relatively large adults ranging in size from 384 to approximately 700 mm TL. Tripletail are known to associate with flotsam such as floating debris, trees and logs, and floating kelp. We assume this to be the mechanism of transport for those individuals reaching southern California waters. Larvae of *Lobotes* have not been identified from the CalCOFI sampling area (Watson 1996).

Mullidae

Goatfish were first reported from California in March 1919 based on “several specimens of a rare and beautiful fish hitherto unknown in southern California waters. . . .” (Higgins 1919). The species was ascribed to *Upeneus dentatus*, now placed in the genus *Mulloidichthys* and known as the Mexican goatfish. No other goatfish were reported from California until a small specimen, 173 mm SL, was collected at San Onofre Nuclear Generating Station in San Diego County in February 1979. This specimen was identified as *Pseudupeneus grandisquamis*, bigscale goatfish, and represented the first record for the species from California (Fitch 1980).

During the 1997–98 El Niño at least four bigscale goatfish were collected off southern California. On 15 July 1998 a specimen was collected by trawl in San Diego Bay, and on 24 August 1998 three specimens were collected in kelp beds off Carlsbad in northern San Diego County. Additionally, a bigscale goatfish was reportedly taken (but not saved) at San Onofre Nuclear Generating Station during the summer of 1998 (Robert Moore, pers. comm.). In 1999 we are aware of one collection and several reports of sport-caught bigscale goatfish from San Diego Bay. We believe these goatfish to have arrived during 1997–98 and successfully settled at that time. Bigscale goatfish commonly associate with flotsam, especially floating logs but also drifting kelp, and this may have been the mechanism of transport to California from more southerly waters.

In reviewing the recent collections and reports of goatfishes from California, including Higgins's (1919) brief note of *Mulloidichthys dentatus* in which he described his specimens as “covered with large scales, and brilliantly marked with crimson and yellow bands,” we questioned that identification. The coloration described by Higgins is more typical of *Pseudupeneus grandisquamis* than of *Mulloidichthys dentatus*. At the California Academy of Sciences RNL located three specimens that are undoubtedly the basis for Higgins's first records of goatfish from California. The three specimens, in one jar, are CAS 125625 (originally at Stanford University—SU 25625). Two included labels state: “Large specimen Haul 238—Off Coronado (San Diego)” and “2 Small Specimens Haul 149 Off Cardiff & Encinitas 21 fm. 1 1/2 mi. offshore.” There is no collection date on the jar labels or in the museum catalog. However, a notation giving a date of identification as “Aug 19, 1922 O. E. Sette” places the specimens in the correct time frame. Although there are some discrepancies in Higgins's published record (off Long Beach) and the museum register (off Coronado) we feel this is a matter of how the specimens and collection data were transferred from the California Department of Fish and Game Laboratory to Stanford University. The three specimens are all *Pseudupeneus grandisquamis*, based on general morphology and low interdorsal scale counts (3 in all specimens). We therefore conclude that *Pseudupeneus grandisquamis* is the only mullid verifiable from California and that the numerous listings and citations of the Mexican goatfish, *Mulloidichthys dentatus*, from California have been a perpetuation of Higgins's report of 1919.

Chaetodontidae

The threebanded butterflyfish, *Chaetodon humeralis*, is considered the “commonest butterflyfish in the tropical eastern Pacific” (Thomson et al. 1987). Prior to the 1997–98 El Niño only one occurrence of the species

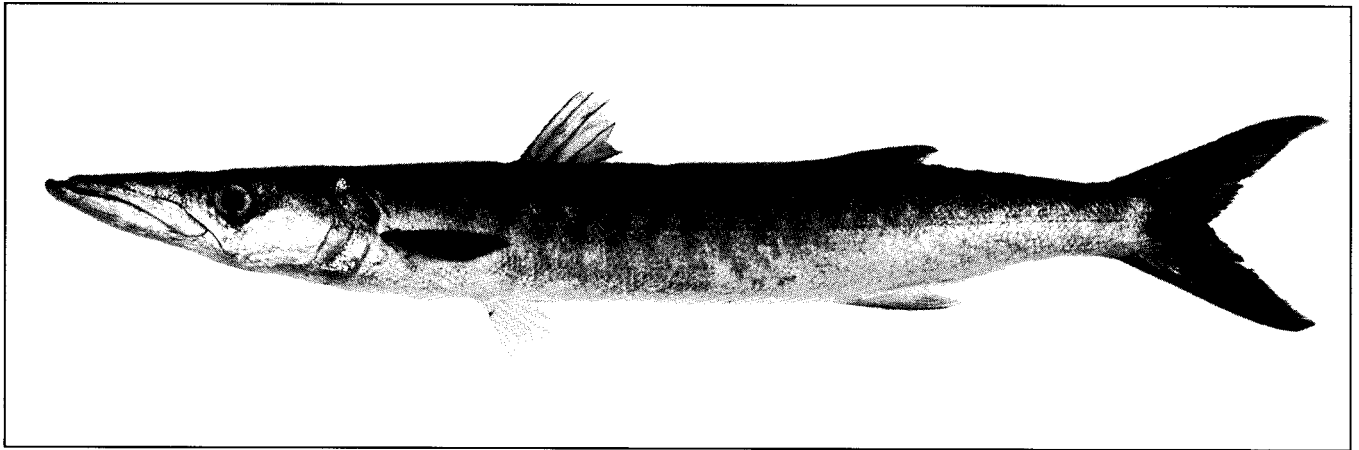


Figure 3. Mexican barracuda, *Sphyraena ensis*. Specimen from off Bird Rock, La Jolla, 11 January 1998, 452 mm SL, SIO 98-35. Note chevrons on side of body.

was known for California: two specimens collected from San Diego Bay during the Pacific Railroad Survey of the 1850s.

On 1 November 1997 a juvenile threebanded butterflyfish was observed in the San Diego–La Jolla Ecological Reserve by Hugh Khim. The butterflyfish was videotaped three weeks later at the same location by the late Robert Snodgrass. On 12 December another threebanded butterflyfish, a juvenile measuring 38.6 mm SL, was collected at King Harbor, Redondo Beach (Pondella et al. 1998). This specimen is deposited at Scripps Institution of Oceanography: SIO 98-23. The reoccurrence of this Panamic species off southern California after a period of almost 150 years is one of the outstanding findings from the 1997–98 El Niño.

Pomacanthidae

A single species of the angelfish family is known from California waters; the family is primarily tropical in distribution. Three Cortez angelfish, *Pomacanthus zonipectus*, were observed or collected between Imperial Beach, San Diego County, and the Los Angeles breakwater between March 1984 and October 1986 (Lea et al. 1989). It was felt that these fishes had most likely been transported to California during the 1982–84 El Niño and not discovered until the end of or after that warm-water event.

On 7 September 1998 an adult Cortez angelfish, 304 mm TL, was collected at the Redondo Generating Station, which takes in water from Santa Monica Bay.

Pomacentridae

The damselfishes are a large family of primarily tropical fishes occurring in all warm seas, with a few species found in temperate waters. Four species are known from California, two of which are common: blacksmith, *Chromis punctipinnis*, and garibaldi, *Hypsypops rubicundus*; and two

of which are rare: Panamic sergeant major, *Abudefduf troschelii*, and swallow damselfish, *Azurina hirundo*. The Panamic sergeant major was added to the California ichthyofauna in August 1996 on the basis of specimens collected and observed at King Harbor, Redondo Beach (Pondella 1997). *Azurina hirundo* was first observed in California at Santa Catalina Island in 1991 and documented photographically the following year at San Clemente Island (Lea and McAlary 1994).

During the 1997–98 El Niño several sightings of swallow damselfish were reported to us: Santa Catalina Island, December 1997 and October 1998; Anacapa Island, August 1998; and San Clemente Island, September 1998. Whether these are fishes that arrived in 1997 or are carryovers from earlier in the 1990s cannot be determined. However, it appears that the species has expanded its range farther to the north.

Sphyraenidae

The barracudas are a small family of about 20 species that are primarily tropical in distribution. The Pacific barracuda, *Sphyraena argentea*, is the only species previously known from California. It is an important recreational and commercial species in the southern part of the state, particularly during the warmer seasons and especially in warm-water years. It is rarely taken north of Point Conception but has been recorded as far north as Kodiak Island, Alaska.

In October 1997 a Mexican barracuda, *Sphyraena ensis*, measuring 463 mm SL, was captured by gill net in a kelp bed off Oceanside. In January 1998 a sport-caught Mexican barracuda, 452 mm SL, was taken at Bird Rock, off La Jolla (fig. 3). At the time of capture the Mexican barracuda was schooling with Pacific barracuda. These two specimens are deposited at the Scripps Institution of Oceanography as SIO 98-36 (Oceanside) and SIO 98-35 (La Jolla). Mexican barracuda were reportedly

caught by recreational anglers off San Diego County in 1998 (Mike Shane, pers. comm.). The species has chevrons on the side of the body that distinguish it from the more uniformly colored Pacific barracuda. The Mexican barracuda can be distinguished from a third Pacific species of barracuda, *S. lucasana*, which has vertical bars (as opposed to chevrons) and a more posterior position of the pelvic fins. These distinctions are subtle and might easily be missed unless one is aware of them. The above two specimens represent the first records for Mexican barracuda from California waters.

Polynemidae

Polynemids, known as threadfins, are a small family of tropical and subtropical marine and brackish-water fishes. Two species are known from the eastern Pacific, and both have been reported from California: the blue bobo, *Polydactylus approximans*, and yellow bobo, *Polydactylus opercularis*. Both species are considered rare north of southern Baja California. Blue bobos were first reported from San Diego, California, in the early 1900s (Jordan and Evermann 1902). Follett (1948) reported on seven *P. approximans* taken during 1940–41, one as far north as Monterey Bay. Radovich (1961) noted an additional specimen taken off Seal Beach, Orange County, during the 1957–59 warm-water period and estimated that perhaps 15 or 20 blue bobos had been taken off California up to that point.

In December 1997 a blue bobo of approximately 200 mm TL was collected in San Diego Bay. Six more blue bobos were taken in January 1998 and four more from February through April, all from San Diego Bay. On 4 August 1998 an additional specimen, approximately 200 mm TL, was taken at Marina Del Rey, Los Angeles County. Juvenile bobos are pelagic, often occurring far offshore. This life-history characteristic may have allowed northward transport of the species during or prior to the 1997–98 El Niño.

We are aware of only three records of the yellow bobo from southern California. To our knowledge, none was taken during the 1997–98 El Niño event.

Labridae

Labrids, or wrasses, are a large family of primarily tropical fishes occurring in the three major oceans. Three species of wrasses are common members of the southern California ichthyofauna: California sheephead, *Semicossyphus pulcher*; rock wrasse, *Halichoeres semicinctus*; and señorita, *Oxyjulis californica*.

In June 1998, two blackspot wrasse, *Decodon melasma*, were taken by trawl, on separate occasions, off Dana Point in 60 m (M. James Allen, pers. comm.). A third blackspot wrasse, measuring 57 mm SL, was taken off San Diego at 100 m in April 1999 by the City of San

Diego Ocean Monitoring Program. This specimen is deposited at the Scripps Institution of Oceanography, SIO 99-100. All three *Decodon* are juveniles. The above collections represent the first records for the species from California.

Scaridae

The Scaridae, parrotfishes, are circumtropical, with six species known to occur in the eastern tropical Pacific (Rosenblatt and Hobson 1969; Thomson et al. 1987). In May 1999 a parrotfish was observed by Erik Erikson at Lovers Cove Reserve, Santa Catalina Island. Several months later the species was documented by photography and videotape at the same location. The fish was identified from the photograph by RNL as *Nicholsina denticulata*, the loosetooth parrotfish; it represents the first record of the family and species from California. Although the sightings were made following the 1997–98 El Niño event and during the colder La Niña period, we feel the occurrence of this parrotfish off Santa Catalina is best explained by arrival sometime in 1998.

The species was observed at Islas San Benito, off central Baja California, in August 1995 and again in August 1998 by RNL. At both San Benito and Catalina it was often observed in association with the brown alga *Eisenia*. Within the Gulf of California it commonly associates with the algae *Sargassum* and *Padina*. Prior to the Islas San Benito observations the range of the loosetooth parrotfish was listed as “from Puerto Peñasco throughout the Gulf and from Bahía Magdalena south to Peru and the Islas Galápagos” (Thomson et al. 1987).

Blenniidae

The Blenniidae, combtooth blennies, are a large family of primarily tropical and subtropical marine fishes. Three species of combtooth blennies are common in southern California waters, all in the genus *Hypsoblennius* (Stephens et al. 1970). On 8 January 1998, two sabertooth blenny, *Plagiotremus azaleus*, were observed in King Harbor, Redondo Beach, at approximately 1.5 m depth (Daniel J. Pondella II, pers. comm.). *Plagiotremus azaleus* is characterized as being “widespread in the tropical eastern Pacific” (Hobson 1969a). Between 8 January and 15 December 1998, four other sightings of sabertooth blenny were made at King Harbor. On 18 August an individual sabertooth blenny, measuring 59.8 mm SL, was collected and is deposited at the Scripps Institution of Oceanography (SIO 98-263). We find it of interest that no Cortez rainbow wrasse, *Thalassoma lucasanum*, were observed during the period of sabertooth blenny sightings. *Plagiotremus* is commonly associated with the Cortez rainbow wrasse, which is by far the more abundant of the two species (Hobson 1969a). D. J. Pondella II and M. T. Craig will present the details of these

observations in a future publication. The above observations and collection of *Plagiotremus azaleus* represent the first record of the species from California.

Callionymidae

Dragonets are perciform fishes occurring in tropical marine waters, primarily in the Indo-West Pacific. A single species is known from the eastern Pacific: *Synchiropus atrilabiatus*, blacklip dragonet (Fricke 1981). In July 1998 a blacklip dragonet was collected by bottom trawl off Santa Catalina Island (M. James Allen, pers. comm.). On 19 January 1999 the City of San Diego Ocean Monitoring Program trawled a second blacklip dragonet off Ocean Beach. This fish, measuring 83 mm SL, was collected by bottom trawl at 100 m on sand bottom and is deposited at the Scripps Institution of Oceanography, SIO 99-1.

The above captures represent the first records of the family and species from California. To our knowledge, these are the first dragonets recorded north of Magdalena Bay, Baja California. The occurrence of this benthonic Panamic species outside its normal range can best be explained by transport of larval or early juvenile fishes.

Gobiidae

There is but a single record of *Ctenogobius sagittula*, longtail goby, from California. Starks and Morris (1907) reported on several specimens taken in San Diego Bay, near Old Town, a locality which most likely has long since disappeared. To our knowledge, the species has not been taken since. The taxonomy of this goby has undergone several changes in nomenclature over the years and has been recorded from California as *Gobionellus sagittula*, *Gobionellus longicaudus*, and most recently as *Ctenogobius sagittula*. The species is a common estuarine and lagoon fish from mainland Mexico to northern Peru.

In May 1998 we began to receive reports of captures of the longtail goby from San Diego Bay. During the ensuing months, longtail goby were collected from Mission Bay, Santa Margarita River lagoon, Newport Bay, Long Beach Harbor, and Marina Del Rey. The 1997-98 El Niño appears to have been an extraordinary period of recruitment off southern California for this species.

Trichiuridae

Cutlassfishes are characterized as primarily tropical in distribution. Records of cutlassfishes from California date from 1921 (Higgins 1921). Occurrence of the species has been sporadic off California. Fitch and Lavenberg (1971) noted that during the early 1930s a small commercial fishery for cutlassfish existed in the Los Angeles Harbor area, but after 1934 the species was "rarely seen and then only a few individuals at a time."

Beginning in March 1998 and extending throughout

the year, Pacific cutlassfish, *Trichiurus nitens*, were taken during most months, at several southern California localities, and by various means. Pacific cutlassfish were collected during March and May from fish screens at the San Onofre Nuclear Generating Station, San Diego County, at times in large numbers (Mike Shane, pers. comm.). During the latter half of August 1998 schools of cutlassfish were observed in Long Beach Harbor, and for a short period a minor sport fishery developed. During September 1998 we received reports of cutlassfish being caught by bait boats off Ventura County. On 1 October 1998 a specimen measuring 512 mm TL was collected by the bait boat *Traveler* fishing off Oxnard in 5 fathoms. This represented a slight northern extension of the range, the previous limit being San Pedro (Hubbs and Hubbs 1941). In late October, Pacific cutlassfish were caught in Dana Harbor, Orange County, by recreational anglers; water temperature at the time was reported as 19.4°C.

The most noteworthy captures of the species were from San Francisco Bay in January 1999, where two cutlassfish were caught by commercial herring boats within a three-week period. The first of these was taken on 6 January in south San Francisco Bay and measured approximately 700 mm TL. The second was caught on 27 January in north San Francisco Bay and measured 681 mm TL. These records are significant, as they set a new northern limit for the species. San Francisco Bay is within the Oregonian biogeographic province of the eastern North Pacific, a region of cold temperate water.

Bothidae

Bothids are left-eyed flatfishes primarily restricted to tropical marine waters on soft bottoms. California flatfishes previously placed in the Bothidae are now assigned to Paralichthyidae fide Chapleau (1993). On 6 September 1998 a speckled-tail flounder, *Engyophrys sanctilaurantii*, was collected off San Diego at 60 m by the City of San Diego Ocean Monitoring Program (M. James Allen, pers. comm.). This represents the first record of the family as well as species from California waters. The species has a broad Panamic distribution and occurs not uncommonly as far north as Magdalena Bay, on the outer coast of Baja California.

Tetraodontidae

Two species of puffers of the genus *Sphoeroides* have been reported from California waters: *Sphoeroides annulatus*, bullseye puffer, and *Sphoeroides lobatus*, longnose puffer.

Sphoeroides annulatus is reported as ranging from San Diego to the Galápagos Islands and northern Peru, but it is extremely rare north of about Magdalena Bay, Baja California (Fitch and Lavenberg 1975). The first California record for the species dates from 1857.

Sphoeroides lobatus was first reported from California at Redondo Pier, in December 1972 (Fitch 1973) and is equally rare. During the 1982–84 El Niño five puffers, all reported to be longnose puffer, were caught again at Redondo Pier, and all were taken in late September and October 1984.

We are aware of five puffers either observed or collected in southern California during the 1997–98 El Niño; all were taken in 1998. A longnose puffer was photographed off La Jolla on 24 January (Constance Gramlich, pers. comm.). Eleven days later, on 4 February, a juvenile longnose puffer, 62 mm SL, was found as a beach cast along La Jolla Shores and brought to the Scripps Institution of Oceanography for identification and subsequent deposit in the Marine Vertebrates Collection: SIO 98-2. It is possible, but unlikely, these two records may represent the same fish. In February a bullseye puffer was observed at Santa Catalina Island (Joe Welsh, pers. comm.). On 19 February and 7 April bullseye puffers were collected at the El Segundo Power Station and Scattergood Power Station, respectively. Both of these power stations are in Los Angeles County and receive water from Santa Monica Bay. They are within close proximity to Redondo Pier, the site of the 1972 and 1982–84 captures.

Diodontidae

The porcupinefishes are a small family of highly specialized fishes with a circumtropical distribution. Some ichthyologists have combined them with the Tetraodontidae. Three diodontids have been recorded from California waters, where all are rare: *Chilomycterus reticulatus*, spotfin burrfish; *Diodon holocanthus*, balloonfish; and *Diodon hystrix*, porcupinefish. In September 1997 a spotfin burrfish was collected from Los Angeles Harbor and displayed for a short period at Cabrillo Marine Aquarium, San Pedro (Lea 1998). In October 1997 a balloonfish was observed at Santa Catalina Island during a shallow-water dive by the research submersible *DELTA*. In March 1998 divers from the Catalina Island Marine Institute snorkeling in Fourth of July Cove, Santa Catalina Island, observed a diodontid estimated to be 750 mm long (Joe Welsh, pers. comm.). The fish is assumed to be *Diodon hystrix*, because of its large size.

SUMMARY AND CONCLUSIONS

We document the occurrence of Panamic fishes from off California during the El Niño event of 1997–98. During this period members of 29 families of Panamic fishes were recorded from California waters. Ten species are reported as new for the state, of which most are first records from the warm-temperate or San Diegan biogeographical region of the eastern North Pacific. Included are two species, blacklip dragonet and loose-

tooth parrotfish, which were collected or observed during the La Niña period of 1999, immediately following El Niño. We regard these post-El Niño records as most likely representing arrival at some point during the 1997–98 period.

In considering fishes at the family level, four circumtropical taxa are new to California. The remarkable number of Panamic species represented can only be attributed to the magnitude and intensity of this most recent El Niño, which surpasses the warm-water event of 1957–59 and El Niño of 1983–84. Reports of Panamic species became relatively frequent during midsummer of 1997 and continued to the end of 1998.

During El Niño conditions, poleward transport of larvae and early-stage juvenile fishes is an extremely important mechanism in the redistribution of Panamic fishes. In some cases, however, species apparently are transferred as advanced juveniles or adults, and explanation by larval transport is not logical. Species within the families of jacks, goatfishes, threadfins, and triple-tails are all known to associate with flotsam, and that has most likely facilitated their redistribution to higher latitudinal waters. Free-swimming fishes such as sharks, herrings, jacks, barracudas, and cutlassfishes most likely move freely within water masses of suitable temperature. Hence, the method of arrival of the various species of Panamic fishes corresponds to the adaptation that best allows for transport and movement into the higher-latitude waters of California.

The appearance of families such as the Fistulariidae, Lobotidae, Pomacanthidae, Polynemidae, Scaridae, Calionymidae, and Bothidae in California waters is extraordinary. At the species level, an amazing array of Panamic fishes appeared off California (threebanded butterflyfish, pink cardinalfish, sabertooth blenny, longtail goby, etc.). The number of tropical families and Panamic species noted off California during the 1997–98 El Niño event, including several post-El Niño records, exemplifies the magnitude and intensity of this most recent warm-water phenomenon. The local recruitment of bonefish and longtail goby during the 1997–98 El Niño, which as far as we can determine is unprecedented, is suggestive of future events. We hypothesize that if warming ocean conditions in the eastern North Pacific continue in the future, an increasing number of Panamic fishes will reach the coast of California; some of them may become established, with a resultant change in the composition of the California ichthyofauna. The 1997–98 El Niño appears to have been the strongest warm-water event off California during the twentieth century.

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