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MIDWATER FISHES FROM THE GULF OF CALIFORNIA AND THE ADJACENT EASTERN TROPICAL PACIFIC

By GARY D. BREWER

CONTRIBUTIONS IN SCIENCE

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MIDWATER FISHES FROM THE GULF OF CALIFORNIA AND THE ADJACENT EASTERN TROPICAL PACIFIC[1]

By GARY D. BREWER[2]

ABSTRACT: This faunal study is based on over 56,000 specimens, representing at least 113 species distributed in 49 families, including Alepocephalidae, Apogonidae, Astronestidae, Balistidae, Bathylagidae, Bothidae, Branchiostegidae, Bregmacerotidae, Carangidae, Cetomimidae, Chiasmodontidae, Chauliodontidae, Coryphaenidae, Cynoglossidae, Diodontidae, Echeneidae, Engraulidae, Exocoetidae, Gonostomatidae, Holocentridae, Idiacanthidae, Kyphosidae, Linophrynidae, Macrouridae, Melamphaeidae, Melanocetidae, Melanostomiatidae, Moridae, Myctophidae, Nemichthyidae, Neoscopelidae, Nomidae, Ogcocephalidae, Oneirodidae, Ophidiidae, Paralepididae, Polynemidae, Scopelarchidae, Scorpaenidae, Scyliorhinidae, Serrivomeridae, Scombridae, Sternoptychidae, Stomiatidae, Stromateidae, Thaumatichthyidae, Trachipteridae, Trichiuridae, and Zoarcidae. Specimens were taken by 10-ft Isaccs-Kidd Midwater Trawl during the University of Southern California R/V *Velero IV* cruises in the Gulf of California and the adjacent eastern tropical Pacific in 1967 and 1970. Approximately 90 percent of the total number of specimens belonged to two families, Myctophidae and Gonostomatidae, and the majority of these to only two species, *Triphoturus mexicanus* and *Cyclothone acclinidens*, respectively.

Several endemic species (*Avocettina bowersi, Bathophilus filifer, Chauliodus barbatus, Lestidiops pacificum, Benthosema panamense, Diaphus pacificus, Bregmaceros bathymaster, Brotuloides emmelas, Melamphaes laeviceps, Melamphaes macrocephalus, Oneirodes luetkeni, Melanocetus ferox, Borophryne apogon*) are adapted, exclusively to the unique hydrological features (i.e. the extensive oxygen minimum layer) present in the eastern tropical Pacific. Furthermore, the tropical eastern Pacific is a center of origin and distribution for a number of fishes which occur along the west coasts of North and South America, including *Vinciguerria lucetia, Idiacanthus antrostomus, Diogenichthys laternatus, Lampanyctus parvicauda, Melamphaes acanthomus, Scopeloberyx robustus,* and *Scopelogadus mizolepis bispinosus.*

A comparison of trawl data from inside the Gulf of California with those data from along the coast of Mexico indicate the Gulf to be a limiting environment for a number of eastern Pacific fishes.

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INTRODUCTION

For a number of years, members of the Department of Biology and Allan Hancock Foundation of the University of Southern California, with support from the National Science Foundation, have been sampling the midwater fauna of the eastern Pacific Ocean aboard the R/V *Velero IV*. As a part of this program, special cruises to the Gulf of California and to the waters off the west coast of Mexico (the Middle American Trench) were made in November, 1967 and January, 1970, respectively. The purpose of these cruises was to survey the midwater fauna of these areas using a 10-ft Isaacs-Kidd Midwater Trawl (IKMWT) (Isaacs and Kidd, 1953).

Almost no deep sea collecting had been undertaken in the eastern tropical Pacific before 1891, when the *Albatross* made its historic voyage from the Galapagos Islands to the tip of Baja California. Garman's description (1899) of the midwater and benthic fishes collected during that cruise included 180 species, of which 85% were described as new to science.

Townsend and Nichols (1925) listed deep sea fishes from *Albatross* stations on the outer coast of Baja California and from two stations at the mouth of the Gulf of California. Parr (1931) described midwater fishes taken during the Pawnee Expedition from the west coast of Central America and Mexico. Mesopelagic fishes from off the coast of Peru were reported by Morrow (1957), and from the Peru-Chile Trench by Bussing (1965). Lavenberg and Fitch (1966) made 25 tows with a midwater trawl in the Gulf of California, and Robison (1972) has recently discussed the distribution of 39 species of midwater fishes in the Gulf of California.

Several other reports of fishes from the Gulf of California and the eastern tropical Pacific have been published, but generally, these are concerned with epipelagic and near-shore species (Meek and Hildebrand, 1923-28; Breder, 1936; Brock, 1938; Fowler, 1944; Seal, 1940-46; Ricker, 1959; Clemens and Nowell, 1963). Other reports have dealt with only a particular group of midwater fishes, such as those by Beebe and Vander Pyl (1944) and Alverson (1961) on the family Myctophidae. More recently, data from the wide-ranging EASTROPAC cruises were used by Moser and Ahlstrom (1970) and Ahlstrom (1971), to describe development in members of the family Myctophidae and the kinds and abundance of fish larvae in the eastern tropical Pacific, respectively.

The eastern tropical Pacific is a hydrographically unique region, largely independent of the major Pacific Ocean gyre systems, with water masses peculiar to it. This uniqueness is reflected in the prominent endemic element of the fauna. A comprehensive survey of the midwater ichthyofauna is not available for a large portion of the eastern tropical Pacific. This study is an attempt to partially fill that void.

Furthermore, a knowledge of the systematics and distribution of the eastern tropical Pacific ichthyofauna is essential for an understanding of the origin and relationships of a number of species which range into the Transitional Waters off the west coasts of North and South America.

This report is intended to 1) give an annotated list of the fishes taken by the R/V *Velero IV* from two cruises in the Gulf of California and the adjacent eastern tropical Pacific; and 2) to correlate the physico-chemical environment with the midwater fish distribution in the tropical eastern Pacific and areas adjacent to it.

MATERIALS AND METHODS

Cruise 922, to the Gulf of California by the R/V *Velero IV*, was undertaken in November, 1967. A total of 35 trawls were made with a 10-ft IKMWT. An additional 26 IKMWT's were taken during cruise 1061, in January, 1970, from off Acapulco, Mexico, to Cabo San Lucas, Baja California. Together, the collections from the two cruises represent a continuous series of stations in the eastern Pacific and the Gulf of California between 16° N, 100° W and 29° N, 113° W.

Station data and a map of the study area are shown in Table 1 and Figure 1, respectively. Station data are listed in sequence, the southernmost stations from cruise 1061 are given first. Included in the data are the date of each trawl and the location when the net started down and when it reached the surface after fishing. Time, in Pacific Standard Time, is listed when the net started down. Bottom depths were taken from fathometer readings and are listed in meters. The maximum depth of each trawl was determined from Benthos time-depth recorder charts. Since the net was without a closing device and fished continuously while in the water, this period is listed as total fishing time. The period in which the net fished at the approximate desired depth is listed as time at depth.

An attempt was made to specifically identify every fish taken. However, this proved impossible because of a number of specimens belonging to poorly known families and genera, some larval forms, and damaged individuals. When specific determination could not be made, individuals were placed in a higher taxonomic category and the reasons briefly explained in the annotations. A number of specimens in the collection undoubtly belong to undescribed species. These individuals have been so designated and have become available to specialists on the various groups.

The listing of orders and families in the annotated list largely follows the phylogenetic sequence adopted by Greenwood et al. (1966), with genera and species in each family listed alphabetically. Positive station numbers follow each species name, and these are followed, in parenthesis, by the number of individuals captured at each station. The size ranges are listed to the nearest millimeter. In all cases, sizes of specimens are in standard length. A plus sign following a measurement indicates that a posterior portion of the animal was missing. Maps, showing the locations of capture are included for the more significant captures only.

Since the net was open and fishing continuously at all depths, a number of epipelagic forms were captured. All fishes taken are reported here, but in the discussion major emphasis is placed on the midwater fishes.

TABLE 1
Station Data

Station	Date	Location Start Lat. N	Start Long. W	End Lat. N	End Long. W	Hour	Bottom Depth	Wire Out	Max. Trawl Depth	Time At Depth	Total Fish. Time
				Cruise 1061							
13727	1-12-70	16°16′	100°08′	Dip net station							
13728	1-12-70	16°16′	100°08′	16°17′	100°14′	22:48	3290	1220	435	1:00	2:02
13729	1-13-70	16°17′	100°14′	16°18′	100°21′	01:05	3290	2750	1100	1:00	2:50
13730	1-13-70	16°33′	100°36′	16°39′	100°59′	04:22	3840	3970	1290	3:00	5:52
13736	1-14-70	17°05′	101°52′	17°01′	102°07′	08:28	2750	3970	1240	3:00	5:49
13737	1-14-70	17°01′	102°07′	17°08′	102°18′	14:28	4300	2750	900	2:00	4:22
13738	1-14-70	17°08′	102°18′	17°10′	102°22′	19:00	4080	915	250	1:00	1:36
13739	1-15-70	17°47′	103°20′	17°54′	103°36′	04:47	3020	3970	1320	3:00	5:57
13740	1-15-70	17°54′	103°36′	18°00′	103°49′	10:51	3200	3360	1050	2:00	4:24
13741	1-15-70	18°00′	103°49′	18°00′	104°01′	15:28	2840	2750	875	2:00	3:59
13748	1-17-70	19°05′	104°10′	19°05′	105°13′	13:40	1560	3360	1050	2:00	3:50
13749	1-17-70	19°05′	105°13′	19°14′	105°32′	17:40	1460	1525	410	1:43	2:30
13750	1-17-70	19°14′	105°32′	19°24′	105°45′	20:20	3290	3660	1200	3:00	5:30
13751	1-18-70	19°24′	105°51′	19°39′	105°51′	02:10	3020	3050	950	3:00	5:04
13757	1-18-70	19°53′	105°59′	20°05′	106°06′	19:40	2510	3050	940	3:00	5:03
13758	1-19-70	20°05′	106°06′	20°21′	106°10′	00:55	2560	3050	950	3:00	5:07
13759	1-19-70	20°21′	106°10′	20°40′	106°24′	06:07	2270	3660	1280	3:00	6:08
13760	1-19-70	21°04′	106°21′	21°14′	106°32′	15:37	4210	3060	980	3:00	5:07
13761	1-19-70	21°19′	106°32′	21°19′	106°39′	20:50	3660	1220	375	1:30	2:14
13762	1-19-70	21°19′	106°39′	21°30′	106°48′	23:20	3300	3360	1090	2:00	5:30
13763	1-20-70	21°30′	106°48′	21°39′	106°53′	04:04	2750	3050	1015	2:00	4:06
13771	1-21-70	22°21′	108°12′	22°25′	108°29′	15:15	2560	3050	940	2:23	4:22
13772	1-21-70	22°25′	108°29′	22°31′	108°45′	19:49	2710	3360	1040	2:30	4:43
13773	1-22-70	22°50′	109°09′	22°35′	109°36′	06:10	1970	3660	1275	2:53	5:40
13777	1-22-70	22°34′	109°29′	22°36′	109°54′	20:30	2800	3970	1150	3:00	5:52
13778	1-23-70	22°36′	109°54′	22°37′	110°11′	02:33	2710	3360	1000	3:00	5:16
13779	1-23-70	22°37′	110°11′	22°41′	110°28′	08:01	2560	3050	875	3:00	5:04
				Cruise 922							
11731	11-07-67	21°26′	106°43′	21°15′	106°37′	22:35	2790	1070	325	2:00	3:13
11732	11-08-67	21°15′	106°37′	21°02′	106°39′	03:00	3660	1980	625	2:00	3:50
11733	11-08-67	21°02′	106°39′	20°35′	106°17′	07:05	4160	3960	1500	4:00	8:15
11734	11-08-67	20°35′	106°17′	20°49′	106°24′	15:25	3294	1070	400	2:00	2:57
11735	11-08-67	20°49′	106°24′	21°00′	106°30′	18:35	3360	1980	650	2:00	4:00
11748	11-11-67	21°39′	106°58′	22°00′	107°19′	13:20	2820	3960	1675	4:00	8:16
11749	11-11-67	22°00′	107°19′	22°51′	108°14′	21:53	2790	1370	450	2:00	3:02
11750	11-12-67	22°51′	108°14′	22°24′	108°01′	14:28	2560	3960	1370	4:00	8:38
11751	11-12-67	22°24′	108°01′	23°03′	108°17′	23:16	2880	3960	1500	4:00	8:36
11752	11-13-67	23°03′	108°17′	22°33′	107°58′	07:47	2870	2290	730	3:00	5:06
11764	11-15-67	23°13′	108°09′	23°32′	108°24′	10:15	2470	3960	1500	4:00	8:30
11765	11-15-67	23°32′	108°24′	23°42′	108°33′	18:52	2470	2290	730	2:00	4:16
11766	11-15-67	23°42′	108°33′	24°01′	108°52′	23:14	2650	3960	1500	4:00	8:26
11767	11-16-67	24°01′	108°52′	24°23′	109°10′	08:12	2560	3960	1500	4:00	7:13
11768	11-16-67	24°23′	109°10′	24°04′	108°54′	15:38	2560	3960	1500	4:00	7:39
11781	11-22-67	24°58′	110°12′	25°10′	110°14′	00:57	1120	1980	550	2:00	3:15
11782	11-22-67	25°10′	110°14′	25°28′	110°12′	04:22	1900	3960	1500	4:00	6:54
11783	11-22-67	25°31′	110°09′	25°36′	110°09′	11:25	2050	1070	400	2:00	2:48
11784	11-22-67	25°36′	110°09′	25°49′	110°10′	14:20	2020	2290	680	2:00	3:33
11785	11-22-67	25°49′	110°10′	25°26′	109°58′	18:05	1920	3960	1500	4:00	7:02
11786	11-23-67	25°26′	109°58′	25°03′	110°23′	01:20	2200	3960	1500	2:45	5:50
11798	11-25-67	26°02′	110°23′	26°19′	110°42′	14:27	1830	3960	1500	4:00	7:03
11799	11-25-67	26°10′	110°42′	26°34′	110°40′	21:45	2280	3050	950	4:00	7:10
11800	11-26-67	26°34′	110°40′	26°44′	110°41′	05:07	1280	1980	550	2:00	3:20
11801	11-26-67	26°44′	110°41′	26°59′	110°58′	08:35	1280	2590	800	3:00	4:52
11802	11-26-67	26°59′	110°58′	27°11′	111°17′	13:40	1460	3960	1500	4:00	7:02
11803	11-26-67	27°11′	111°17′	27°14′	111°22′	20:52	1700	305	100	1:00	1:10
11804	11-26-67	27°14′	111°22′	27°33′	111°52′	22:15	1920	3960	1500	5:20	8:25
11818	11-28-67	27°27′	Mechanical failure, all specimens lost								
11819	11-29-67	27°43′	111°56′	27°56′	112°10′	18:14	1560	3050	950	3:35	
								2130	660	0:25	6:06
11820	11-30-67	27°56′	112°11′	28°17′	112°28′	00:30	600	1370	400	4:30	6:22
11821	11-30-67	28°33′	112°49′	28°46′	113°06′	11:15	732	2130	630	4:10	5:31
11822	11-30-67	28°46′	113°06′	28°35′	112°52′	16:53	1280	1530	450	3:00	4:00
11823	11-30-67	28°35′	112°52′	29°03′	113°21′	21:00	915	2750	850	8:17	9:37
11839	12-03-67	27°08′	111°37′	27°01′	111°32′	10:25	1875	3360	1100	1:23	3:20

All material has been deposited at the Natural History Museum of Los Angeles County.

ANNOTATED LIST OF FISHES

SQUALIFORMES

Scyliorhinidae

Galeus piperatus Springer and Wagner, 1966
11821 (1) 283 mm.

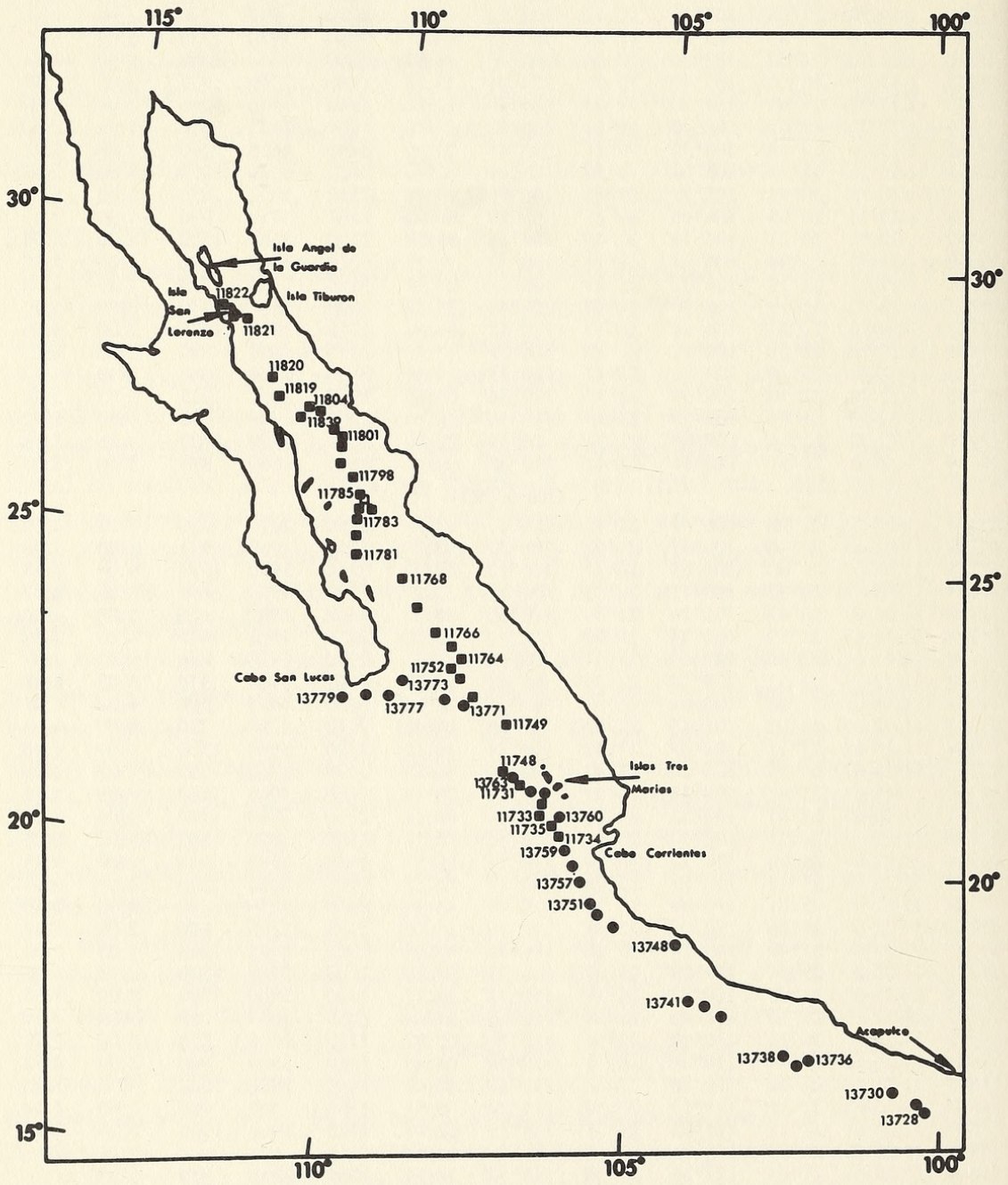

FIGURE 1. Midwater trawl stations occupied in the Gulf of California and the eastern tropical Pacific during November 1967 (squares) and January 1970 (circles).

ANGUILLIFORMES

Leptocephali

13729 (11) 65-226 mm; 13730 (2) 103-112 mm; 13737 (1) 120 mm; 13738 (2) 62-106 mm; 13739 (4) 85-124 mm; 13741 (2) 73-99 mm; 13748 (12) 84-180 mm; 13749 (11) 49-191 mm; 13750 (10) 82-119 mm; 13751 (11) 74-182 mm; 13758 (25) 73-120 mm; 13759 (22) 93-165 mm; 13760 (12) 53-108 mm; 13762 (10) 52-123 mm; 13763 (10) 90-189 mm; 13771 (8) 80-165 mm; 13772 (16) 50-180 mm; 13777 (1) 80 mm; 13779 (2) 77-120 mm; 11734 (49) 62-175 mm.

On the basis of pigmentation, body length and depth, and the shape and size of the head and jaws, at least eight species of leptocephali are represented in the collection.

Serrivomeridae

Serrivomer sector Garman, 1899 (Fig. 2)

13729 (1) 394 mm; 13730 (2) 410-526 mm; 13736 (3) 398-525 mm; 13737 (5) 340-410 mm; 13739 (4) 351-508 mm; 13740 (8) 410-605 mm; 13741 (1) 300 mm; 13748 (7) 340-410 mm; 13751 (3) 448-540 mm; 13757 (7) 404-473 mm; 13758 (6) 460-490 mm; 13759 (5) 344-558 mm; 13760 (2) 380-458 mm; 13761 (1) 325 mm; 13762 (6) 441-561 mm; 13763 (4) 400-603 mm; 13771 (4) 425-485 mm; 13772 (3) 420-470 mm; 13773 (1) 422 mm; 13777 (3) 443-574 mm; 13778 (3) 470-530 mm; 13779 (10) 425-520 mm; 11733 (8) 362-600 mm; 11748 (2) 425-558 mm; 11750 (4) 432-504 mm; 11751 (5) 412-584 mm; 11752 (1) 420 mm; 11764 (4) 448+-537 mm; 11766 (3) 419-590 mm; 11767 (5) 339-553 mm; 11768 (1) 606 mm; 11782 (2) 405-575 mm; 11784 (1) 150+ mm; 11785 (6) 420-586 mm; 11786 (2) 480-540 mm; 11802 (3) 480-546 mm; 11804 (5) 465-570 mm; 11819 (1) 490 mm; 11839 (1) 554 mm.

Nemichthyidae

Avocettina bowersi (Garman, 1899) (Fig. 2)

13738 (2) 240-386+ mm; 13748 (1) 323+ mm; 13757 (2) 249+-455 mm; 13758 (2) 347-390+mm; 13760 (3) 346-420 mm; 13761 (1) 365+mm; 11766 (1) 420 mm; 11799 (1) 420 mm; 11802 (1) 441 mm; 11804 (1) 458 mm; 11819 (3) 453-515 mm.

Avocettina infans (Günther, 1878) (Fig. 2)

13773 (2) 455-525 mm; 13778 (1) 552 mm; 11750 (1) 612 mm; 11751 (1) 490+ mm; 11765 (1) 612 mm; 11766 (1) 714 mm; 11767 (1) 645 mm; 11802 (1) 554 mm.

It is with some hesitation that I have assigned specific names to the above specimens of *Avocettina*. The taxonomic limits of the genus are not well understood, and much confusion exists in the literature. Part of the confusion arises because the long, slender bodies of the animals are easily broken, and after regeneration of new caudal fin rays, it is difficult to determine how much of the tail has been lost. Thus, at times, meristic data are of little value. The problem is further confounded by the apparent extreme intraspecific variation in such characters as number of fin rays, number of vertebrae, and length of snout.

In their revision of the family, Roule and Bertin (1929) suggested that *Nemichthys infans* (Günther), *Labichthys elongatus* Gill and Ryder, *Labichthys gilli* Bean, and *Labichthys bowersi* Garman were synonymous with *Avocettina infans* (Günther). This suggestion was based on the extreme variability of several characters in "Dana" specimens from both Atlantic and Pacific Oceans. They were hesitant to include *bowersi* in the synonmy, but

only because Garman's dorsal ray count of 252 was low compared to over 300 rays for other described species. All other morphometric and meristic data of *bowersi,* they felt, were within the range found for *A. infans.*

In the present specimens a broad range of morphometric and meristic characters was similarly found. Two groups were finally established on the basis of cephalic sensory pore arrangement. In *A. bowersi,* the anteriormost supraorbital pore lies in front of the posterior nare, while in *A. infans* all of the supraorbital pores are posterior to the nares. The ranges of counts and measurements were found to vary for the two species as follows:

	A. infans	*A. bowersi*
Dorsal rays	303-340	202-287
Lateral line pores	183-195	143-183
Diameter of eye into postorbital distance (distance from posterior margin of the eye to the opercular opening)	2.7-3.7	3.8-4.4
Dorsal-fin origin	0.0-0.5 eye diameters behind the posterior end of the pectoral fin base	1.5-2.0 eye diameters behind the posterior end of the pectoral fin base
Anal-fin origin beneath	24-34 dorsal-fin ray	16-24 dorsal-fin ray

Environmental influences undoubtedly play an important role in causing variation in morphometric and meristic characters in these eels, but the degree of geographical variation for each species is as yet, unknown. Clearly, a more detailed study with a larger sample size is needed.

Nemichthys scolopaceus Richardson, 1848 (Fig. 3)
13751 (2) 293-856 mm; 13759 (2) 867-924 mm; 13760 (1) 795 mm; 13772 (2) 300-785 mm; 13777 (1) 310 mm; 13779 (3) 880-989 mm; 11766 (1) 795+ mm; 11767 (1) 853 mm; 11768 (2) 835-1147 mm; 11784 (1) 529 mm; 11785 (1) 882 mm; 11786 (2) 651-760+ mm; 11798 (1) 755 mm; 11799 (2) 535-970 mm; 11801 (1) 880 mm; 11802 (1) 626+ mm; 11803 (1) 556 mm; 11804 (4) 389-960 mm; 11819 (2) 715+-748 mm; 11820 (1) 605 mm.

CLUPEIFORMES

Engraulidae

Engraulidae — unidentified larvae
13760 (2) 13 mm.

SALMONIFORMES

Bathylagidae

Bathylagus nigrigenys Parr, 1931 (Fig. 3)
13728 (1) 36 mm; 13729 (8) 25-44 mm; 13730 (2) 31-64 mm; 13736 (2) 51-52 mm; 13737 (6) 22-87 mm; 13738 (5) 28-79 mm; 13740 (25) 21-89 mm; 13741 (24) 19-74 mm; 13748 (6) 21-40 mm; 13750 (3) 37-70 mm; 13751 (6) 25-71 mm; 13757 (12) 24-73 mm; 13758 (27) 20-73 mm; 13759 (5) 25-53 mm; 13760 (33) 25-85 mm; 13761 (6) 23-63 mm; 13763 (29) 24-79 mm; 13771 (17) 28-69 mm; 13772 (11)

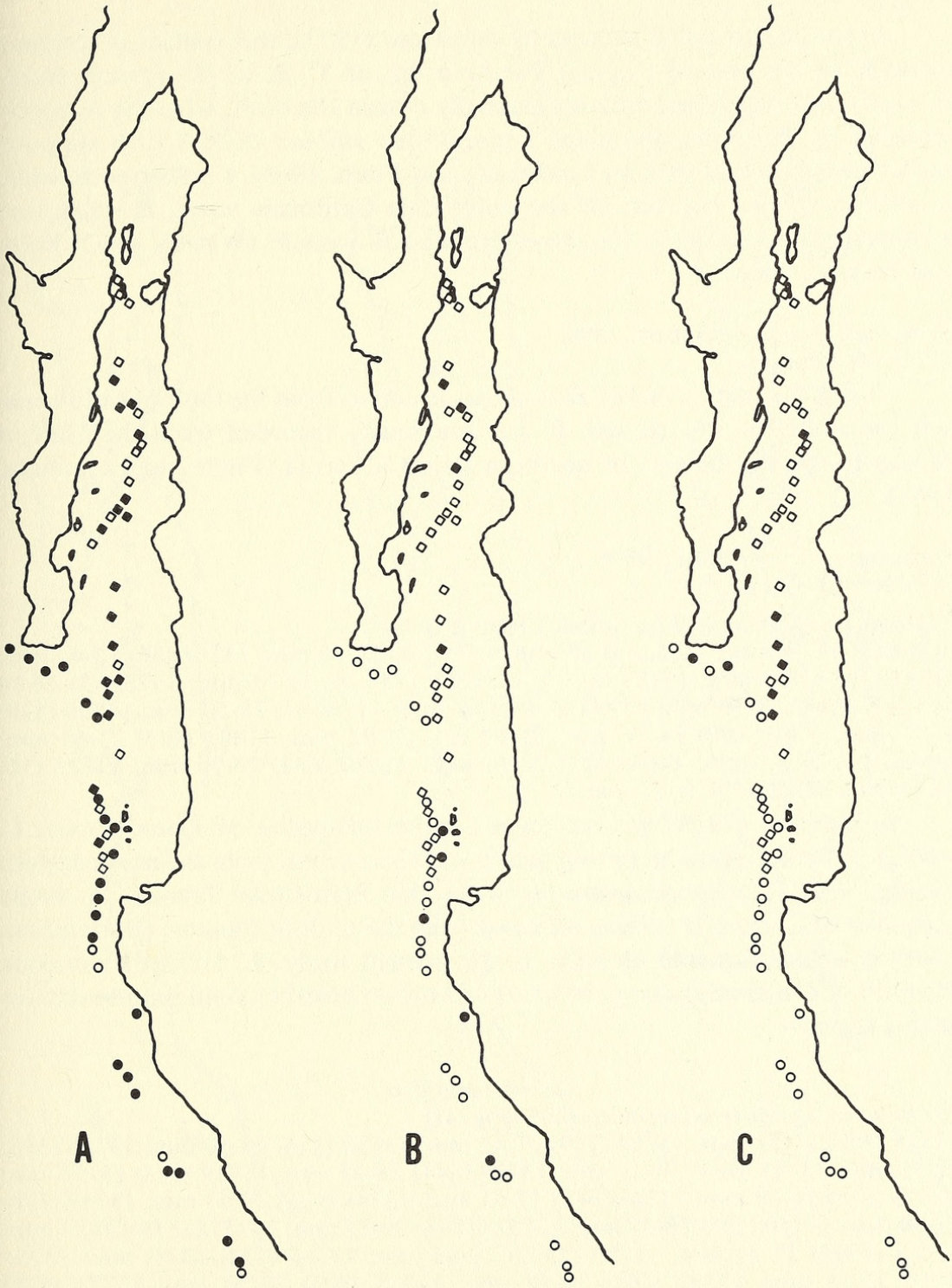

FIGURE 2. Locations of capture of A) *Serrivomer sector*, B) *Avocettina bowersi*, and C) *Avocettina infans* indicated by blackened squares and circles.

26-69 mm; 11731 (1) 58 mm; 11732 (5) 23-31 mm; 11733 (10) 15-82 mm; 11748 (6) 14-65 mm; 11749 (2) 63-74 mm; 11750 (9) 17-83 mm; 11751 (3) 19-50 mm; 11764 (2) 52-53 mm; 11766 (1) 58 mm; 11767 (1) 80 mm; 11782 (1) 25 mm; 11802 (1) 63 mm.

According to larval surveys by Ahlstrom (1971), this species is common throughout the eastern tropical Pacific north of 5° S. In the present study, *B. nigrigenys* was taken only occasionally within the Gulf, where it is largely replaced by the more abundant *Leuroglossus stilbius stilbius* (this supports earlier distributional data by Lavenberg and Fitch, 1966). Furthermore, while *L. stilbius stilbius* is taken off the outer Baja California coast, *B. nigrigenys* is apparently replaced by the closely related *B. wesethi* (Wisner, 1962; Berry and Perkins, 1966).

Bathylagus pacificus Gilbert, 1890
11750 (1) 155 mm.

This is the first record of *Bathylagus pacificus* from the Gulf of California, and the southernmost record. It was previously recorded from the Gulf of Alaska to the Pacific side of northern Baja California (Fitch and Lavenberg, 1968).

Bathylagus wesethi Bolin, 1939
13779 (4) 24-59 mm.

Leuroglossus stilbius stilbius Gilbert, 1890 (Fig. 3)
11764 (3) 27-36 mm; 11765 (1) 26 mm; 11767 (8) 21-56 mm; 11768 (16) 15-47 mm; 11781 (10) 21-80 mm; 11782 (3) 26-32 mm; 11784 (6) 31-74 mm; 11785 (5) 20-34 mm; 11786 (6) 24-30 mm; 11798 (37) 24-67 mm; 11799 (4) 25-50 mm; 11800 (129) 27-79 mm; 11801 (90) 24-79 mm; 11802 (21) 21-92 mm; 11803 (441) 23-65 mm; 11804 (21) 23-55 mm; 11819 (23) 22-74 mm; 11820 (632) 25-96 mm; 11821 (51) 31-51 mm; 11839 (29) 21-91 mm.

Borodulina (1968) has recognized three subspecies of *Leuroglossus, L. stilbius schmidti* from the Bering Sea, *L. stilbius stilbius* from the north eastern Pacific, and *L. stilbius urotranus* from the Peru-Chile Trench. A single specimen of *L. stilibus stilbius* reported from the Gulf of Panama (Borodulina, 1968) is of questionable identity. In the present study, 26 IKMWT's outside the Gulf of California, along the coast of Mexico failed to yield representatives of this form.

Gonostomatidae

Cyclothone acclinidens Garman, 1899 (Fig. 4)
13728 (499) 21-51 mm; 13729 (229) 27-47 mm; 13730 (176) 26-50 mm; 13736 (130) 27-56 mm; 13737 (564) 20-53 mm; 13738 (444) 25-49 mm; 13739 (321) 28-54 mm; 13740 (614) 26-48 mm; 13741 (462) 17-51 mm; 13748 (628) 20-53 mm; 13749 (138) 26-50 mm; 13750 (205) 20-51 mm; 13751 (1846) 20-55 mm; 13757 (2556) 20-53 mm; 13758 (1962) 17-54 mm; 13759 (1302) 20-48 mm; 13760 (734) 18-51 mm; 13761 (930) 23-55 mm; 13762 (261) 20-48 mm; 13763 (903) 20-50 mm; 13771 (879) 18-52 mm; 13772 (1189) 16-49 mm; 13773 (454) 22-53 mm; 13777 (78) 10-55 mm; 13778 (458) 24-54 mm; 13779 (653) 17-48 mm; 11733 (1) 35 mm.

This was the second most abundant fish taken in the survey. A total of 18,606 individuals were collected at 27 stations. Surprisingly, not a single

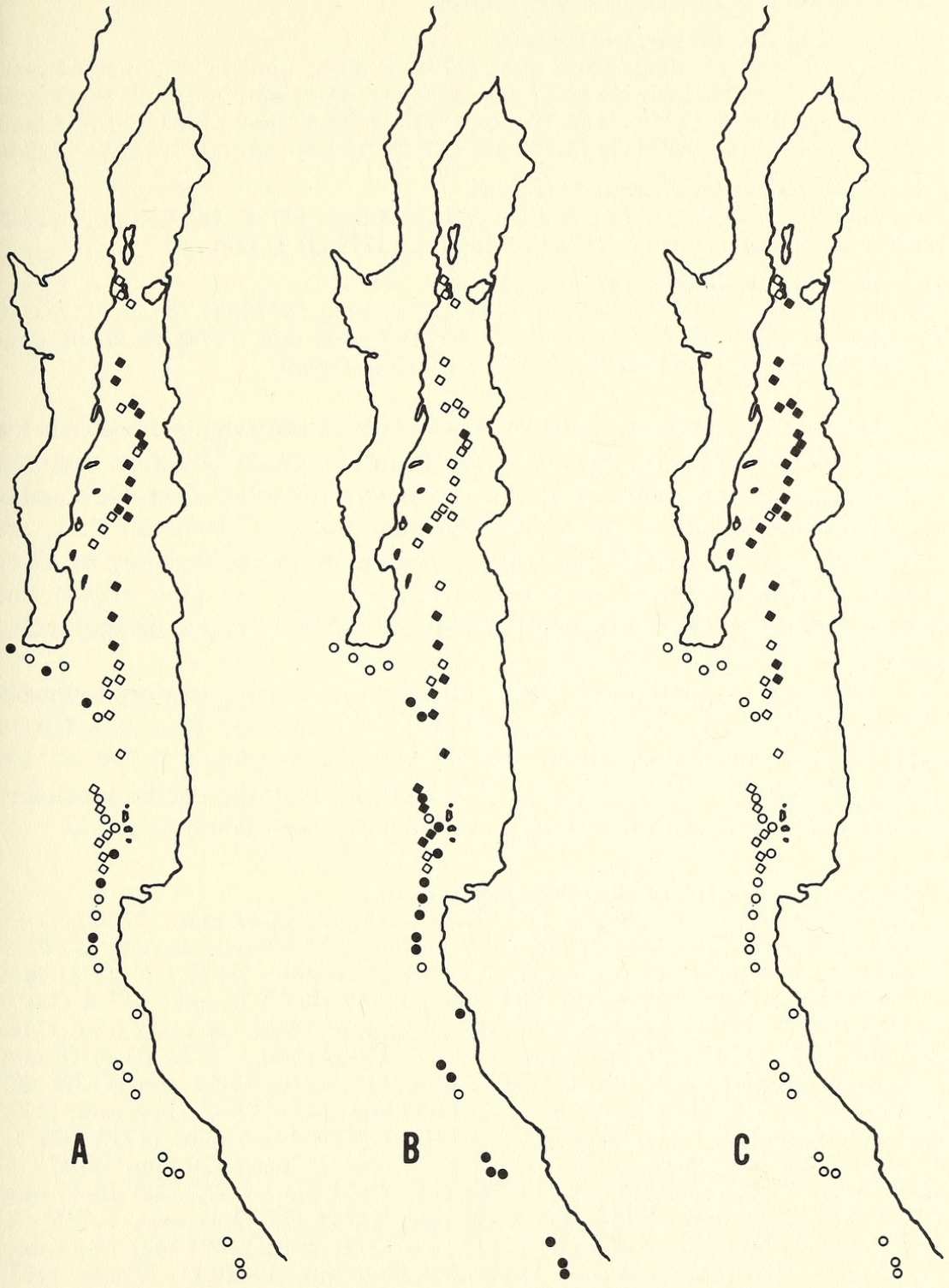

FIGURE 3. Locations of capture of A) *Nemichthys scolopaceus*, B) *Bathylagus nigrigenys*, and C) *Leuroglossus stilbius stilbius* indicated by blackened squares and circles.

individual was taken north of 22°50′N in the Gulf of California. This phenomenon is discussed in a later section.

Cyclothone pallida Brauer, 1902 (Fig. 4)
13729 (1) 62 mm; 13730 (2) 50-56 mm; 13737 (4) 53-65 mm; 13739 (6) 50-64 mm; 13740 (2) 45-57 mm; 13741 (2) 42-45 mm; 13748 (2) 45-55 mm; 13750 (2) 54-61 mm; 13751 (2) 58-61 mm; 13759 (3) 55-59 mm; 13762 (4) 38-64 mm; 13763 (2) 51-55 mm; 13772 (8) 50-59 mm; 13773 (3) 53-59 mm; 13778 (7) 44-60 mm; 13779 (2) 54-58 mm.

Cyclothone signata Garman, 1899 (Fig. 4)
13748 (1) 19 mm; 13751 (1) 21 mm; 13757 (1) 28 mm; 13758 (2) 24-33 mm; 13760 (1) 26 mm; 13762 (1) 16 mm; 13763 (1) 18 mm; 13779 (1) 21 mm.

Diplophos taenia Günther, 1873 (Fig. 5)
13763 (2) 36 mm; 13773 (1) 84 mm; 13777 (1) 44 mm; 13778 (1) 78 mm; 11731 (3) 36-105 mm; 11732 (6) 86-106 mm; 11734 (12) 58-102 mm; 11748 (3) 68-99 mm; 11750 (1) 119 mm; 11752 (4) 95-115 mm; 11786 (1) 93 mm.

Until the taxonomic status of this species is thoroughly reviewed, the specific identification of these individuals must remain tentative. Johnson (1970) suggested that three species of *Diplophos* described from the Pacific, *D. pacificus* Günther, *D. orientalis* Matsubara, and *D. proximus* Parr, are synonymous with the Atlantic form *D. taenia.* In an earlier study by Grey (1960), Pacific specimens were placed in *D. taenia,* but later (1964), she questioned this synonomy because of lower photophore counts in the Pacific specimens.

The range of photophore counts for the present specimens are followed, in parentheses, by counts by Grey (1964) for the Atlantic *D. taenia:* BR 11 (12); IV 39-41 (47); VAV 14-16 (16-17); AC 41-44+2 (46-47+2-3); IC 97-102 (111-113); OA 77-84 (71). Body proportions of these Pacific specimens are not significantly different from those listed for the Atlantic *D. taenia.*

Vinciguerria lucetia (Garman, 1899) (Fig. 5)
13728 (52) 9-36 mm; 13729 (27) 11-35 mm; 13730 (6) 18-41 mm; 13736 (17) 15-45 mm; 13737 (9) 22-51 mm; 13738 (23) 7-35 mm; 13739 (94) 22-46 mm; 13740 (5) 15-36 mm; 13741 (11) 12-30 mm; 13748 (19) 15-30 mm; 13749 (10) 12-31 mm; 13750 (23) 9-34 mm; 13751 (18) 12-36 mm; 13757 (7) 22-39 mm; 13758 (38) 9-46 mm; 13759 (13) 12-46 mm; 13760 (9) 12-30 mm; 13761 (2) 11-54 mm; 13762 (21) 8-33 mm; 13763 (23) 10-48 mm; 13771 (24) 14-44 mm; 13772 (3) 13-19 mm; 13773 (24) 19-28 mm; 13777 (12) 20-44 mm; 13778 (10) 12-39 mm; 13779 (32) 13-46 mm; 11732 (1) 12 mm; 11733 (201) 11-38 mm; 11734 (150) 12-43 mm; 11735 (331) 12-38 mm; 11748 (148) 15-41 mm; 11751 (135) 12-46 mm; 11752 (90) 11-33 mm; 11764 (38) 14-41 mm; 11765 (2) 13-29 mm; 11766 (1) 20 mm; 11767 (19) 18-31 mm; 11768 (18) 12-27 mm; 11781 (23) 12-34 mm; 11782 (18) 16-46 mm; 11783 (82) 12-34 mm; 11784 (23) 12-30 mm; 11785 (7) 30-41 mm; 11786 (52) 14-52 mm; 11798 (31) 14-41 mm; 11799 (59) 18-51 mm; 11801 (42) 13-34 mm; 11802 (37) 11803 (44) 13-53 mm; 11804 (40) 12-48 mm; 11820 (1) 37 mm; 11839 (59) mm.

Vinciguerria lucetia was described by Ahlstrom and Counts (1958) as "the most ubiquitous and abundant species of fish in plankton collections from the eastern Pacific." Over 2000 individuals were collected at 52 stations in the present study.

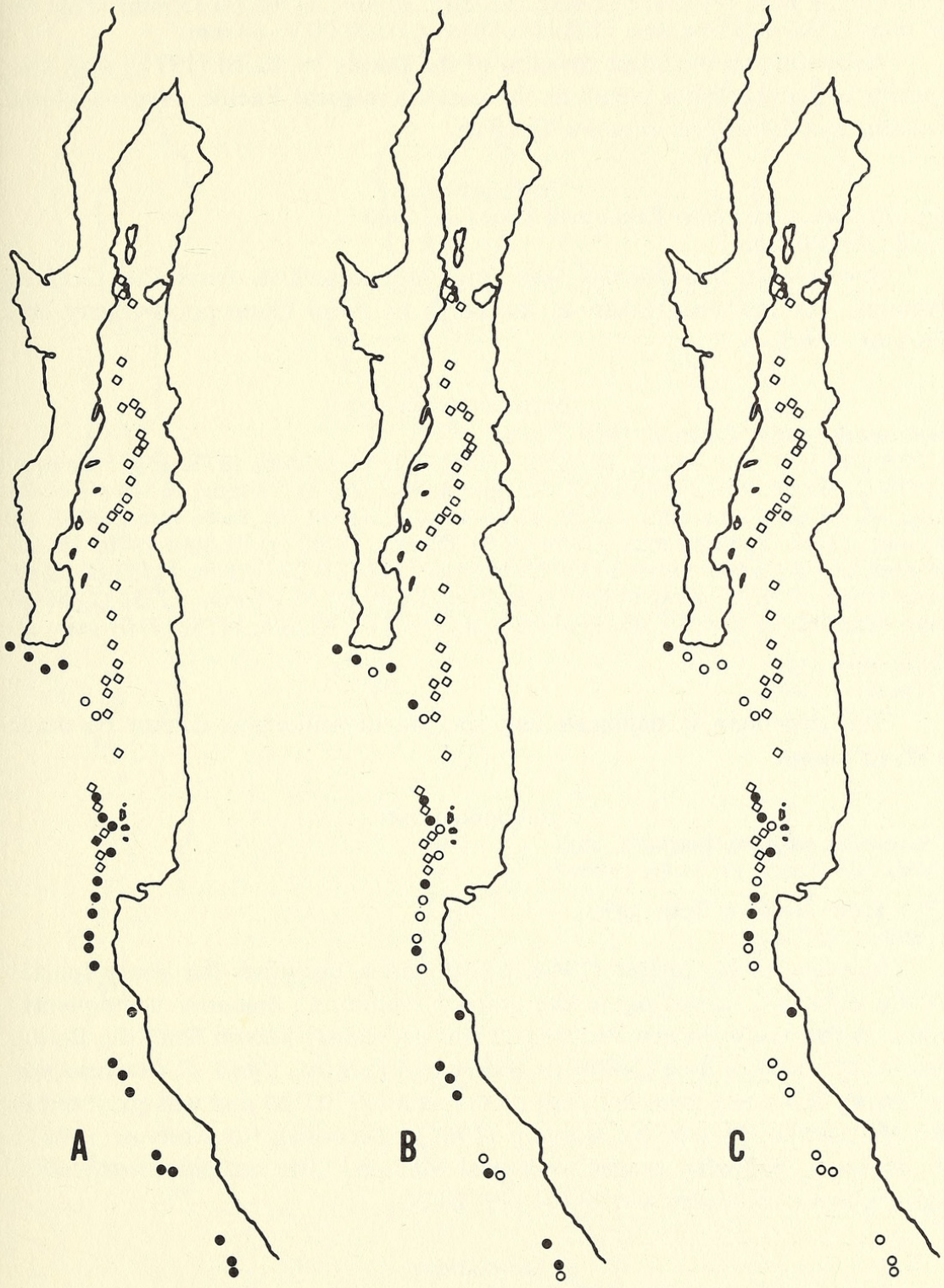

FIGURE 4. Locations of capture of A) *Cyclothone acclinidens*, B) *Cyclothone pallida*, and C) *Cyclothone signata* indicated by blackened squares and circles.

Sternoptychidae

Argyropelecus lychnus (Garman, 1899) (Fig. 5)
13773 (1) 32 mm; 13777 (1) 50 mm; 13778 (1) 50 mm; 11766 (1) 35 mm; 11781 (1) 34 mm; 11783 (6) 11-16 mm; 11784 (1) 13 mm; 11820 (5) 35-64 mm.

According to the latest revision of the family by Baird (1971), only two species of hatchetfishes occur in the eastern tropical Pacific, *Argyropelecus lychnus* and *Sternoptyx obscura* Garman.

Astronesthidae

Borostomias panamensis Regan and Trewavas, 1930
11782 (1) 220 mm.

Borostomias panamensis was originally described from the Gulf of Panama, but has been taken as far north as Point Conception (Berry and Perkins, 1966).

Melanostomiatidae

Bathophilus filifer Garman, 1899 (Fig. 6)
13729 (5) 21-54 mm; 13730 (1) 56 mm; 13737 (2) 62-63 mm; 13738 (5) 35-82 mm; 13739 (5) 21-82 mm; 13740 (4) 27-75 mm; 13741 (22) 61-79 mm; 13748 (4) 21-76 mm; 13749 (4) 15-73 mm; 13750 (3) 66-86 mm; 13751 (9) 56-86 mm; 13757 (1) 68 mm; 13758 (3) 44-60 mm; 13759 (3) 71-78 mm; 13760 (1) 73 mm; 13763 (2) 65-69 mm; 13772 (2) 60-75 mm; 11731 (2) 69 mm; 11732 (2) 29-30 mm; 11733 (3) 29-68 mm; 11734 (4) 43-67 mm; 11735 (1) 58 mm; 11750 (7) 63-85 mm; 11752 (2) 56-66 mm; 11764 (1) 76 mm; 11766 (4) 63-83 mm; 11767 (1) 82 mm; 11782 (1) 67 mm.

Bathophilus sp.
11766 (1) 83 mm.

This specimen is damaged and specific identification cannot be made with certainty.

Chauliodontidae

Chauliodus barbatus Garman, 1899
13741 (1) 40 mm; 13751 (1) 198 mm.

Chauliodus macouni Bean, 1890
11802 (1) 188 mm.

Morrow, in his review (1964) of the genus, describes the above species as the only two occurring in the eastern Pacific. *C. macouni* is frequently taken in the north eastern Pacific and was previously known from the Bering Sea to off northern Baja California (Berry and Perkins, 1966). *C. barbatus* was originally described from the Gulf of Panama (13°01′N) and was recorded in the Peru-Chile Trench by Bussing (1965). According to Morrow (1961), *C. barbatus* "probably ranges to central Mexico." The northernmost station that yielded *C. barbatus* was 13751 (19°24′N).

Stomiatidae

Stomias atriventer Garman, 1899 (Fig. 6)
13740 (1) 29 mm; 13741 (1) 124 mm; 13750 (3) 29-35 mm; 13757 (2) 44-56 mm; 13758 (5) 76-145 mm; 13759 (10) 89-162 mm; 13760 (3) 96-125 mm; 13771 (13) 97-211 mm; 13772 (20) 87-202 mm; 13773 (9) 43-183 mm; 13777 (1) 140 mm; 13778 (19) 30-172 mm; 13779 (88) 56-210 mm; 11731 (1) 181 mm; 11732 (2) 38-

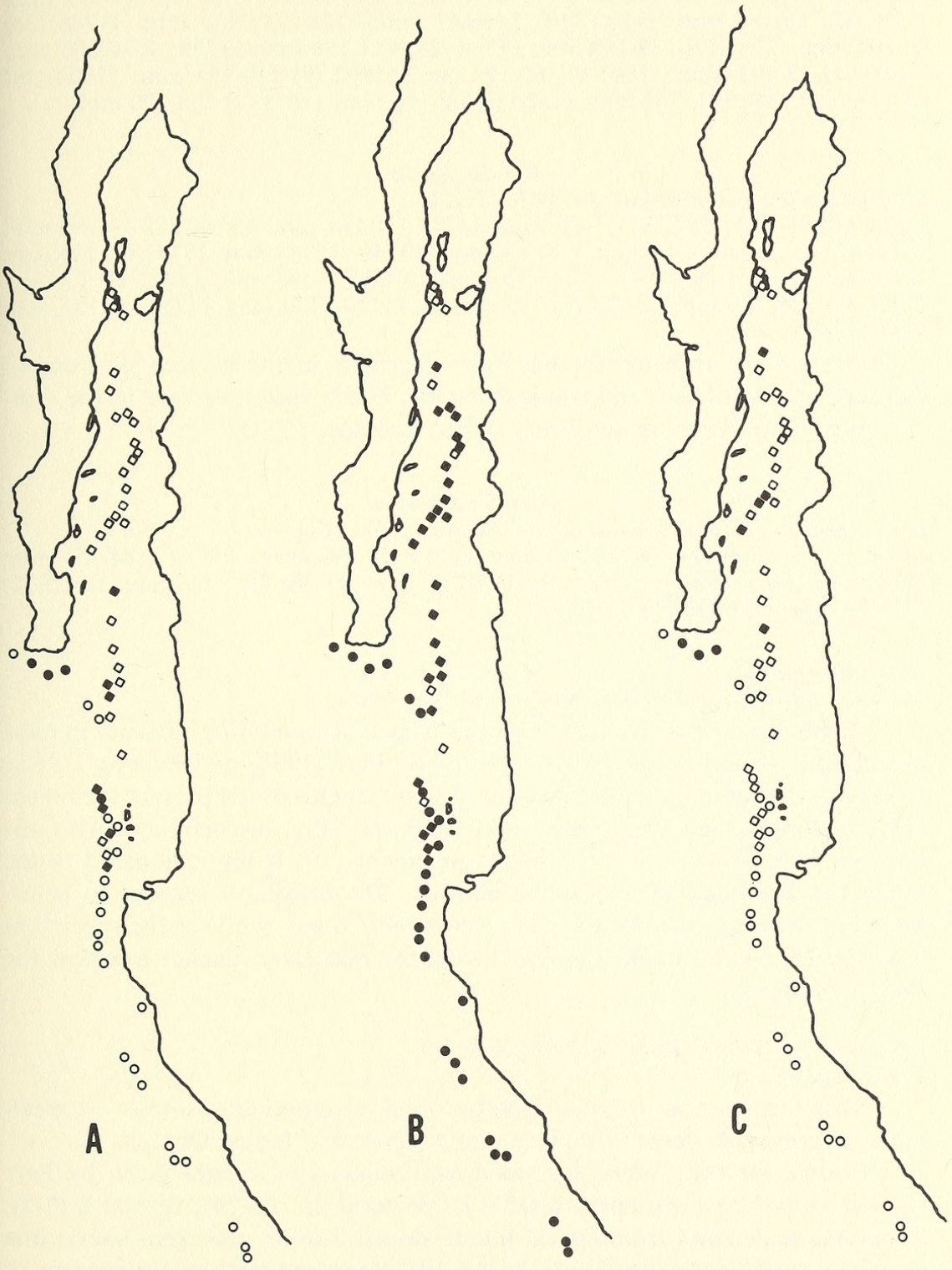

FIGURE 5. Locations of capture of A) *Diplophos taenia,* B) *Vinciguerria lucetia,* and C) *Argyropelecus lychnus* indicated by blackened squares and circles.

54 mm; 11733 (2) 71-94 mm; 11734 (5) 60-103 mm; 11735 (1) 182 mm; 11748 (2) 101-102 mm; 11751 (1) 179 mm; 11752 (1) 85 mm; 11764 (2) 96 mm; 11765 (1) 118 mm; 11766 (8) 60-160 mm; 11767 (29) 95-206 mm; 11768 (13) 97-195 mm; 11781 (2) 85-148 mm; 11782 (10) 126-187 mm; 11784 (1) 130 mm; 11785 (36) 96-201 mm; 11786 (7) 129-189 mm; 11798 (20) 111-198 mm; 11799 (4) 60-203 mm; 11800 (5) 22-197 mm; 11801 (6) 60-194 mm; 11802 (9) 110-191 mm; 11804 (29) 83-212 mm; 11819 (1) 143 mm; 11820 (2) 68-116 mm; 11839 (2) 168-190 mm.

Idiacanthidae

Idiacanthus antrostomus Gilbert, 1890 (Fig. 6)
13728 (1) 45 mm; 13729 (1) 137 mm; 13737 (1) 174 mm; 13740 (2) 43-157 mm; 13741 (7) 44-180 mm; 13748 (3) 70-137 mm; 13749 (1) 148 mm; 13751 (1) 135 mm; 13757 (2) 43-44 mm; 13758 (2) 44-48 mm; 13760 (1) 185 mm; 13771 (1) 63 mm; 13772 (2) 128-180 mm; 13778 (1) 105 mm; 11731 (1) 170 mm; 11734 (1) 151 mm; 11735 (1) 151 mm.

Idiacanthus antrostomus has been captured in the eastern portions of the northern, southern, and tropical Pacific, but is absent or rare in the Gulf of California (Lavenberg and Fitch, 1966; Robison, 1972).

Alepocephalidae

Bajacalifornia burragei Townsend and Nichols, 1925 (Fig. 7)
13730 (1) 180 mm; 13736 (1) 142 mm; 11751 (1) 156 mm; 11767 (2) 84-154 mm; 11782 (2) 100-138 mm; 11785 (3) 104-144 mm; 11799 (1) 111 mm; 11802 (2) 121-133 mm; 11804 (6) 79-152 mm.

Bajacalifornia sp.
11748 (1) 72 mm; 11751 (1) 48 mm; 11782 (1) 29 mm.

These specimens strongly resemble *Bajacalifornia drakei* (Beebe) in most morphometric and meristic data as listed by Parr (1937) and Bussing (1965). However, the snout length (in percent of body length) of the present specimens (13.1) is longer than previously listed (10.5 and 10.9, respectively). Also, the number of gill rakers in the present specimens (19) is low compared to the range (24-26) listed by the above authors. The maxillary reaches to below the anterior rim of the orbit in the present individuals, while in the specimens listed by Parr (1937) and Bussing (1965), the maxillary reaches to below the middle of the eye.

Barbantus curvifrons (Roule and Angel, 1931)
11767 (1) 107 mm.

This specimen is in good condition and is remarkably similar to specimens described by Parr (1960) from the Atlantic and Indian Oceans.

Counts for the *Velero* specimen are followed by ranges given by Parr (1960): Dorsal 15 (15); anal 16 (15-17); pectoral 25 (20-24); ventral 8 (7-8); transverse scale rows from lateral line to dorsal 8 (6-8), and from lateral line to anal 8 (6-8); gillrakers 5+14 (4-5+14). Body proportions (in percent of body length) for the *Velero* specimen are followed in parentheses by those listed by Parr (1960) for a 115 mm specimen from the Indian Ocean: Head 27.5 (28.7); snout 6.0 (5.6); orbit 9.8 (9.8); upper jaw 13.5 (14.4); lower jaw

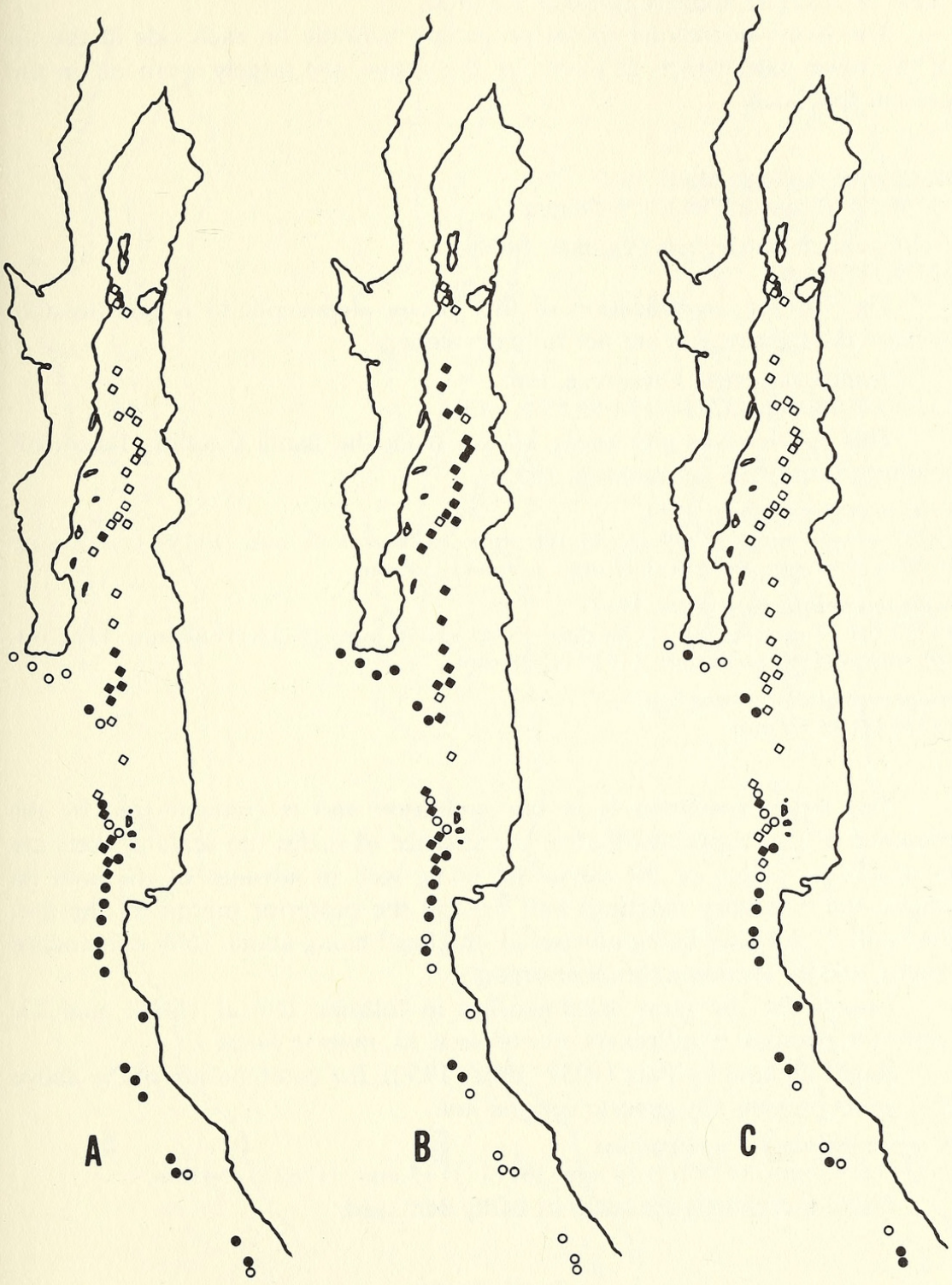

FIGURE 6. Locations of capture of A) *Bathophilus filifer*, B) *Stomias atriventer*, and C) *Idicanthus antrostomus* indicated by blackened squares and circles.

15.1 (14.9); interorbital 4.6 (4.5); snout to dorsal 58.3 (62.6); snout to anal 68.6 (68.9); base of pectoral 4.6 (4.8); longest pectoral ray 9.6 (9.6); greatest depth 20.5 (21.7); longest gillraker 3.7 (3.5).

The bony, horizontal spines projecting laterally on each side at the tip of the lower jaw, which characterize the genus, are largely worn off in the present specimen.

Holtbyrnia macrops Maul, 1957
11766 (1) 63 mm; 11799 (2) 56-68 mm.

Holtbyrnia melanocephala (Vaillant, 1888)
13758 (1) 38 mm.

The specific identification of this young alepocephalid is questionable because the light organs are not fully developed.

Normichthys campbelli Lavenberg, 1965
13740 (1) 86 mm; 13771 (2) 81-98 mm.

This species was previously known from the Santa Catalina Basin, off southern California (Lavenberg, 1965).

Pellisolus facillis Parr, 1951
13737 (1) 98 mm; 13739 (3) 41-100 mm; 13740 (1) 27 mm; 13759 (1) 22 mm; 11764 (1) 34 mm; 11733 (1) 47 mm; 11766 (1) 59 mm.

Talismania bifurcata (Parr, 1951)
13737 (1) 27 mm; 13738 (1) 38 mm; 13741 (1) 50 mm; 13779 (1) 89 mm; 11782 (1) 208 mm; 11798 (1) 28 mm; 11839 (1) 28 mm.

Alepocephalidae — unidentified
13730 (2) 35-80 mm.

The larger specimen is in fair condition and is characterized by the presence of two supramaxillaries; the absence of scales (no scale pockets are evident); the origin of the dorsal fin being well in advance of the anal fin origin; the maxillary reaching well beyond the posterior margin of the eye; the teeth in the jaws being pluriserial; the head being about 36% of standard length; and by lacking a shoulder organ.

Counts for the same specimen are as follows: Dorsal 15-16; anal 11; ventral 8; pectoral 6; gillrakers on first arch 13; pyloric caeca 7.

Based on keys by Parr (1937, 1951, 1952), the combination of the above characters prevent any generic designation.

Alepocephalidae — unidentified
13730 (1) 15 mm; 13757 (1) 24 mm; 13777 (1) 15 mm; 11767 (1) 56 mm.

These individuals are small or badly damaged.

Paralepididae

Lestidiops pacificum (Parr, 1931) (Fig. 7)
13736 (1) 127 mm; 13737 (1) 125 mm; 13738 (1) 29 mm; 13740 (2) 83-87 mm; 13741 (1) 68 mm; 13771 (1) 139 mm; 11731 (1) 76 mm; 11733 (4) 78-167 mm; 11734 (1) 86 mm; 11750 (1) 96 mm.

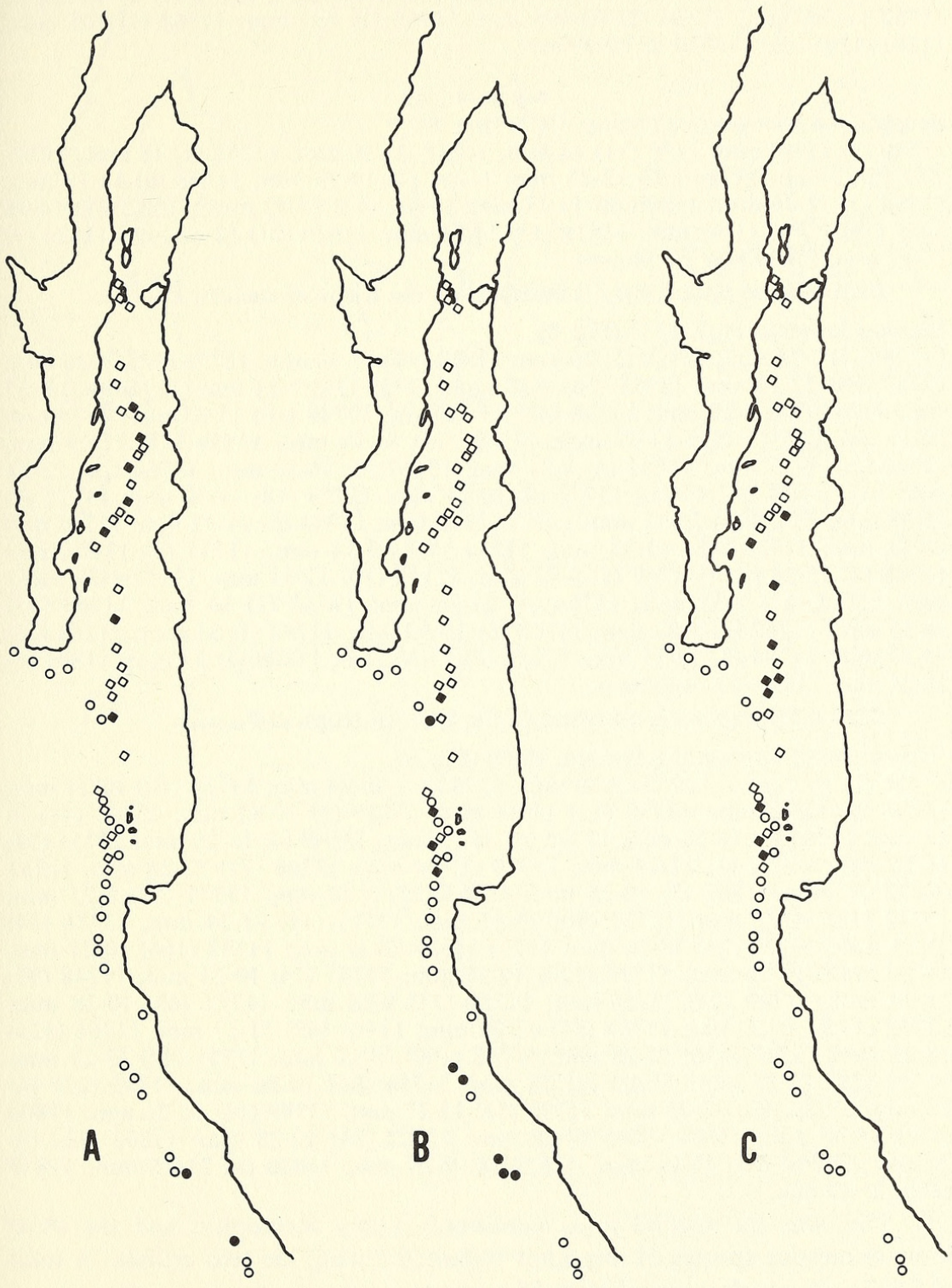

FIGURE 7. Locations of capture of A) *Bajacalifornia burragei*, B) *Lestidiops pacificum*, and C) *Scopelarchoides nicholsi* indicated by blackened squares and circles.

Scopelarchidae

Scopelarchoides nicholsi Parr, 1931 (Fig. 7)
11731 (1) 99 mm; 11733 (2) 34-46 mm; 11735 (1) 102 mm; 11750 (3) 25-104 mm; 11752 (1) 96 mm; 11764 (5) 90-106 mm; 11766 (1) 101 mm; 11768 (1) 105 mm; 11781 (1) 83 mm; 11786 (2) 69-99 mm.

Myctophidae

Benthosema panamense (Taning, 1932) (Fig. 8)
13736 (3) 15-19 mm; 11765 (1) 14 mm; 11768 (1) 10 mm; 11782 (1) 18 mm; 11783 (35) 12-22 mm; 11784 (10) 12-22 mm; 11786 (4) 19-23 mm; 11798 (6) 14-19 mm; 11799 (3) 12-16 mm; 11800 (8) 13-17 mm; 11801 (12) 14-42 mm; 11802 (29) 14-36 mm; 11803 (71) 11-47 mm; 11819 (11) 11-36 mm; 11820 (21) 12-41 mm; 11821 (9) 16-37 mm; 11839 (38) 10-34 mm.

Benthosema panamense is endemic to the tropical eastern Pacific.

Diaphus pacificus Parr, 1931 (Fig. 8)
13728 (44) 5-28 mm; 13729 (1) 26 mm; 13730 (58) 17-30 mm; 13736 (27) 16-30 mm; 13737 (29) 22-32 mm; 13738 (36) 9-30 mm; 13739 (34) 7-31 mm; 13740 (83) 9-32 mm; 13741 (58) 9-29 mm; 13748 (43) 13-32 mm; 13749 (10) 11-31 mm; 13750 (4) 10-11 mm; 13751 (10) 11-32 mm; 13758 (15) 11-34 mm; 13759 (17) 25-29 mm; 13760 (18) 9-33 mm; 13761 (6) 9-31 mm; 13762 (2) 16-29 mm; 13763 (26) 12-31 mm; 13771 (10) 21-31 mm; 13772 (8) 10-29 mm; 13773 (18) 19-30 mm; 13777 (5) 25-28 mm; 13778 (3) 20-33 mm; 13779 (1) 17 mm; 11731 (5) 13-32 mm; 11732 (68) 13-43 mm; 11733 (68) 13-33 mm; 11734 (485) 9-34 mm; 11735 (8) 13-30 mm; 11748 (5) 15-28 mm; 11749 (5) 9-31 mm; 11750 (30) 11-31 mm; 11751 (42) 10-31 mm; 11752 (61) 9-35 mm; 11764 (4) 21-26 mm; 11765 (1) 16 mm; 11766 (15) 16-32 mm; 11767 (9) 9-22 mm; 11768 (6) 10-32 mm; 11782 (1) 32 mm; 11783 (22) 13-34 mm; 11784 (2) 14-15 mm; 11786 (4) 17-35 mm; 11800 (1) 31 mm; 11801 (3) 23-24 mm; 11839 (2) 14-21 mm.

Diaphus pacificus is endemic to the eastern tropical Pacific.

Diogenichthys laternatus (Garman, 1899) (Fig. 8)
13728 (1) 16 mm; 13729 (3) 9-10 mm; 13730 (4) 20-24 mm; 13736 (10) 10-23 mm; 13737 (5) 12-17 mm; 13738 (15) 11-24 mm; 13739 (3) 13-32 mm; 13740 (48) 9-25 mm; 13741 (2) 16-26 mm; 13748 (4) 18-25 mm; 13749 (4) 13-20 mm; 13751 (58) 16-25 mm; 13757 (3) 21-24 mm; 13758 (1) 24 mm; 13760 (11) 12-26 mm; 13761 (4) 22-24 mm; 13762 (5) 10-28 mm; 13763 (25) 8-24 mm; 13771 (58) 8-25 mm; 13772 (18) 18-25 mm; 13773 (60) 15-27 mm; 13777 (15) 21-24 mm; 13778 (24) 15-25 mm; 13779 (24) 18-26 mm; 11731 (133) 12-26 mm; 11732 (166) 10-27 mm; 11733 (117) 10-26 mm; 11734 (120) 10-25 mm; 11735 (74) 10-23 mm; 11748 (95) 11-26 mm; 11749 (24) 15-24 mm; 11750 (71) 9-28 mm; 11751 (63) 10-28 mm; 11752 (115) 10-21 mm; 11764 (57) 13-25 mm; 11765 (49) 11-27 mm; 11766 (125) 11-26 mm; 11767 (136) 11-28 mm; 11768 (109) 13-26 mm; 11781 (44) 13-27 mm; 11782 (38) 12-27 mm; 11783 (1) 26 mm; 11784 (66) 14-26 mm; 11785 (22) 16-24 mm; 11786 (86) 13-25 mm; 11798 (51) 13-27 mm; 11799 (13) 14-26 mm; 11800 (112) 15-30 mm; 11801 (206) 14-28 mm; 11802 (74) 12-28 mm; 11803 (33) 13-26 mm; 11804 (23) 16-26 mm; 11819 (8) 9-24 mm; 11820 (3) 21-25 mm; 11839 (288) 13-27 mm.

This was the second most commonly taken myctophid and the third most numerous species of any kind collected during the two cruises. A total of 2827 individuals were taken at 55 stations.

Gonichthys tenuiculus (Garman, 1899)
13773 (2) 42 mm; 13778 (1) 50 mm; 13779 (3) 39-44 mm; 11764 (1) 14 mm; 11781 (1) 31 mm; 11798 (1) 46 mm.

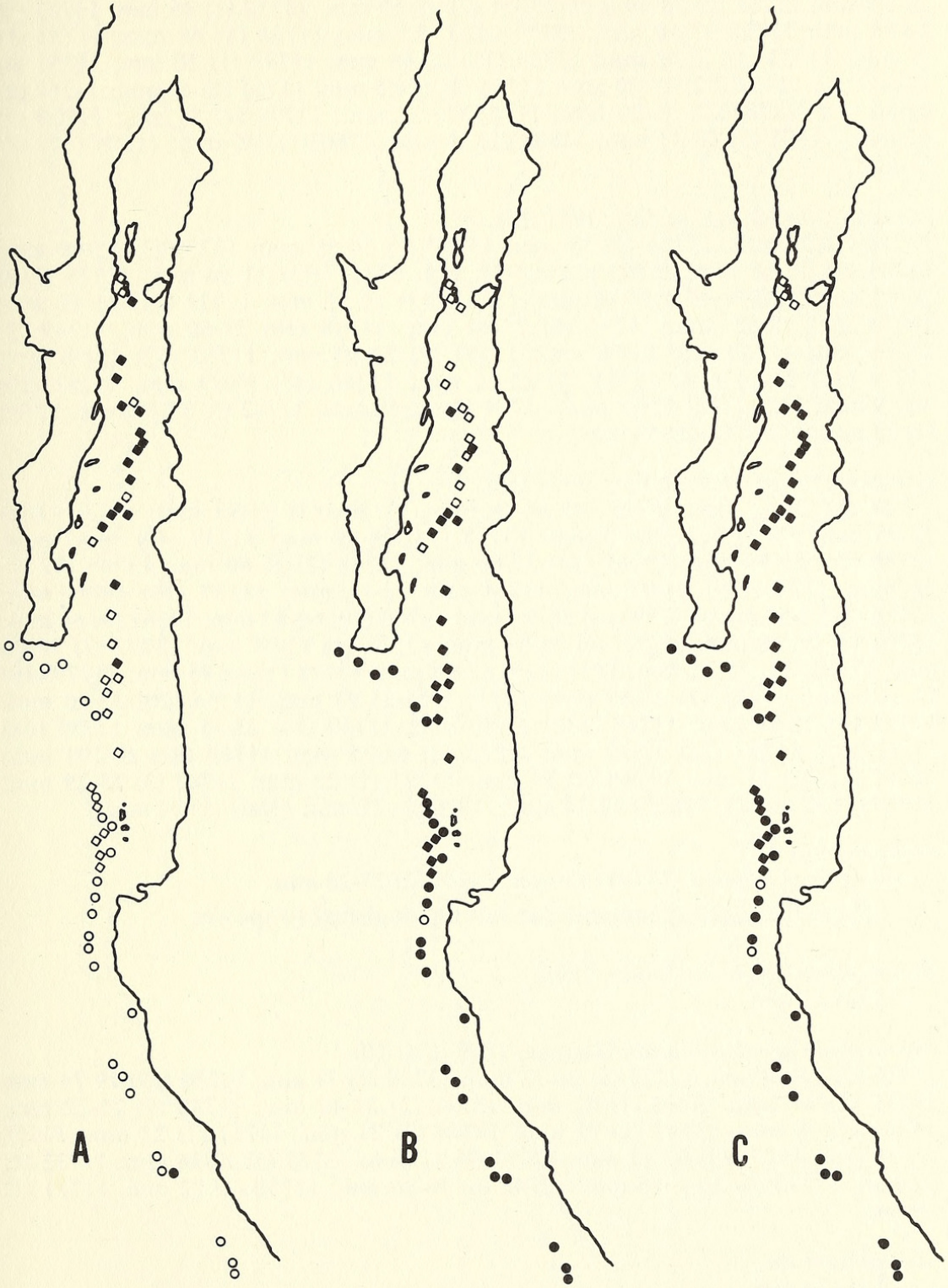

FIGURE 8. Locations of capture of A) *Benthosema panamense*, B) *Diaphus pacificus*, and C) *Diogenichthys laternatus* indicated by blackened squares and circles.

Hygophum atratum (Garman, 1899) (Fig. 9)
13740 (1) 49 mm; 13748 (1) 43 mm; 13760 (1) 49 mm; 13761 (1) 50 mm; 13761 (5) 35-60 mm; 13763 (2) 38-48 mm; 13771 (2) 48-50 mm; 13772 (1) 45 mm; 13773 (5) 24-48 mm; 13778 32-50 mm; 13779 (4) 37-53 mm; 11731 (1) 46 mm; 11732 (1) 17 mm; 11733 (4) 15-42 mm; 11734 (11) 22-48 mm; 11748 (1) 20 mm; 11751 (6) 13-48 mm; 11752 (72) 17-60 mm; 11764 (4) 24-45 mm; 11765 (1) 43 mm; 11767 (2) 17-36 mm; 11781 (2) 20-23 mm; 11785 (1) 32 mm; 11799 (1) 56 mm; 11800 (1) 51 mm; 11801 (3) 40-47 mm; 11802 (1) 48 mm; 11803 (1) 46 mm; 11804 (17) 12-51 mm.

Lampanyctus idostigma Parr, 1931 (Fig. 9)
13750 (1) 58 mm; 13751 (1) 38 mm; 13757 (7) 30-66 mm; 13759 (3) 55-60 mm; 13761 (5) 35-60 mm; 13762 (13) 27-75 mm; 13771 (22) 31-80 mm; 13778 (119) 26-82 mm; 13779 (191) 30-86 mm; 11731 (13) 18-57 mm; 11733 (11) 21-49 mm; 11734 (62) 18-62 mm; 11735 (6) 27-44 mm; 11748 (10) 21-60 mm; 11749 (7) 21-33 mm; 11750 (45) 24-76 mm; 11751 (7) 24-60 mm; 11752 (57) 19-58 mm; 11764 (18) 21-66 mm; 11765 (5) 23-54 mm; 11766 (47) 19-79 mm; 11767 (20) 48-79 mm; 11768 (18) 42-73 mm; 11781 (7) 23-60 mm; 11782 (5) 32-82 mm; 11784 (1) 23 mm; 11786 (2) 20-53 mm.

Lampanyctus parvicauda Parr, 1931 (Fig. 9)
13728 (6) 29-54 mm; 13729 (4) 24-76 mm; 13730 (84) 21-83 mm; 13736 (102) 23-90 mm; 13737 (77) 26-70 mm; 13738 (16) 24-80 mm; 13739 (40) 30-87 mm; 13740 (23) 20-90 mm; 13741 (13) 27-66 mm; 13748 (2) 20-80 mm; 13749 (3) 27-62 mm; 13750 (29) 25-97 mm; 13751 (20) 22-75 mm; 13757 (16) 44-93 mm; 13758 (2) 24-68 mm; 13759 (14) 26-95 mm; 13760 (10) 60-83 mm; 13761 (1) 66 mm; 13762 (8) 26-90 mm; 13763 (4) 78-94 mm; 13771 (2) 32-95 mm; 13772 (3) 75-92 mm; 13773 (21) 25-45 mm; 13777 (49) 17-96 mm; 13778 (5) 22-95 mm; 13779 (39) 21-113 mm; 11731 (2) 27-89 mm; 11733 (75) 21-93 mm; 11734 (20) 32-90 mm; 11735 (7) 22-88 mm; 11748 (242) 23-89 mm; 11749 (14) 23-75 mm; 11750 (68) 21-92 mm; 11764 (25) 22-79 mm; 11765 (2) 63-75 mm; 11766 (82) 20-101 mm; 11767 (14) 23-85 mm; 11768 (1) 91 mm; 11781 (1) 28 mm; 11782 (3) 23-29 mm; 11784 (1) 92 mm; 11786 (3) 22-34 mm; 11800 (1) 73 mm; 11804 (1) 84 mm.

Lampanyctus sp.
13740 (3) 25-31 mm; 13757 (1) 13 mm; 11749 (2) 25-28 mm.

These damaged specimens can not be identified to species.

Bolinichthys longipes (Brauer, 1906)
13777 (1) 21 mm.

Myctophum aurolaternatum Garman, 1899 (Fig. 10)
13728 (3) 21-58 mm; 13729 (6) 26-77 mm; 13730 (1) 73 mm; 13736 (19) 19-74 mm; 13737 (1) 45 mm; 13738 (1) 25 mm; 13739 (2) 23-44 mm; 13740 (3) 21-22 mm; 13741 (1) 70 mm; 13743 (1) 75 mm; 13748 (2) 21 mm; 13751 (1) 23 mm; 13758 (1) 22 mm; 13771 (2) 67-77 mm; 13772 (1) 21 mm; 13773 (5) 32-36 mm; 11732 (1) 51 mm; 11733 (2) 20+-25 mm; 11748 (6) 26-80 mm; 11750 (1) 22 mm; 11751 (1) 19 mm.

Myctophum sp.
13773 (1) 24 mm.

This specimen is badly damaged.

Taaningichthys bathyphilus Taning, 1928
11733 (1) 62 mm; 11767 (1) 57 mm.

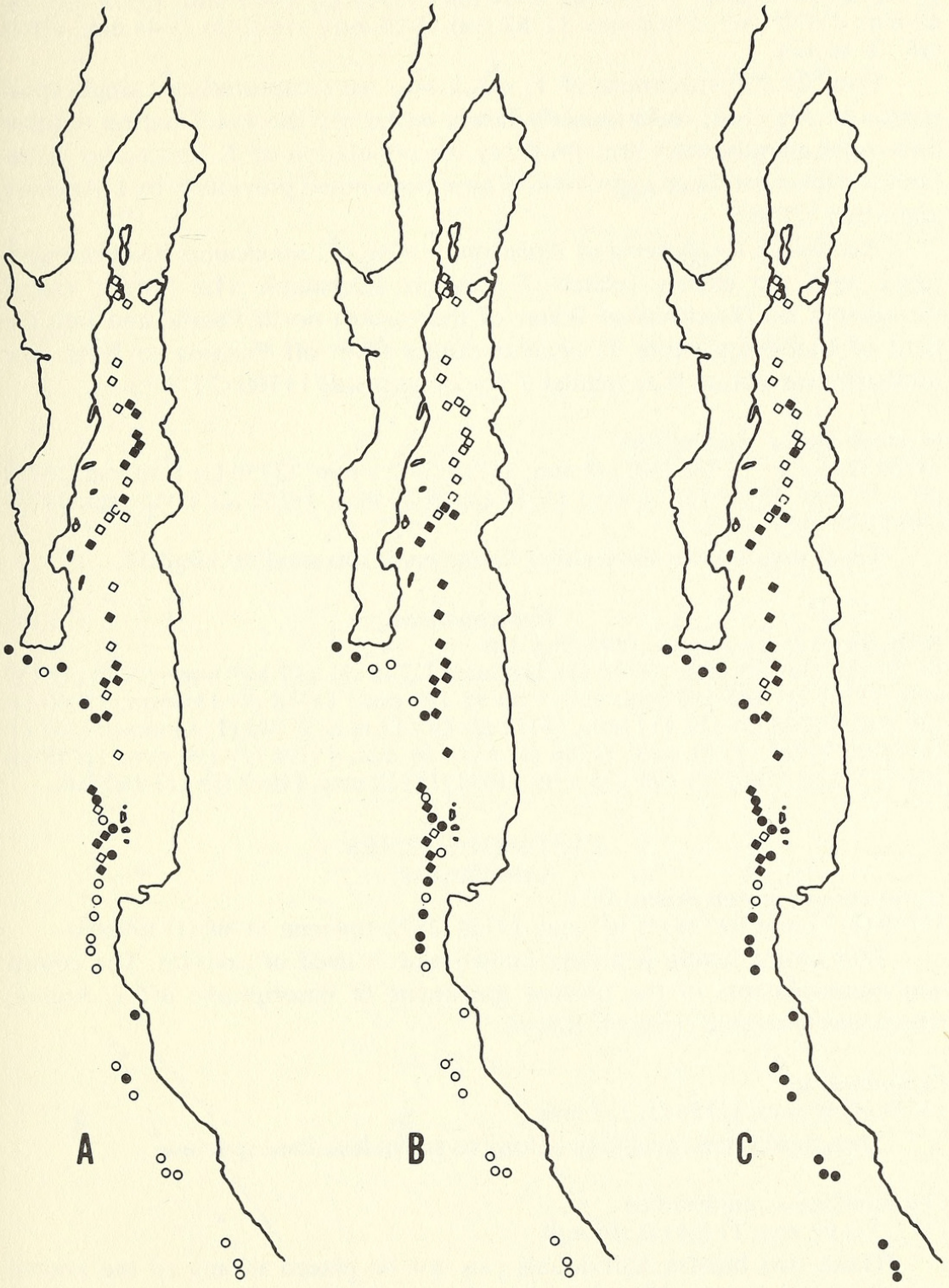

FIGURE 9. Locations of capture of A) *Hygophum atratum*, B) *Lampanyctus idostigma*, and C) *Lampanyctus parvicauda* indicated by blackened squares and circles.

Triphoturus mexicanus Gilbert, 1890 (Fig. 10)
13760 (3) 42 mm; 13762 (1) 40 mm; 13763 (7) 25-49 mm; 13771 (36) 28-57 mm; 13772 (6) 40-56 mm; 13773 (10) 19-64 mm; 13777 (3) 43-57 mm; 13778 (20) 28-60 mm; 13779 (262) 14-69 mm; 11783 (14) 15-20 mm; 11822 (3) 25-44 mm; 11823 (18) 18-46 mm.

Over 23,000 specimens of *T. mexicanus* were captured at a single trawl station in the Gulf; unfortunately labels indicating the exact station number have subsequently been lost. Probably the population of *T. mexicanus* in the Gulf is enormous. Such aggregations have been noted previously by Lavenberg and Fitch (1966).

According to Moser and Ahlstrom (1970), *T. mexicanus* has been confused with the closely related *T. oculeus* (Garman). The former ranges throughout the Transitional Water of the eastern north Pacific and into the Gulf of California while *T. oculeus* ranges from off Panama to Peru. The southernmost station that yielded *T. mexicanus* was 13760 (21°N).

Myctophidae — unidentified
13729 (2) 6 mm; 13738 (10) 6-8 mm; 13739 (7) 7-8 mm; 13750 (3) 5-10 mm; 13758 (6) 7-11 mm; 13759 (1) 21 mm; 11733 (3) 19-20 mm; 11750 (2) 11-15 mm; 11751 (10) 11-27 mm.

These myctophids were either damaged or too small to identify.

Neoscopelidae

Scopelengys tristis Alcock, 1892 (Fig. 10)
13736 (2) 136-175 mm; 13739 (1) 148 mm; 13740 (3) 140-167 mm; 13748 (1) 139 mm; 13751 (3) 135-150 mm; 13757 (6) 98-139 mm; 13758 (1) 155 mm; 13760 (1) 140 mm; 13763 (3) 112-157 mm; 13771 (2) 89-133 mm; 11748 (1) 84 mm; 11751 (1) 161 mm; 11768 (1) 61 mm; 11786 (3) 113-146 mm; 11798 (1) 150 mm; 11799 (4) 104-142 mm; 11802 (5) 104-175 mm; 11804 (1) 158 mm; 11819 (5) 112-160 mm.

CETOMIMIFORMES

Cetomimidae

Gyrinomimus bruuni Rofen, 1957
13729 (1) 71 mm; 13739 (1) 101 mm; 11748 (2) 72-104 mm; 11768 (1) 199 mm.

This entire family is poorly known and in need of revision. The counts and measurements of the present specimens fit descriptions of *G. bruuni,* which was described from off Kenya.

Cetomimus sp.
13737 (1) 86 mm; 11786 (1) 127 mm.

These specimens probably belong to an undescribed species.

Cetomimidae — unidentified
11733 (1) 92 mm; 11764 (1) 102 mm.

These two bizarre individuals can not be placed in any of the known genera of the family. They are characterized by a long, curved upper jaw that projects well beyond the slightly curved lower jaw. Their description will appear in a forthcoming paper by Gerald Citek, of the University of Southern California.

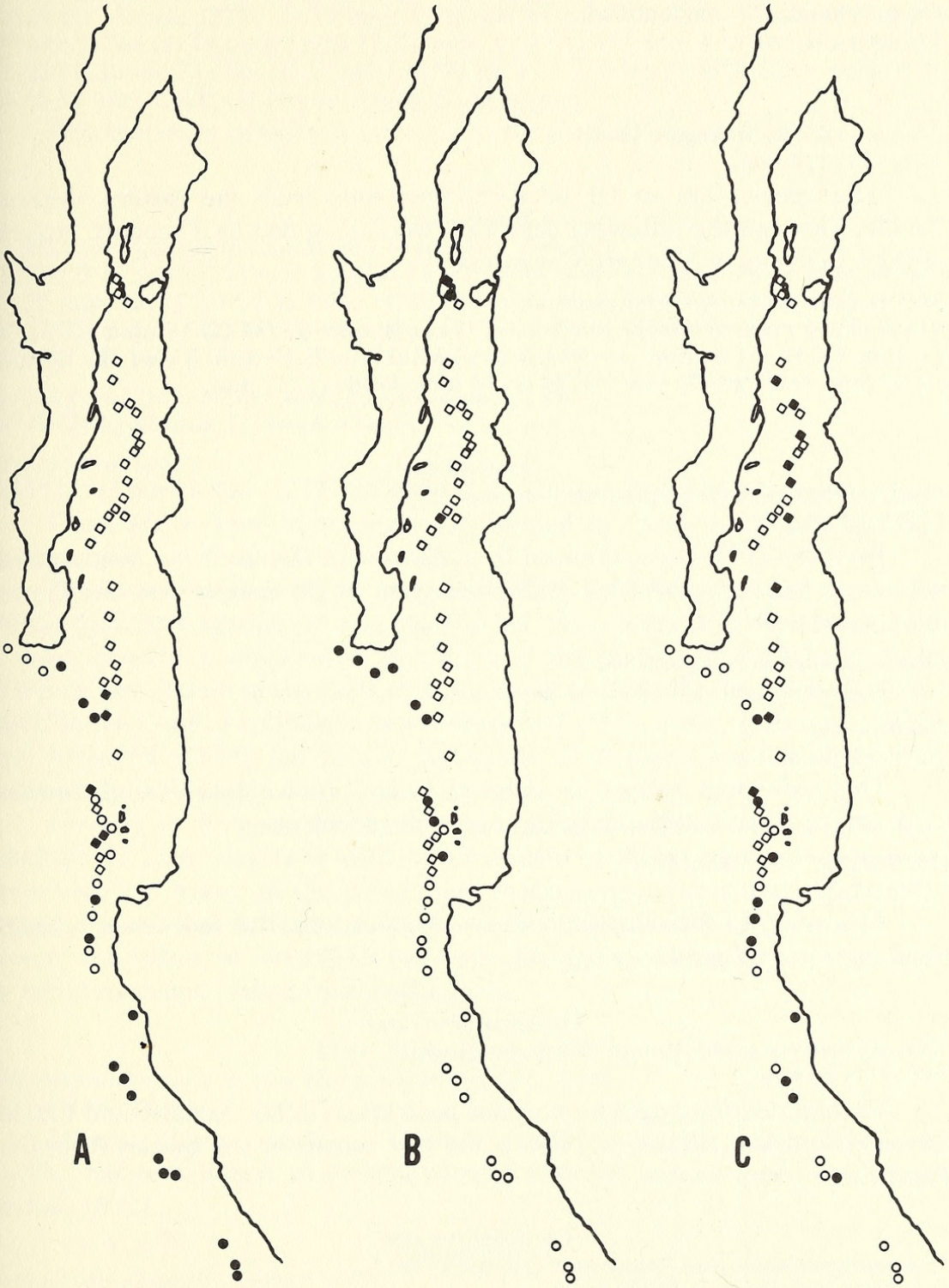

FIGURE 10. Locations of capture of A) *Myctophum aurolaternatum*, B) *Triphoturus mexicanus*, and C) *Scopelengys tristus* indicated by blackened squares and circles.

LOPHIIFORMES

Ogcocephalidae

Ogcocephalidae — unidentified
11800 (1) 32 mm.

Melanocetidae

Melanocetus ferox Regan, 1926
11748 (1) 114 mm.

This species has so far been reported only from the eastern tropical Pacific. This and the following ceratioids were identified by Theodore Pietsch of the University of Southern California.

Melanocetus johnsoni Günther, 1864
13729 (1) 15 mm; 13730 (1) 20 mm; 13737 (1) 20 mm; 13739 (1) 18 mm; 13751 (1) 24 mm; 13758 (1) 20 mm; 13759 (1) 24 mm; 13760 (2) 19 mm; 13761 (2) 19 mm; (1) 17 mm; 13772 (2) 20 mm; 13779 (1) 34 mm; 11764 (1) 22 mm.

Oneirodidae

Dolopichthys pullatus Regan and Trewavas, 1932
11764 (1) 48 mm.

Bertelsen (1951) synonymized *D. pullatus* with *Dolopichthys longicornus,* but recent work by Pietsch (1972b) based on larger sample size has shown this species to be distinct.

Oneirodes luetkeni (Regan, 1925)
13740 (2) 45-60 mm; 13759 (1) 15 mm.

Oneirodes sp.
13750 (1) 24 mm.

This individual cannot be assigned to any known species until further work on the genus clarifies existing taxonomic problems.

Oneirodidae — unidentified
11767 (1) 11 mm.

According to Pietsch (personal communication), this individual belongs to an undescribed genus.

Thaumatichthyidae

Thaumatichthys pagidostomus Smith and Radcliff, 1912
13737 (1) 22 mm.

Thaumatichthys pagidostomus has been taken in the Atlantic and Indian Oceans (Bertelsen, 1951), and this is the first record of the species from the Pacific.

Centrophrynidae

Centrophryne spinulosa Regan and Trewavas, 1932
13730 (2) 168-209 mm; 13737 (1) 16 mm.

The 168 mm female taken at station 13730 had a male *Melanocetus johnsoni* attached to its upper lip, and was the subject of a paper by Pietsch and Nafpaktitis (1971). This monotypic family was recently reviewed by Pietsch (1972a).

Linophrynidae

Borophryne apogon Regan, 1925 (Fig. 11)
13729 (2) 13 mm; 13736 (1) 19 mm; 13737 (1) 15 mm; 13739 (1) 36 mm; 13740 (1) 35 mm; 13741 (1) 14 mm; 11751 (1) 14 mm; 11767 (1) 33 mm; 11768 (2) 16-19 mm; 11783 (1) 18 mm; 11786 (1) 13 mm; 11798 (8) 13-110 mm; 11799 (1) 13 mm; 11802 (8) 12-36 mm; 11803 (1) 15 mm; 11804 (5) 18-25 mm.

This species is apparently endemic to the tropical eastern Pacific.

GADIFORMES

Bregmacerotidae

Bregmaceros atlanticus Goode and Bean, 1886 (Fig. 11)
13730 (1) 43 mm; 13739 (1) 22 mm; 13748 (1) 48 mm; 13749 (6) 18-51 mm; 13761 (2) 38 mm; 13771 (3) 24-26 mm; 11732 (2) 45-49 mm; 11733 (3) 38-49 mm; 11734 (9) 22-52 mm; 11750 (6) 24-56 mm; 11751 (2) 47-49 mm; 11752 (4) 45-50 mm; 11764 (1) 56 mm; 11766 (1) 47 mm; 11802 (1) 50 mm.

Bregmaceros bathymaster Jordan and Bollman, 1890
13749 (2) 36-42 mm; 11734 (2) 34 mm.

Bregmaceros spp.
13759 (2) 15 mm; 13760 (1) 13 mm; 13763 (1) 17 mm; 13758 (6) 8-11 mm.

There are at least three forms represented by these unidentified larvae and juveniles.

The latest revision of the bregmacerotids by D'Ancona and Cavinato (1965) lists three species of *Bregmaceros (B. atlanticus, B. bathymaster,* and *B. macclellandii* Thompson) as occurring in the eastern tropical Pacific, all of which were taken in the Gulf of Panama. *B bathymaster* was subsequently taken in the Gulf of California (Lavenberg and Fitch, 1966; Robison, 1972), and Ahlstrom (1971) has found five kinds of *Bregmaceros* larvae in the eastern tropical Pacific.

The key to *Bregmaceros* by D'Ancona and Cavinato relies heavily on longitudinal scale counts, a difficult character in these small, often poorly preserved fish. Many of the counts and measurements overlap considerably among the various species, making specific identification difficult. In the present specimens, *B. atlanticus* has been distinguished from *B. bathymaster* by vertebral counts, taken from radiographs.

Moridae

Microlepidium verecundum (Jordan and Cramer, 1896)
13759 (3) 63-82 mm; 11750 (1) 72 mm.

Microlepidium grandiceps Garman (1899), from the eastern tropical Pacific, has been found to be synonymous with *M. verecundum* (Fitch and Barker, 1972).

Ophidiidae

Brotuloides emmelas (Gilbert, 1890)
13771 (1) 67 mm; 11732 (1) 46 mm; 11734 (1) 51 mm; 11735 (1) 43 mm; 11749 (2) 42-48 mm; 11751 (1) 43 mm; 11765 (2) 51-55 mm.

Ophidiidae — unidentified
13728 (1) 10 mm; 13739 (2) 14-44 mm; 13750 (2) 35-41 mm; 13761 (1) 16 mm; 13763 (1) 28 mm; 13772 (1) 38 mm; 11786 (1) 36 mm.

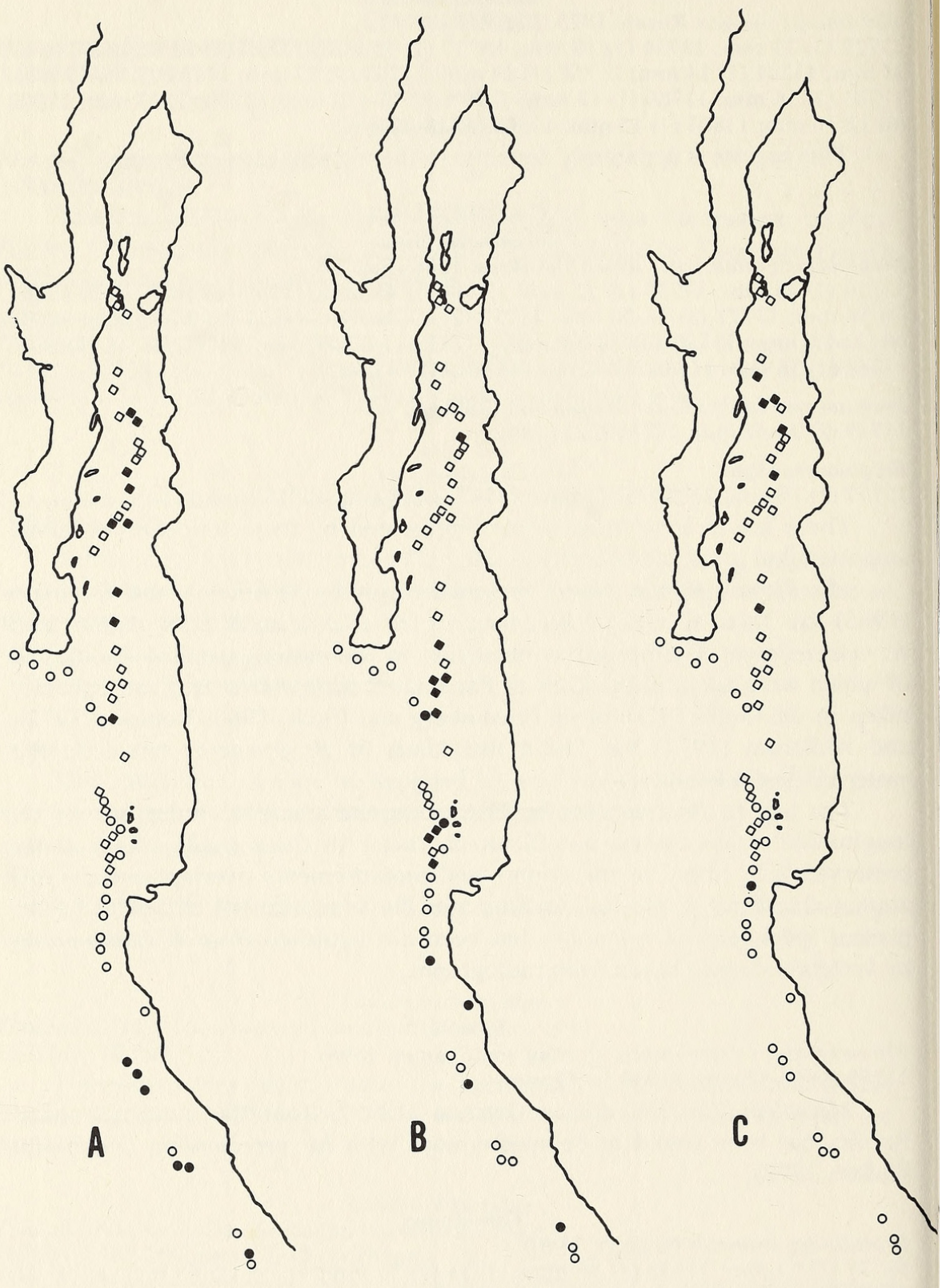

FIGURE 11. Locations of capture of A) *Borophryne apogon*, B) *Bregmaceros atlanticus*, and C) *Melanostigma pammelas* indicated by blackened squares and circles.

Zoarcidae

Melanostigma pammelas Gilbert, 1893 (Fig. 11)
13758 (1) 96 mm; 11767 (1) 77 mm; 11798 (4) 60-83 mm; 11802 (4) 57-89 mm; 11804 (5) 40-113 mm; 11819 (2) 105-115 mm; 11839 (2) 26-88 mm.

Following Bussing (1965), these specimens were identified on the basis of vertebral and fin-ray counts (specimens were X-rayed). McAllister and Rees (1964) in their revision of the genus, proposed an antitropical distribution for the three then known species of *Melanostigma* and suggested a means of dispersal for the group. The subsequent discovery of a fourth species, *M. bathium* Bussing (1965), in the Peru-Chili Trench, between 33° and 46°S, supports the hypothesis of McAllister and Rees (1964) regarding the existence of a tropical barrier.

The capture of *M. pammelas* at 20° N (station 13758) is the southernmost record of this species.

Macrouridae

Coelorhynchus scaphopsis Gilbert, 1890
13771 (1) 97 mm; 13778 (1) 81 mm; 11748 (1) 91 mm; 11819 (1) 69 mm.

ATHERINIFORMES

Exocoetidae

Exocoetus monocirrhus Richardson, 1846
13737 (1) 36 mm.

This specimen was taken by dip net.

Hyporhamphus unifasciatus (Ranzani, 1842)
13727 (9) 18-84 mm; 13728 (1) 48 mm; 13730 (7) 33-65 mm; 13741 (1) 31 mm.

BERYCIFORMES

Melamphaeidae

Melamphaes acanthomus Ebeling, 1962 (Fig. 12)
13729 (2) 70-76 mm; 13737 (2) 29-83 mm; 13738 (2) 21-31 mm; 13740 (1) 99 mm; 13741 (1) 81 mm; 13748 (5) 66-84 mm; 13749 (2) 25-87 mm; 13751 (7) 75-96 mm; 13757 (2) 51 mm; 13758 (12) 78-105 mm; 13759 (3) 74-86 mm; 13760 (9) 74-90 mm; 13762 (2) 91-107 mm; 13763 (7) 75-97 mm; 13771 (8) 85-98 mm; 13772 (6) 56-105 mm; 13773 (1) 42 mm; 13777 (1) 67 mm; 13778 (3) 88-115 mm; 13779 (2) 77-87 mm; 11733 (2) 65-93 mm; 11750 (2) 42-88 mm; 11751 (3) 74-93 mm; 11767 (5) 70-92 mm; 11768 (1) 99 mm; 11785 (11) 63-99 mm; 11786 (1) 95 mm; 11798 (5) 75-84 mm; 11799 (7) 73-89 mm; 11802 (10) 73-101 mm; 11804 (8) 79-89 mm; 11819 (8) 71-94 mm; 11839 (3) 80-96 mm.

Melamphaes laeviceps Ebeling, 1962
13750 (1) 84 mm; 13751 (1) 27 mm; 13773 (1) 93 mm.

Melamphaes macrocephalus Parr, 1931 (Fig. 12)
13728 (1) 45 mm; 13729 (7) 24-112 mm; 13736 (4) 26-98 mm; 13737 (7) 27-101 mm; 13739 (10) 26-97 mm; 13740 (1) 42 mm; 13741 (3) 42-98 mm; 13748 (3) 96-100 mm; 13750 (6) 27-102 mm; 13751 (4) 23-77 mm; 13757 (1) 106 mm; 13758 (2) 56-82 mm; 13759 (3) 40-99 mm; 13772 (8) 68-104 mm; 13773 (4) 76-108 mm; 11732 (2) 58-68 mm; 11733 (6) 54-102 mm; 11734 (3) 41-79 mm; 11735 (2) 58-66 mm; 11748 (11) 28-94 mm; 11750 (9) 42-94 mm; 11751 (8) 46-88 mm; 11752 (2) 66-92 mm; 11766 (6) 54-95 mm; 11767 (3) 89-106 mm; 11768 (2) 70-83 mm; 11782 (3) 77-95 mm; 11786 (6) 52-91 mm; 11798 (1) 70 mm; 11802 (1) 103 mm.

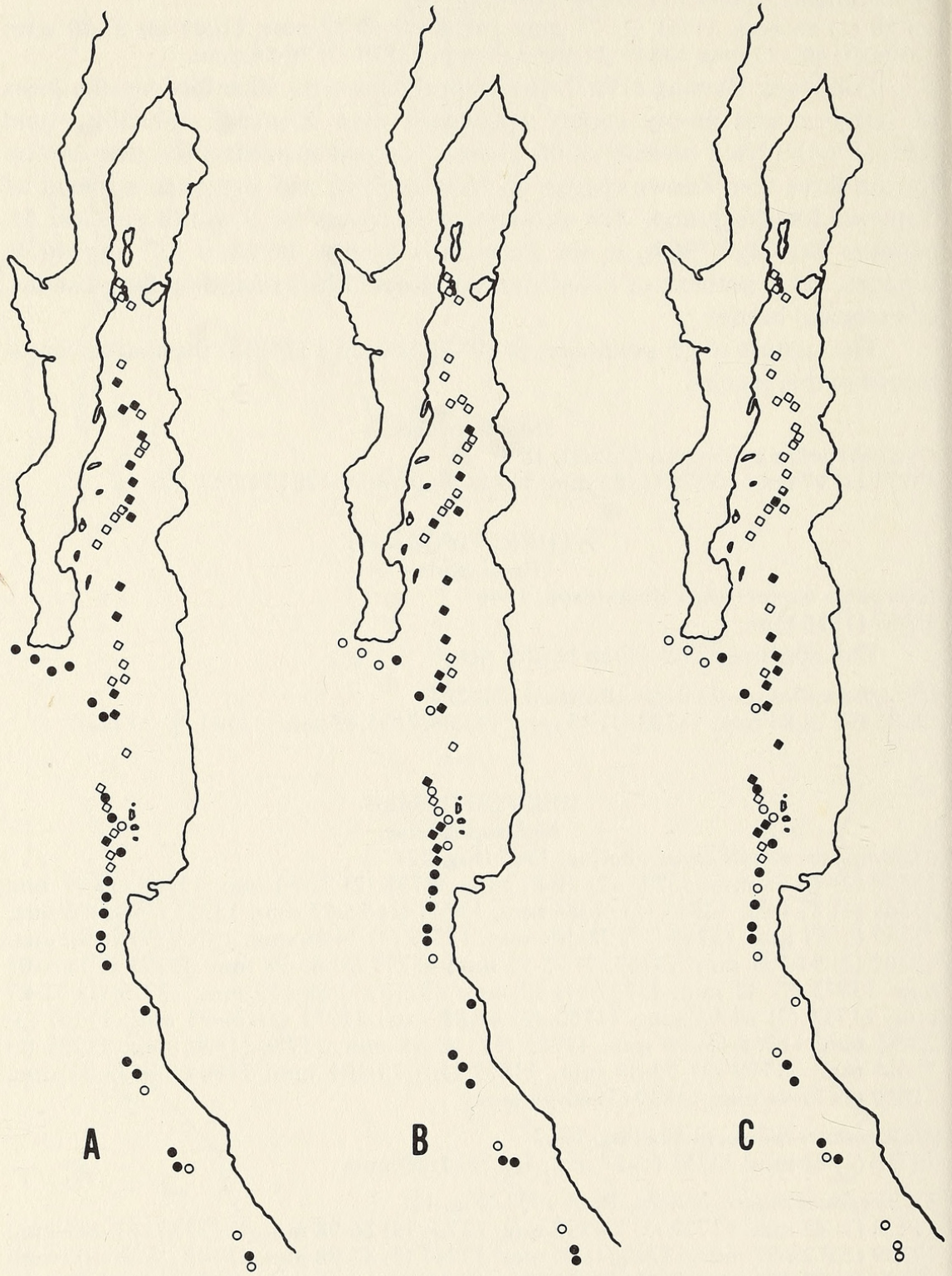

FIGURE 12. Locations of capture of A) *Melamphaes acanthomus,* B) *Melamphaes macrocephalus,* and C) *Melamphaes spinifer* indicated by blackened squares and circles.

Melamphaes spinifer Ebeling, 1962 (Fig. 12)
13736 (1) 25 mm; 13738 (2) 30-39 mm; 13739 (1) 35 mm; 13740 (1) 31 mm; 13750 (4) 26-41 mm; 13751 (3) 23-48 mm; 13757 (1) 24 mm; 13759 (1) 44 mm; 13760 (1) 62 mm; 13763 (2) 57-64 mm; 13772 (5) 33-56 mm; 13773 (1) 59 mm; 11732 (4) 26-48 mm; 11733 (3) 22-55 mm; 11748 (5) 37-66 mm; 11749 (1) 21 mm; 11750 (3) 17+-43 mm; 11751 (3) 21-49 mm; 11764 (3) 44-53 mm; 11765 (2) 49-55 mm; 11766 (4) 20-50 mm; 11768 (1) 26 mm; 11784 (1) 54 mm.

Melamphaes spp.
13739 (5) 16-17 mm; 13771 (1) 18 mm.

These juveniles could not be identified specifically.

Poromitra crassiceps (Günther, 1878) (Fig. 13)
13729 (1) 71 mm; 13737 (1) 60 mm; 13739 (1) 123 mm; 13740 (7) 69-131 mm; 13751 (2) 48-55 mm; 13758 (1) 46 mm; 13759 (4) 67-120 mm; 13762 (3) 39-122 mm; 13763 (1) 106 mm; 13772 (2) 63-65 mm; 13773 (1) 71 mm; 13778 (2) 99-126 mm; 11750 (8) 78-121 mm; 11766 (1) 57 mm; 11767 (2) 66-88 mm.

Poromitra sp.
13730 (1) 61 mm; 13739 (1) 65 mm; 11733 (1) 75 mm; 11748 (1) 64 mm; 11750 (1) 62 mm; 11751 (1) 64 mm.

These fish represent an undescribed species of *Poromitra*. Their small eye, low dorsal fin-ray count (III-10), and low gillraker count (23-24) distinguish them from the known species of this genus. According to Ebeling (personal communication), this species ranges from the eastern tropical Pacific through the west Pacific and the Indian Ocean.

Scopeloberyx robustus (Gunther, 1887) (Fig. 13)
13729 (2) 41-46 mm; 13730 (7) 29-64 mm; 13736 (6) 31-61 mm; 13737 (10) 24-60 mm; 13739 (17) 30-57 mm; 13750 (7) 35-69 mm; 13751 (4) 30-44 mm; 13759 (4) 30-46 mm; 13762 (2) 42-60 mm; 13773 (20) 32-66 mm; 13777 (9) 28-58 mm; 13778 (14) 35-52 mm; 11733 (2) 31-53 mm; 11748 (6) 48-64 mm; 11750 (5) 41-56 mm; 11751 (13) 34-66 mm; 11764 (26) 38-67 mm; 11766 (24) 36-62 mm; 11767 (3) 48-58 mm; 11768 (8) 40-65 mm; 11782 (8) 45-68 mm; 11785 (4) 48-61 mm; 11786 (15) 49-59 mm; 11798 (3) 54-60 mm; 11799 (2) 49-55 mm; 11802 (1) 63 mm.

Scopelogadus mizoloepis bispinosus (Gilbert, 1890) (Fig. 13)
13728 (18) 12-60 mm; 13729 (15) 18-51 mm; 13730 (3) 30-50 mm; 13736 (10) 20-60 mm; 13737 (11) 21-55 mm; 13738 (32) 16-51 mm; 13739 (19) 10-54 mm; 13740 (168) 23-65 mm; 13741 (83) 17-55 mm; 13748 (33) 15 mm; 13749 (9) 37-53 mm; 13750 (19) 19-59 mm; 13751 (75) 14-54 mm; 13757 (96) 10-50 mm; 13758 (99) 8-57 mm; 13759 (71) 25-62 mm; 13760 (263) 13-67 mm; 13761 (61) 11-52 mm; 13762 (14) 10-63 mm; 13763 (96) 9-68 mm; 13771 (24) 28-50 mm; 13772 (10) 16-57 mm; 13773 (9) 14-43 mm; 13777 (1) 37 mm; 13778 (5) 33-55 mm; 13779 (18) 28-63 mm; 11731 (38) 11-63 mm; 11732 (38) 10-56 mm; 11733 (57) 20-60 mm; 11734 (12) 18-44 mm; 11735 (38) 18-56 mm; 11748 (15) 29-54 mm; 11749 (7) 30-56 mm; 11750 (51) 25-57 mm; 11751 (16) 11-59 mm; 11752 (139) 11-58 mm; 11764 (2) 28-32 mm; 11765 (8) 31-57 mm; 11766 (5) 17-40 mm; 11767 (10) 26-50 mm; 11768 (5) 29-52 mm; 11781 (5) 34-63 mm; 11782 (7) 26-52 mm; 11784 (1) 40 mm; 11785 (2) 37-39 mm; 11798 (1) 44 mm; 11799 (2) 35-37 mm; 11800 (8) 26-49 mm; 11801 (1) 49 mm; 11819 (8) 22-34 mm.

Holocentridae

Holocentrus suborbitalis Gill, 1863
13727 (12) 17-40 mm; 13731 (6) 14-34 mm.

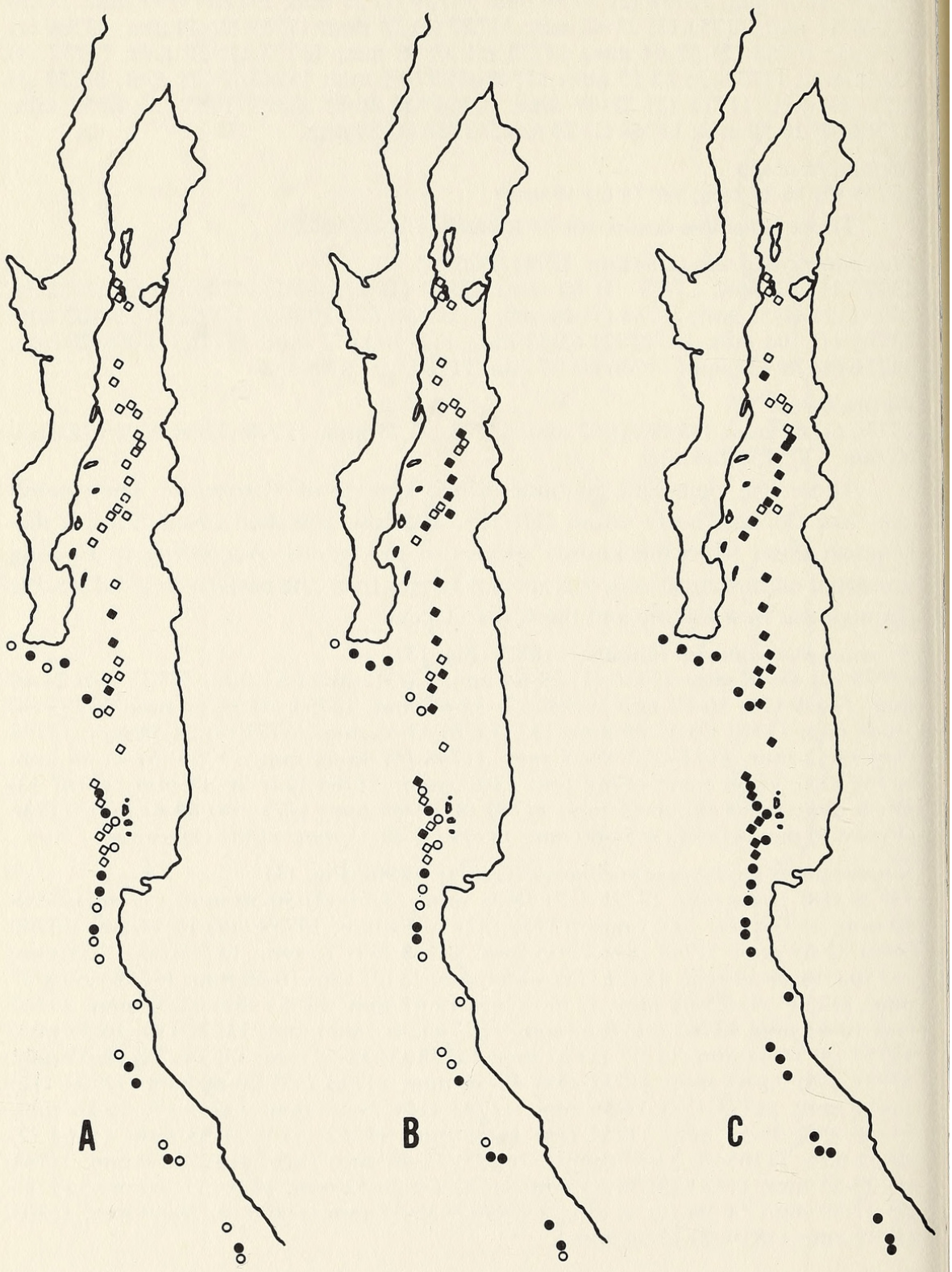

FIGURE 13. Locations of capture of A) *Poromitra crassiceps,* B) *Scopeloberyx robustus,* and C) *Scopelogadus mizolopis bispinosus* indicated by blackened squares and circles.

LAMPRIDIFORMES

Trachipteridae

Trachipterus sp.
13738 (1) 11 mm.

SCORPAENIFORMES

Scorpaenidae

Sebastes sinensis Gilbert, 1890
11822 (14) 46-128 mm; 11823 (22) 47-148 mm.

Sebastes sp.
11823 (1) 160 mm.

This specimen represents an undescribed species (Lo-chai Chen, personal communication).

Scorpaena sp.
13741 (1) 21 mm.

Scorpaenidae-unidentified
13738 (13) 3-8 mm; 13739 (1) 5 mm; 13740 (2) 9-13 mm; 13750 (2) 9-13 mm.

PERCIFORMES

Apogonidae

Apogon dovii Günther, 1861
13737 (1) 20 mm.

This individual was identified by a key in Breder (1936), but because of its small size, the specific identification is not certain.

Branchiostegidae

Caulolatilus princeps (Jenyns, 1842)
13751 (1) 16 mm; 13758 (2) 14-18 mm; 13762 (1) 18 mm.

Echeneidae

Phtheirichthys lineatus (Menzies, 1791)
13743 (1) 51 mm.

Remora remora (Linnaeus, 1758)
13731 (1) 65 mm.

Carangidae

Caranx caninus Günther, 1869
13727 (7) 56-72 mm; 13728 (1) 55 mm; 13738 (1) 52 mm; 13748 (1) 82 mm.

Decapterus hypodus Gill, 1862
13751 (1) 97 mm.

Selene brevoortii (Gill, 1863)
13736 (1) 18 mm.

The identification of this juvenile must remain tentative until comparative material is obtained.

Coryphaenidae

Coryphaena hippurus Linnaeus, 1758
13727 (2) 91 mm.

Kyphosidae

Kyphosus elegans (Peters, 1869)
13727 (3) 55-70 mm.

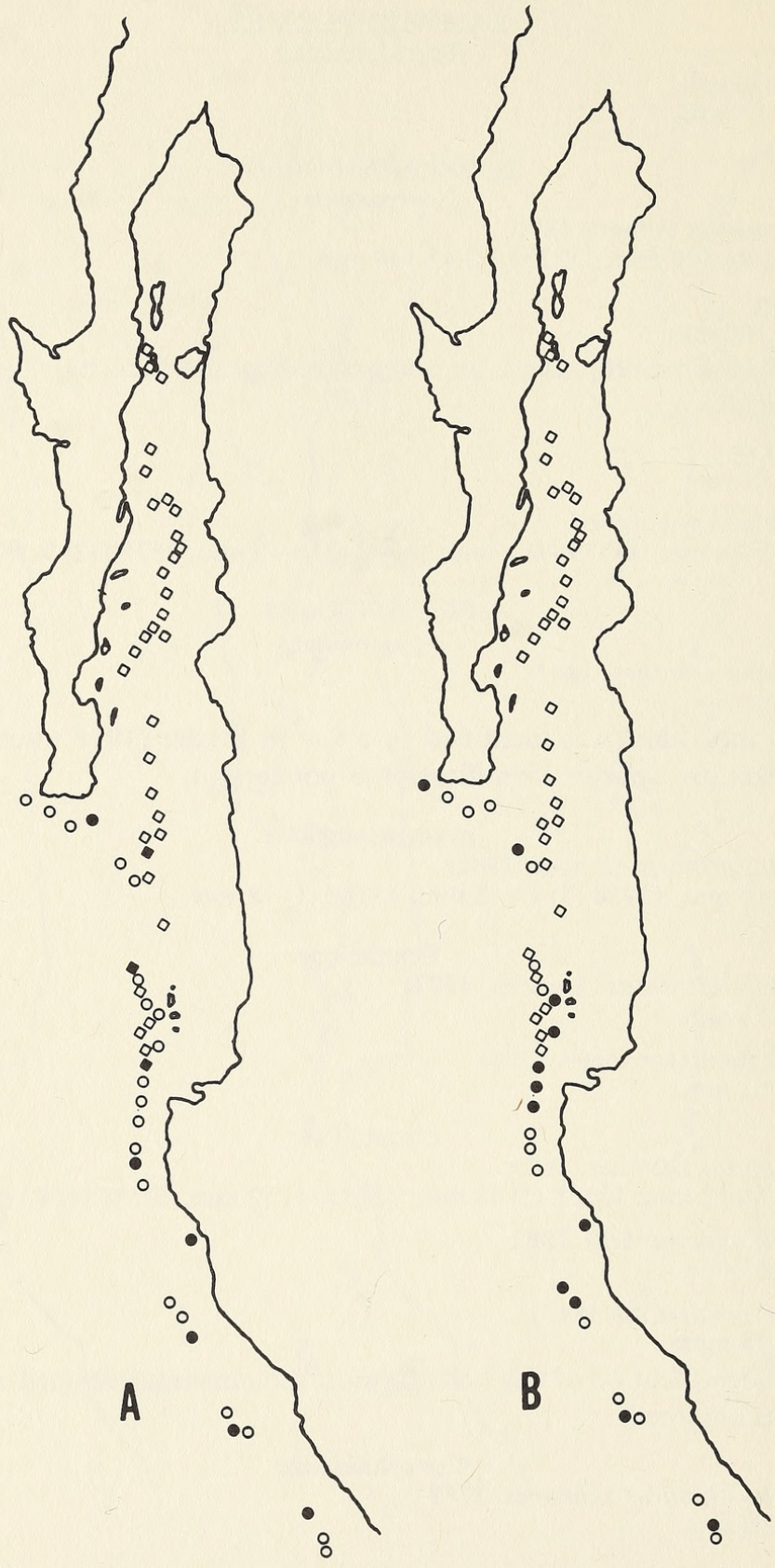

FIGURE 14. Locations of capture of A) *Chiasmodon niger,* and B) *Kali normani* indicated by blackened squares and circles.

Polynemidae

Polydactylus opercularis Gill, 1863
13761 (1) 41 mm.

Chiasmodontidae

Chiasmodon niger Johnson, 1863 (Fig. 14)
13730 (1) 105 mm; 13737 (1) 74 mm; 13739 (2) 78-119 mm; 13748 (1) 103 mm; 13750 (1) 116 mm; 13773 (1) 39 mm; 11734 (2) 43-44 mm; 11748 (1) 44 mm; 11750 (2) 39-89 mm.

This genus is in need of revision, but these specimens fit Norman's (1929) key for *C. niger*.

Kali normani (Parr, 1931) (Fig. 14)
13729 (2) 64-139 mm; 13737 (1) 142 mm; 13740 (1) 142 mm; 13741 (2) 56-74 mm; 13748 (1) 125 mm; 13757 (1) 139 mm; 13758 (1) 136 mm; 13759 (1) 133 mm; 13760 (1) 160 mm; 13761 (1) 132 mm; 13772 (1) 136 mm; 13779 (1) 76 mm.

Trichiuridae

Lepidopus xantusi Goode and Bean, 1896
11820 (1) 314 mm.

Scombridae

Scombridae — unidentified
13731 (47) 7-17 mm.

Nomeidae

Cubiceps carinatus Nichols and Murphy, 1944
13728 (6) 6-18 mm; 13729 (1) 16 mm; 13736 (1) 77 mm; 13738 (1) 20 mm; 13741 (1) 11 mm; 13748 (1) 11 mm; 13759 (1) 98 mm; 13760 (1) 17 mm; 13773 (2) 64-68 mm; 13778 (1) 24 mm.

These fish were identified with the help of the key to the stromateoid fishes by Haedrich and Horn (1969). The species was originally described from the Panama Bight by Nichols and Murphy (1944).

Stromateidae

Peprilus spp.
13730 (1) 13 mm; 13736 (1) 23 mm; 13739 (1) 6 mm; 13751 (1) 11 mm; 13760 (1) 13 mm; 13761 (1) 5 mm.

According to Horn (1970), three species of *Peprilus* occur in all or part of the study area, but these young fish are too small to identify.

PLEURONECTIFORMES

Bothidae

Citharichthys sp. — larvae
13739 (1) 9 mm; 13761 (1) 12 mm.

Etropus crossatus Jordan and Gilbert, 1881
13728 (2) 13 mm; 13729 (2) 10-24 mm; 13749 (4) 13-23 mm; 13750 (2) 16-20 mm; 13751 (1) 13 mm; 13759 (1) 22 mm; 13762 (2) 15-16 mm; 13763 (1) 13 mm.

Bothidae — unidentified
13748 (1) 13 mm; 13751 (1) 10 mm.

Cynoglossidae

Symphurus spp.
13741 (1) 19 mm; 13751 (1) 23 mm; 13758 (1) 20 mm; 13759 (3) 17 mm.

Two species of *Symphurus* are represented here. One form has a large midlongitudinal, darkly pigmented area, the other has small scattered areas of pigmentation.

TETRAODONTIFORMES

Balistidae

Canthidermis rotundus (de Proce, 1822)
13727 (4) 35-111 mm.

Alutera scripta (Osbeck, 1765)
13731 (1) 156 mm.

Diodontidae

Diodon holacanthus Linnaeus, 1758
13743 (3) 60-82 mm.

Unidentified

13727 (3) 13-15 mm; 13728 (14) 4-18 mm; 13729 (6) 4-14 mm; 13736 (2) 17-21 mm; 13738 (9) 8-13 mm; 13739 (9) 4-8 mm; 13748 (1) 16 mm; 13749 (1) 8 mm; 13750 (6) 7-28 mm; 13758 (26) 4-22 mm; 13759 (6) 9-25 mm; 13761 (7) 4-10 mm; 13762 (3) 4-22 mm; 13763 (2) 8-10 mm; 13771 (1) 78 mm; 11766 (1) 14 mm; 11767 (1) 35 mm.

At least a dozen forms are represented in these larvae and damaged individuals.

SUMMARY OF FISHES

Over 56,000 individual fish were taken during cruises of the R/V *Velero IV* to the Gulf of California and the eastern tropical Pacific. These specimens belong to at least 14 orders, 49 families, 82 genera, and 113 species. The exact number of species cannot be determined until a number of larval forms are identified.

A single species of the family Myctophidae made up a substantial portion of the total number of specimens. Over 23,000 individuals of *Triphoturus mexicanus* were taken at a single IKMWT station. The gonostomatid, *Cyclothone acclinidens,* contributed over 18,000 individuals, making it the second most numerous species taken. The myctophid, *Diogenichthys laternatus,* and the gonostomatid, *Vinciguerria lucetia* were also quite numerous, with over 2,900 and 2,100 specimens, respectively.

The most frequently captured species were *Diogenichthys laternatus* (55 stations), *Vinciguerria lucetia* (52 stations), the melamphaeid *Scopelogadus mizolepis bispinosus* (50 stations), and the myctophid *Diaphus pacificus* (47 stations). The most numerous species, *Triphoturus mexicanus* and *Cyclothone acclinidens,* were captured in only 12 and 27 trawls, respectively. At least 26 species were not taken in more than one IKMWT, and of these, 24 species were represented by single specimens. The greatest number of species identified from one trawl was 30, taken at station 13751.

The most speciose orders were the Salmoniformes, with 39 species distributed in 15 families and 32 genera, and the Perciformes, with 13 families, 18 genera, and 21 species. The families with the greatest number of species were the Myctophidae, with 10 genera and 11 species; the Alepocephalidae (including Searsidae), with 7 genera and 9 species; and the Melamphaeidae, with 4 genera and 8 species. Two families, the Myctophidae and the Gonostomatidae, included approximately 90% of all individuals taken.

Table 2 provides a summary of fishes collected. The number of positive trawl stations and the number of individuals are listed for each species. Furthermore, a comparison is made of the number of occurrences and the number of specimens between positive stations within the Gulf of California (north of 23°N), and stations south of the Gulf. This table will be considered in the discussion section in reference to the Gulf as a limiting environment.

DISCUSSION

In recent years it has become common practice for biologists to relate water masses, as defined by temperature-salinity curves, to the distribution of pelagic organisms. Since the studies by Bieri (1959), McGowan (1960), Brinton (1962), and Ebeling (1962), it has been popular to superimpose the distribution of pelagic organisms over water mass boundaries. Although water masses are not the final answer to distributional problems, as pointed out recently by Backus et al. (1970), the fact remains that the distributions of many pelagic species are best understood when considered in relation to temperature-salinity and oxygen profiles. In the following distributional analysis, water masses are used to categorize the broad distributional trends of the midwater fishes collected during the survey.

The water mass characteristics of the eastern tropical Pacific remain largely independent of those in adjacent regions. The area, lying in the concavity formed by North, Central, and South American coastlines, is protected from the major Pacific gyral systems by its geographic position. The conservative and non-conservative properties of the eastern tropical Pacific waters reflect this isolation when compared to adjacent regions. The subsurface waters of the entire eastern tropical Pacific, north of the equator, and in the Gulf of California, are relatively uniform and result from the slow horizontal spread of water from the Equatorial Undercurrent. The great depths in the southern and northern sections of the eastern tropical Pacific are filled with Intermediate Water of Antarctic and North Pacific origin, respectively.

Probably the outstanding feature of the subsurface waters off the coast of Mexico and in the Gulf of California is the presence of an oxygen minimum layer. This layer forms a zone as thick as 1200 m off Mexico, where oxygen content falls below 1.0 ml/l. Oxygen concentrations below 0.1 ml/l are present vertically through several hundred meters (Griffiths, 1968).

Several midwater species taken in the survey are apparently endemic to the eastern tropical Pacific. These include *Avocettina bowersi, Bathophilus*

TABLE 2
Summary of fishes collected in the Gulf of California and the eastern tropical Pacific by the R/V Velero

	Gulf of California		Pacific Ocean South of Gulf of California		Total	
Species	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens
Scyliorhinidae						
Galeus piperatus	1	1	0	0	1	1
Leptocephali	0	0	20	221	20	221
Serrivomeridae						
Serrivomer sector	13	35	26	108	39	143
Nemichthyidae						
Avocettina bowersi	5	7	6	11	11	18
Avocettina infans	4	4	4	5	8	9
Nemichthys scolopaceus	14	21	6	11	20	32
Engraulidae unidentified	0	0	1	2	1	2
Bathylagidae						
Bathylagus nigrigenys	5	6	26	264	31	270
Bathylagus pacificus	0	0	1	1	1	1
Bathylagus wesethi	0	0	1	4	1	4
Leuroglossus stilbius stilbius	20	1536	0	0	20	1536
Gonostomatidae						
Cyclothone acclinidens	0	0	27	18,616	27	18,616
Cyclothone pallida	0	0	16	52	16	52
Cyclothone signata	0	0	8	9	8	9
Diplophos taenia	2	5	9	30	11	35
Vinciguerria lucetia	20	686	32	1498	52	2184
Sternoptychidae						
Argyropelecus lychnus	5	14	3	3	8	17
Astronesthidae						
Borostomias panamensis	1	1	0	0	1	1
Melanostomiatidae						
Bathophilus filifer	5	9	23	95	28	104
Bathophilus sp.	1	1	0	0	1	1
Chauliodontidae						
Chauliodus barbatus	0	0	2	2	2	2

Species	Gulf of California		Pacific Ocean South of Gulf of California		Total	
	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens
Chauliodus macouni	1	1	0	0	1	1
Stomiatidae						
Stomias atriventer	20	188	20	189	40	377
Idiacanthidae						
Idiacanthus antrostomus	0	0	17	29	17	29
Alepocephalidae						
Bajacalifornia burragei	6	16	3	3	9	19
Bajacalifornia sp.	1	1	2		3	3
Barbantus curvifrons	1	1	0	0	1	1
Holtbyrnia macrops	2	3	0	0	2	3
Holtbyrnia melanocephala	0	0	1	1	1	1
Normichthys campbelli	0	0	2	3	2	3
Pellisolus facillis	3	3	4	6	6	9
Talismania bifurcata	3	3	4	4	7	7
unidentified	1	1	4	5	5	6
Paralepididae						
Lestidiops pacificum	0	0	10	14	10	14
Scopelarchidae						
Scopelarchoides nicholsi	6	11	4	7	10	18
Myctophidae						
Benthosema panamense	16	260	1	3	17	263
Diaphus pacificus	13	131	34	1282	47	1413
Diogenichthys laternatus	22	1658	33	1269	55	2927
Gonichthys tenuiculus	3	3	3	6	6	9
Hygophum atratum	12	106	16	47	28	153
Lampanyctus idostigma	10	180	17	523	27	703
Lampanyctus parvicauda	11	134	33	1021	44	1155
Lampanyctus sp.	0	0	3	6	3	6
Bolinicthys longipes	0	0	1	1	1	1

Species	Gulf of California		Pacific Ocean South of Gulf of California		Total	
	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens
Myctophum aurolaternatum	0	0	21	61	21	61
Myctophum sp.	0	0	1	1	1	1
Taaningichthys bathyphilus	1	1	1	1	2	2
Triphoturus mexicanus	3	23,000	9	348	12	23,000
unidentified	0	0	9	44	9	44
Neoscopelidae						
Scopelengys tristus	7	20	12	25	19	45
Cetomimidae						
Gyrinomimus bruuni	1	1	3	4	4	5
Cetomimus sp.	1	1	1	1	2	2
unidentified	1	1	1	1	2	2
Ogcocephalidae						
unidentified	1	1	0	0	1	1
Melanocetidae						
Melanocetus ferox	0	0	1	1	1	1
Melanocetus johnsoni	1	1	12	15	13	16
Oneirodidae						
Dolopichthys pullatus	1	1	0	0	1	1
Oneirodes luetkeni	0	0	2	3	2	3
Oneirodes sp.	0	0	1	1	1	1
unidentified	1	1	0	0	1	1
Thaumatichthyidae						
Thaumatichthys pagidostomus	0	0	2	3	2	3
Linophrynidae						
Borophryne apogon	9	28	7	8	16	36
Bregmacerotidae						
Bregmaceros atlanticus	4	7	11	36	15	43
Bregmaceros bathymaster	0	0	2	4	2	4
Bregmaceros spp.	0	0	4	10	4	10
Moridae						
Microlepidium verecundum	0	0	2	4	2	4
Ophidiidae						
Brotuloides emmelas	1	2	6	7	7	9
unidentified	1	1	6	8	7	9

Species	Gulf of California		Pacific Ocean South of Gulf of California		Total	
	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens
Zoarcidae						
Melanostigma pammelas	6	18	1	1	7	19
Macrouridae						
Coelorhynchus scaphopsis	1	1	3	3	4	4
Exocoetidae						
Exocoetus monocirrhus	0	0	1	1	1	1
Hyporhamphus unifasciatus	0	0	4	18	4	18
Melamphaeidae						
Melamphaes acanthomus	10	59	23	85	33	144
Melamphaes laeviceps	0	0	3	3	3	3
Melamphaes macrocephalus	8	24	22	105	30	129
Melamphaes spinifer	5	11	18	42	23	53
Melamphaes spp.	0	0	2	6	2	6
Poromitra crassiceps	2	3	13	34	15	37
Poromitra sp.	0	0	6	6	6	6
Scopeloberyx robustus	10	94	16	128	26	222
Scopelogadus mizoloepis bispinosus	15	204	35	1534	50	1738
Holocèntridae						
Holocentrus suborbitalis	0	0	2	18	2	18
Trachipteridae						
Trachipterus sp.	0	0	1	1	1	1
Scorpaenidae						
Sebastes sinensis	2	36	0	0	2	36
Sebastes sp.	1	1	0	0	1	1
Scorpaena sp.	0	0	1	1	1	1
unidentified	0	0	4	18	4	18
Apogonidae						
Apogon dovii	0	0	1	1	1	1
Branchiostegidae						
Caulolatilus princeps	0	0	3	4	3	4
Echeneidae						
Phtheirichthys lineatus	0	0	1	1	1	1
Remora remora	0	0	1	1	1	1

Species	Gulf of California		Pacific Ocean South of Gulf of Califonia		Total	
	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens	No. of occurrences	No. of specimens
Carangidae						
Caranx caninus	0	0	4	10	4	10
Decapterus hypodus	0	0	1	1	1	1
Selene *brevoortii*	0	0	1	1	1	1
Coryphaenidae						
Coryphaena hippurus	0	0	1	2	1	2
Kyphosidae						
Kyphosus elegans	0	0	1	3	1	3
Polynemidae						
Polydactylus opercularis	0	0	1	1	1	1
Chiasmodontidae						
Chiasmodon niger	0	0	9	12	9	12
Kali normani	0	0	12	14	12	14
Trichiuridae						
Lepidopus xantusi	1	1	0	0	1	1
Scombridae unidentified	0	0	1	47	1	47
Nomeidae						
Cubiceps carinatus	0	0	10	16	10	16
Stromateidae						
Peprilus spp.	0	0	6	6	6	6
Bothidae						
Citharichthys sp.	0	0	2	2	2	2
Etropus crossotus	0	0	8	15	8	15
unidentified	0	0	2	2	2	2
Cynoglossidae						
Symphurus spp.	0	0	4	6	4	6
Balistidae						
Canthidermis rotundus	0	0	1	4	1	4
Alutera scripta	0	0	1	1	1	1
Diodontidae						
Diodon holacanthus	0	0	1	3	1	3
Unidentified	2	2	15	96	17	98

filifer, Chauliodus barbatus, Lestidiops pacificum, Benthosema panamense, Diaphus pacificus, Bregmaceros bathymaster, Brotuloides emmelas, Melamphaes laeviceps, Melamphaes macrocephalus, and the ceratioids, *Oneirodes luetkeni, Melanocetus ferox,* and *Borophryne apogon.*

From the north flows the California Current carrying relatively cool, low salinity water which is gradually warmed and mixed with subtropical water as it approaches the tip of the Baja Peninsula. Oceanographers have classically considered the region around the tip of Baja California to be the southern limit of Transitional Water, a derivative of Subarctic Water (Sverdrup et al., 1942). It is not mere coincidence, then, that the southern range limits of several northern species have been found in this area. The capture of two bathylagids, *Bathylagus wesethi* and *Bathylagus pacificus,* and the zoarcid *Melanostigma pammelas,* in the mouth of the Gulf, suggests the influence of California Current water in this region. California Current water may at times enter the Gulf (Griffiths, 1968), and this may explain the presence of another northern species, *Chauliodus macouni,* some distance into the Gulf itself.

The eastern tropical Pacific is the center of origin and distribution of a number of species that are common in the Transitional Water Mass along the west coast of North America. Those species able to adapt to the cooler, less saline Transitional Water may have achieved their northern ranges by being carried by the subsurface counter current flowing northward along the coast. The following fish, taken in the present survey, range into the Transitional Water of the California Current system: *Vinciguerria lucetia, Argyropelecus lychnus, Borostomias panamensis, Stomias atriventer, Idiacanthus antrostomus, Bajacalifornia burragei, Talismania bifurcata, Holtbyrnia melanocephala, Normichthys campbelli, Pellisolus facilis, Scopelarchoides nicholsi, Diogenichthys laternatus, Gonichthys tenuiculus, Hygophum atratum, Lampanyctus parvicauda, Melamphaes acanthomus, Poromitra crassiceps, Scopeloberyx robustus, Scopelogadus mizolepis bispinosus, Kali normani,* and *Lepidopus xantusi.*

A system of water masses and currents, analagous to those in the northeast Pacific, exists along the west coast of South America. In this system, water of subantarctic origin flows through a transitional region where it is gradually warmed and mixed with subtropical water as it turns westward and becomes the South Equatorial Current.

A tongue of warm, high salinity water, of low oxygen content indicates southward movement of subsurface equatorial water along the coast of Chile (Craddock and Mead, 1970). It is tempting to relate this southern extension of equatorial water to the presence of tropical species taken along the coast of South America (Bussing, 1965; Craddock and Mead, 1970). These species include *Vinciguerria lucetia, Bathylagus nigrigenys, Pellisolus facilus, Idiacanthus antrostomus, Diogenichthys laternatus, Lampanyctus parvicauda, Melamphaes acanthomus, Melamphaes spinifer Scopeloberyx robustus,* and *Scopelogadus mizolepis bispinosus.* As mentioned earlier, several of these species have been taken quite far north along the west coast of North

America. The northern and southern range limits of some of these forms seem to be far removed from their breeding area based on the paucity of juvenile fish in these areas, in which case they may very well represent expatriate populations.

The number of widely distributed species continues to increase as midwater trawl data from all parts of the world are published. Several species from the present survey have been shown to have circumtropical or worldwide distributions. These include *Serrivomer sector, Nemichthys scolopaceus, Avocettina infans, Cyclothone acclinidens, Cyclothone pallida, Diplophos taenia, Bolinichthys longipes, Taaningichthys bathyphilus, Scopelengys tristus, Holtbyrnia macrops, Bregmaceros atlanticus, Thaumatichthys pagidostomus, Dolopichthys pullatus, Melanocetus johnsoni, Centrophryne spinulosa,* and *Chiasmodon niger.*

A comparison of the Gulf of California midwater ichthyofauna with that of the adjacent Pacific is of interest. The faunas of the Gulf and outer coast of Baja California are indeed distinct (Berry and Perkins, 1966; present data). The differences may be attributed to water mass characteristics and currents in the two regions. However, faunal differences in the midwaters between the Gulf and the adjacent tropical Pacific are difficult to explain because the depths of the Gulf are filled with water which has identical characteristics with that of the entire eastern tropical Pacific. Furthermore, there is no shallow sill restricting fish movement into the Gulf. Nevertheless, some type of barrier is apparently present, as the following discussion will illustrate.

Not a single individual of the genus *Cyclothone* was taken in the Gulf of California. This is remarkable because members of the genus are among the most abundant fishes in the world (Fitch and Lavenberg, 1968), and Robison (1972) captured them throughout the Gulf in summer and fall cruises of the Stanford Oceanographic Expeditions.

Cyclothone spp. were taken at each of the 26 stations of cruise 1061 (in November) south of the Gulf and across the Gulf entrance — a total of over 18,000 individuals and as many as 2,500 at a single station (Fig. 4). During cruise 922 (in January), only one individual of the genus was captured, despite the fact that several trawls were taken in the same area, at similar depths, across the Gulf entrance. Garman (1899) recorded *C. acclinidens* in the Gulf at 27° N, but none were taken by Lavenberg and Fitch (1966) in their midwater trawl survey in March and April.

It is difficult to explain this phenomonon on the basis of available data. The answer may, in part, lie in the poorly known fluctuating surface and subsurface currents in the Gulf. The movement of water in and out of the Gulf has been pictured by Roden (1962) as an outflow of water at the surface and an inflow at greater depths during the winter, with the reverse occurring during the summer. The life habits of *Cyclothone* [i.e. restricted vertical migration (De Witt, 1972) and the timing of their life stages] may be out of phase with the fluctuating currents, which could exclude them from the Gulf

during part of the year. In any case, more data are needed before any conclusions can be drawn concerning this problem.

A number of species appear restricted to waters south of the Gulf, or to waters south of the southernmost one-third of the Gulf. Nineteen midwater species captured in waters south of the Gulf were not taken in the Gulf north of 23°N (Table 2). Only 7 midwater species taken in the Gulf were not captured at stations south of 23°N. Twenty-five trawls taken within the Gulf resulted in over 28,000 individuals and an average of 13 species per trawl, while 35 trawls south of 23°N also took over 28,000 individuals but with an average of 22 species per trawl. It must be realized that some 23,000 of the Gulf specimens were represented by a single species (*Triphoturus mexicanus*) taken in a single trawl.

These findings, which agree with those of Robison (1972), indicate a relatively depauperate midwater ichthyofauna in the Gulf as compared to that in waters to the south.

The impoverishment of the Gulf midwater ichthyofauna can perhaps best be considered in relationship to the Gulf as a limiting environment. Despite the fact that the subsurface waters in the Gulf are similar to the eastern tropical Pacific waters, broadly fluctuating surface salinities and temperatures are present in the Gulf when compared to surface waters to the south (Roden, 1962; Wyrtki, 1967; Griffiths, 1968). Fluctuating surface waters combined with the remoteness of the Gulf (at higher and higher latitudes) to open ocean currents may, in part, explain the Gulf as a limiting environment to the epipelagic larvae of some midwater fishes.

In conclusion, the Gulf of California and eastern tropical Pacific remain largely independent of the major current and water mass systems in adjacent areas. This independence is reflected in some unique hydrographical conditions and results in biotic features which will remain among the most intriguing of the world's oceans.

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RESUMEN

Este estudio faunístico está basado sobre 56,000 especímenes, representando de menos 113 especies las cuales fueron capturadas en una red Isaacs-Kidd Midwater Trawl de 10 pies de tamaño, durante los cruceros del R/V *Velero IV*, University of Southern California, en el Golfo de California y el

adyacente Pacífico oriental tropical durante 1967 y 1970. Aproximadamente 90% del número total de especímenes pertenecen a dos familias, Myctophidae y Gonostomatidae, y la mayoría de estos a sólo dos especies, *Triphoturus mexicanus y Cyclothone acclinidens,* respectivamente.

La hidrografía del Pacífico oriental tropical es considerada en relación a su ictiofauna endémica de aguas de profundidad media y el papel del Pacífico oriental tropical como un centro de origen y distribución de peces, a lo largo de las costas occidentales de Norte y Sud América es discutida. Una comparación do la fauna do Golfo de California con aquella a lo largo de las costa de México se considera brevemente.

LITERATURE CITED

AHLSTROM, E. H. 1971. Kinds and abundance of fish larvae in the eastern tropical Pacific, based on collections made on EASTROPAC I. Fish. Bull. 69: 3-77.

_____, AND R. C. COUNTS. 1958. Development and distribution of *Vinciguerria lucetia* and related species in the eastern tropical Pacific. U.S. Fish Wildl. Serv., Fish. Bull. 58: 363-416.

ALVERSON, F. G. 1961. Daylight surface occurrence of myctophid fishes off the coast of Central America. Pac. Sci. 15: 483.

BACKUS, R. H., J. E. CRADDOCK, R. L. HAEDRICH, AND D. L. SHORES. 1970. The distribution of mesopelagic fishes in the equatorial and western north Atlantic Ocean. J. Mar. Res. 28: 179-201.

BAIRD, R. C. 1971. The systematics, distribution, and zoogeography of the marine hatchetfishes (family Sternoptychidae). Bull. Mus. Comp. Zool., Harvard 142: 1-128.

BARLOW, G. W. 1961. Causes and significance of morphological variation in fishes. Syst. Zool. 10: 105-117.

BEEBE, W., AND M. VANDER PYL. 1944. Eastern Pacific expeditions of the New York Zoological Society. XXXIII. Pacific Myctophidae (Fishes). Zoologica, N.Y. 29(9): 59-95.

BERRY, F. H., AND H. C. PERKINS. 1966. Survey of the pelagic fishes of the California Current area. U.S. Fish Wildl. Serv., Fish. Bull. 65(3): 625-682.

BERTELSEN, E. 1951. The ceratioid fishes, ontogeny, taxonomy, distribution and biology. Dana Rep. 39. 276 pp.

BIERI, R. 1959. The distribution of the planktonic Chaetognatha in the Pacific and their relationship to the water masses. Limnol. Oceanogr. 4: 1-28.

BORODULINA, O. D. 1968. Taxonomy and distribution of the genus *Leuroglossus* (Bathylagidae, Pisces). Vopr. Ichthyol. 8: 1-10.

BREDER, C. M. 1936. Heterosomata to Pediculata from Panama to Lower California. Scientific results of the second oceanographic expedition of the *Pawnee* 1926. Bull. Bing. Oceanogr. Coll. 2(3): 1-56.

BRINTON, E. 1962. The distribution of the Pacific euphausiids. Bull. Scripps Inst. Oceanogr. 8: 51-270.

BROCK, V. C. 1938. Notes on the ranges of fishes from Lower California and the west coast of Mexico. Copeia 1938: 128-131.

BUSSING, W. A. 1965. Studies of the midwater fishes of the Peru-Chile Trench. *In* G. A. Llano (ed.), Biology of the Antarctic Seas II. Antarctic Res. Ser. 6. Nat. Acad. Sci., Nat. Res. Counc. Publ. 1297, pp. 185-227.

CLEMENS, H. B., AND J. C. NOWELL. 1963. Fishes collected in the eastern Pacific during tuna cruises, 1952-1959. Calif. Fish and Game 49(4): 240-264.

CRADDOCK, J. E., AND G. E. MEAD. 1970. Midwater fishes from the eastern South Pacific Ocean. Scientific results of the southeast Pacific expedition. Anton Bruun Rep. 3. 46 pp.

D'ANCONA, U., AND G. CAVINATO. 1965. The fishes of the family Bregmacerotidae. Dana Rep. 64. 92 pp.

DEWITT, F. A. 1972. Bathymetric distributions of two common deep sea fishes, *Cyclothone acclinidens* and *C. signata,* off southern California. Copeia 1972: 88-92.

EBELING, A. W. 1962. Melamphaidae I. Systematics and zoogeography of the species in the bathypelagic fish genus *Melamphaes* Gunther. Dana Rep. 58. 164 pp.

FITCH, J. E., AND L. W. BARKER. 1972. The fish family Moridae in the eastern North Pacific with notes on morid otoliths, caudal skeletons, and the fossil record. Nat. Mar. Fish. Serv., Fish. Bull. 70(3): 565-584.

FITCH, J. E., AND R. J. LAVENBERG. 1968. Deep-water teleostean fishes of California. Univ. Calif. Press, Berkeley. 155 pp.

FOWLER, H. W. 1944. Results of the 5th George Vanderbilt Expedition (1941). Acad. Nat. Sci. Phila. Monogr. 6: 57-475.

GARMAN, S. 1899. Reports on the exploration off the west coasts of Mexico, Central, and South America, and off the Galapagos Islands . . . by the . . . *Albatross.* Mem. Mus. Comp. Zool., Harvard 24. 431 pp.

GREENWOOD, P. H., D. E. ROSEN, S. H. WEITZMAN, AND G. S. MYERS. 1966. Phyletic studies of teleostean fishes, with a provisional classification of living forms. Amer. Mus. Nat. Hist. Bull. 13(4): 341-455.

GREY, M. 1960. A preliminary review of the family Gonostomatidae, with a key to the genera and the description of a new species from the tropical Pacific. Bull. Mus. Comp. Zool., Harvard 122(2): 57-125.

_____. 1964. Family Gonostomiatidae. In fishes of the Western North Atlantic. Mem. Sears Found. Mar. Res. 1, pt. 4, pp. 78-240.

GRIFFITHS, R. C. 1968. Physical, chemical, and biological oceanography of the entrance to the Gulf of California, spring of 1960. U.S. Fish and Wildl. Serv. Spec. Sci. Rep., Fisheries 573. 47 pp.

HAEDRICH, R. L., AND M. HORN. 1969. A key to stromateioid fishes. Woods Hole Oceanogr. Inst., Tech. Rep. Ref. No. 69-70.

HORN, M. 1970. Systematics and biology of the stromateid fishes of the genus *Peprilus.* Mus. Comp. Zool., Harvard 140 (5): 165-261.

ISAACS, J. D., AND L. W. KIDD. 1953. Isaacs-Kidd midwater trawl. Scripps Inst. Oceanogr., Ref. 53-3. 21 pp.

JOHNSON, R. K. 1970. A new species of *Diplophos* (Salmoniformes: Gonostomatidae) from the western Pacific. Copeia 1970: 437-443.

LAVENBERG, R. J. 1965. A new species of searsiid fish, *Normichthys campbelli,* from the eastern North Pacific Ocean. Bull. So. Calif. Acad. Sci. 64(1): 22-26.

_____, AND A. W. EBELING. 1967. Distribution of midwater fishes among deep water basins of the southern California shelf. *In* Proceedings of the Symposium on the Biology of the California Islands. R. N. Philbrick (ed.), pp. 185-201.

_____, AND J. E. FITCH. 1966. Annotated list of fishes collected by midwater trawl in the Gulf of California, March-April 1964. Calif. Fish and Game 52(2): 92-110.

MCALLISTER, D. E., AND E. I. S. REES. 1964. A revision of the eelpout genus *Melanostigma* with a new genus and with comments on *Maynea.* Bull. Mat. Mus. Canada 199: 85-109.

MCGOWAN, J. A. 1960. The relationship of the distribution of the planktonic worm, *Poeobius meseres* Heath, to the water masses of the North Pacific. Deep-sea Res. 6: 125-139.

MEEK, S. E., AND S. F. HILDEBRAND. 1923-28. The marine fishes of Panama. Field Mus. Nat. Hist. Publ., Zool. Ser. 15, parts 1, 2, 3. 1045 pp.