

DEEPSLOPE FISHES COLLECTED DURING THE 1995 ERUPTION OF ISLA FERNANDINA, GALÁPAGOS

By: John E. McCosker, Godfrey Merlen, Douglas J. Long,
R. Grant Gilmore and Carlos Villon

INTRODUCTION

The volcanic nature and steep terrain of much of the Galápagos Archipelago has made collecting deep shorefish nearly impossible by traditional oceanographic methods. The majority of deepwater fishes collected at or near the Galápagos were the result of the 1891 voyage of the U. S. Fish Commission Steamer *Albatross* (Garman 1899). Thirteen stations, the deepest at 1740 fathoms, were made along a southerly transect from north of Isla Darwin to the central Galápagos plateau, then to the east from northern Isla Floreana (Charles) to Isla San Cristóbal (Chatham) and across to the mainland. The western, southern, and eastern margins of the archipelago were not sampled. The sampling methodology, primarily benthic trawling, was hindered by the volcanic submarine

terrain, and as a result most of the fishes that were captured are associated with sand and mud bottoms. The collections were remarkable, however, and resulted in many new taxa several of which were not seen again for 104 years. Two extraordinary events occurred in 1995 which allowed us an opportunity to contribute to the knowledge of Galápagos fishes. First was the eruption and lava flow from a fissure on the slope of Isla Fernandina during January and February 1995 that provided an exceptional ichthyological sampling opportunity rivaling the efforts of most collectors since the *Albatross*. Similar serendipitous fish kills associated with volcanic eruptions in Hawaii have occurred in the past (Jordan 1922, Gosline *et al.* 1954). Just off Isla Fernandina, hundreds of fish died at Cabo Hammond (00° 28'S, 91° 37'W) when copious amounts of lava plunged into the water forming a new coastline

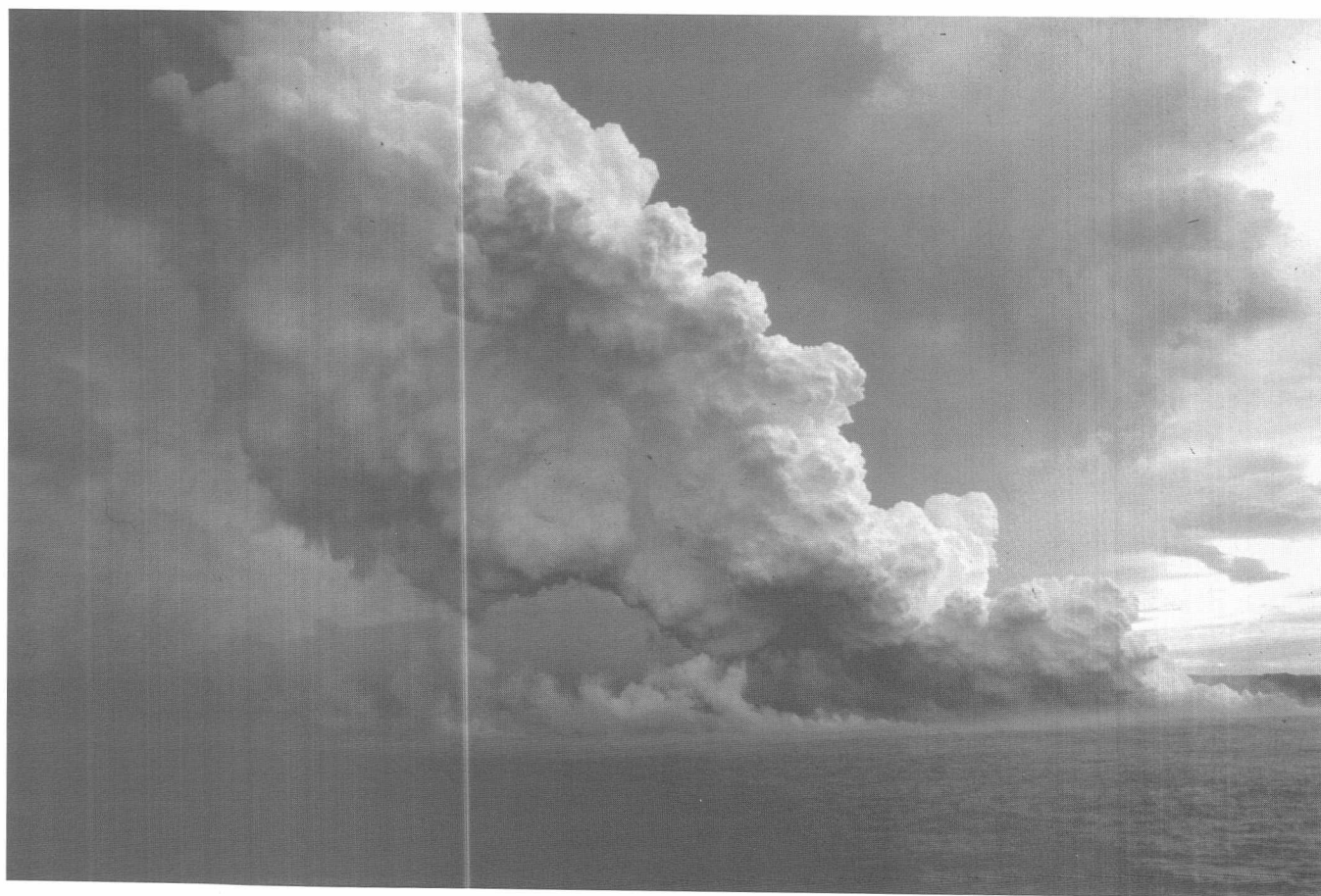


Figure 1. Steam and smoke from volcanic materials entering the ocean at Cabo Hammond, Isla Fernandina on 29 January 1996. Photograph by Godfrey Merlen.

(Merlen 1995, Figures 1 and 2). Low-frequency, echoing explosions could be heard through hydrophones, miles offshore. The sea temperature near the coast rose to the boiling point. Several marine iguanas and brown pelicans died, and the coastal algal beds were destroyed. The submarine topography offshore of Cabo Hammond drops off to depths of 550 m and 914 m at one and two kilometers from shore, respectively.

During 6-7 February 1995 Merlen, in virile competition with feeding seabirds, was able to capture a small sample of the fishes found dead and dying at the surface, but it was not adequate to provide either a complete qualitative or quantitative sample of the fishes that live along the submarine slope of Isla Fernandina. Even though incomplete, this sample, resulted in some interesting discoveries, particularly of deepwater species which appear to have been brought to the surface by violent upwelling of cold water associated with lava entering the sea, and included new records and two new species of fishes.

The second extraordinary event was the Harbor Branch Oceanographic Institute/California Academy of Sciences (HBOI/CAS) Expedition during November 1995 aboard the *R/V Seward Johnson*. During that trip the research submersible *Johnson Sea-Link (JSL)*, allowed the first opportunity to observe, film, and capture deepwater Galápagos fishes to the submarine's limit of 1000 m depth. In this report we describe the fishes which were captured and photographed by Godfrey Merlen while Isla Fernandina erupted and combine information about the

habitat and depth distribution of those species as observed from the submersible. Further results from the HBOI/CAS Expedition are forthcoming.

MATERIALS AND METHODS

Specimens and 35 mm transparencies are deposited in the ichthyological collections of the CAS in San Francisco and at the Charles Darwin Research Station (CDRS). Additional Galápagos specimens were deposited with the Instituto Nacional de Pesca (INP) in Guayaquil. Institutional abbreviations follow the Standard Symbolic Codes for Institutional Research Collections in Herpetology and Ichthyology (Leviton *et al.* 1985). Our other abbreviations are SL, standard length; and HL, head length. English and Spanish common names are based on FAO documents, Humann (1993), Merlen (1988), common usage by Galápagos residents, and some were created with the assistance of William Bussing.

ACCOUNTS

An adult dogface witch eel (*anguila cariporro*), *Faciolella gilberti* (Garman 1899), was found floating (CAS 86454, 380 mm SL). This species is widespread in the eastern Pacific, from Point Conception, California, to Panama. We are unaware of any previous records from Galápagos for this species. It was commonly observed from the *JSL* at or near the bottom on slopes from 600-1000 m depth.



Figure 2. Coastline at Cabo Hammond, Isla Fernandina on 15 November 1996. Photograph by John E. McCosker.

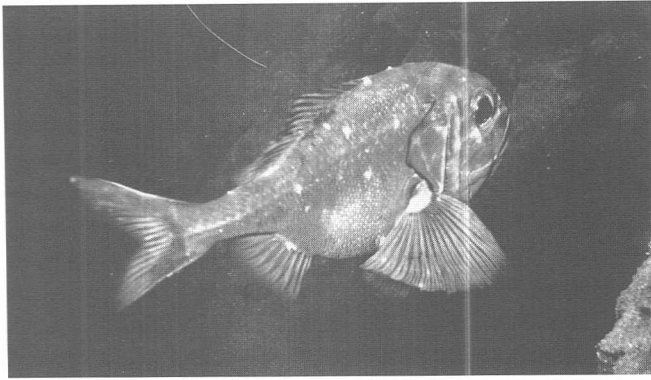


Figure 3. Adult Galápagos slimehead, *Hoplostethus pacificus*, photographed from *JSL* submersible at 600 m depth off of Cabo Hammond.

Many specimens of silver hatchetfish (hacha plateada), *Argylopelecus lychnus* (Garman 1899) were found floating (CAS 86456, 49-62 mm SL). These are midwater fishes, typically "concentrated between 300 m and 400 m off California by day, with the highest concentration near 400 m; by night major concentrations occur from 200 m to 350 m, with no marked indication of geographical variation in depth" (Baird 1971: 66). They are primarily restricted to the tropical Pacific; found in abundance in the eastern Pacific between 35° N and 35° S and across the Pacific as far as 160° W (Baird 1971). They were observed but not captured from the *JSL* during its ascent and descent.

Several slender hatchetfishes (hacha fina), *Maurollicus breviculus*, recently described from the equatorial Pacific between 84° W and 105° W, including the Galápagos Islands (Parin and Kobylansky 1993), were found floating (CAS 86498, 33-36 mm SL). The type series was captured by midwater trawl between the surface and 1200 m. They were probably observed but were not recognized by divers in the submersible.

An adult Galápagos slimehead (guadaña del Pacífico), *Hoplostethus pacificus* (Garman 1899), was found floating (CAS 86499, 88 mm SL). Slimeheads were observed to aggregate along the deep volcanic slopes, approximately 3-5 m above the substrate (Figure 3). From our observations aboard *JSL*, it appeared that the juvenile and adult specimens occupied slightly different depths, the younger fish between 400-600 m, and the adults between 600-750 m. Other species of slimeheads are fished commercially elsewhere, however based on our observations it seems that there is far too small a biomass to allow a significantly commercial fishery.

An adult specimen of Panamic soldierfish (soldado panámico), *Myripristis leiognathos* (Valenciennes 1855), was collected (CDRS V-1230, 157 mm SL). Soldierfishes are nocturnally-active reef associates that live throughout the archipelago and from Baja California to Ecuador at depths of 3-25 m.

An immature male deepwater cardinalfish (cardenal de profundidad) represents the first of the genus *Epigonus*

from the Galápagos and a new species as well (McCosker and Long, in prep., CAS 86581, 146 mm SL). Species of *Epigonus* are found in all tropical oceans and seas, and live between 200-1000 m depth. Other specimens of *Epigonus*, presumably of this species, were seen and videotaped but not captured by the senior author and R. Grant Gilmore during *JSL* dives on two occasions along the southwest shore of Isla Fernandina, off Cabo Douglas (0°14.6'S, 91°26.6'W). The fish were approximately the size of the floating specimen and were inactive or swimming slowly about 2-3 m above a steeply sloping sediment-coated volcanic bottom which fell off rapidly from 740 m into deeper water.

Four species of seabasses were found dead in the area where the lava flowed into the sea. Not surprisingly, specimens of creole fish (gringo), *Paranthias colonus* (Valenciennes 1855) were observed and collected (CDRS V-1228, 157 mm SL). *P. colonus* is widespread in the eastern Pacific, from the Gulf of California to Perú, and at all offshore islands (Revillagigedos, Cocos, Clipperton, and Malpelo). From our scuba and submersible observations, it appears to be the most abundant fish in Galápagos, occupying reef and near-reef habitats from the surface to 100 m depth. A subadult flag cabrilla (cabrilla), *Epinephelus labriformis* (Jenyns 1842), was found floating, photographed, and discarded. It is a common species from the Gulf of California to Perú and Galápagos, and occupies nearshore rock reefs to a depth of 50 m. An adult wrasse bass (cabrilla rayada), *Liopropoma fasciatum* (Bussing 1980) was photographed and collected (CDRS V-1227, 90 mm SL). It is unmistakable in appearance (see photos in Humann 1993: 83, and Allen and Robertson 1994: 117), and also known from deep reef habitats at Cabo San Lucas, Baja California, and off Costa Rica. It is an associate of deepwater reefs, and like the scythmarked butterflyfish and the oval damselfish, it is occasionally found in the Galápagos in caves and reef cracks beneath the thermocline. It was observed during *JSL* dives to a depth of 130 m, beneath which it appeared to be replaced by its congener, *L. liolepis* (Garman 1899), which was associated with reefs between 120-250 m depth. Several threadfin bass (plumero), *Pronotogrammus multifasciatus* (Gill 1863), were observed floating and two specimens were preserved (CAS 86501, 105-165 mm SL). It is a widespread species in the eastern Pacific (including its synonyms *Anthias gordensis* [Wade 1946], and *Holanthias sechurae* [Barton 1947]) from the outer coast and Gulf of California to Perú, and lives between 40-200 m depth. From the *JSL* we observed it to be very abundant along rock reefs to depths of 150-300 m.

An adult Peruvian grunt (roncador peruano), *Anisotremus scapularis* (Tschudi 1845) was found floating, photographed, and discarded. Peruvian grunts are common in Galápagos and Perú, and form large schools above rocky reefs in about 5-20 m depth (Allen and Robertson 1994).

An adult little barracuda (barracuda chica), *Sphyraena idiastes* (Heller and Snodgrass 1903), was found floating, photographed, and discarded. This species forms abundant nearshore schools throughout the archipelago, between the surface and approximately 25 m, and is also found in Perú.

An intermediate scabbardfish (pez daga), *Aphanopus intermedius* (Parin 1983), represents the first known Galápagos record (CAS 86497, 520 mm SL). The species is widely distributed in tropical and subtropical seas; in the northeastern Pacific it is known from British Columbia to California, and in the southeastern Pacific from Perú. Adults are benthopelagic from 800-1350 m depth, and juveniles are mesopelagic from 300-1000 m. It reaches approximately 1 m in length, and is not commercially fished (Nakamura and Parin 1993).

Two specimens of Galápagos drum (gungo de Galápagos), *Pareques perissa* (Heller and Snodgrass 1903), including a large and badly-damaged adult were collected (CAS 86808, ~230 mm SL, and CDRS V-1226, 183 mm SL). Endemic to Galápagos, this species is very secretive and normally found in reef crevices between 3-40 m depth. The maximum size of this species is 250 mm.

Several specimens of the deepwater oval damselfish (castañuela gorda), *Chromis alta* (Greenfield and Woods 1980), were observed and collected (CDRS V-1210, 1215-1219, 1221-1222, 1225, 100-120 mm SL). It is also known from the Gulf of California, between approximately 30-150 m depth, and from Cocos Island. This is the deepest-living damselfish in the Galápagos, and was observed below the thermocline by divers as shallow as 15 m, and observed from the *JSL* to be abundant along reefs to 200 m depth.

Three adult scythemarked butterflyfishes (mariposa guadaña), *Prognathodes falcifer* (Hubbs and Rechnitzer 1958), were photographed and preserved (CDRS V-1229, 71-100 mm SL). It is an associate of deep reefs, and like the oval damselfish, is found in the Galápagos beneath the thermocline. It is also known from islands off Southern California and deepwater off Baja California and Costa Rica. In Galápagos we found it in water as shallow as 10 m, and observed it from the *JSL* to depths of 270 m off Isla Baltra.

Several specimens of two species of deepwater scorpionfish, genus *Pontinus*, were found dead and floating. The large gas bladder which extends from the mouth of rapidly ascending scorpionfishes insures that they will float to the surface after traumatic death. The mottled scorpionfish (pez brujo), *P. clemensi* (Fitch 1955), is a rock associate previously known from the type specimen, captured at 91 m off the coast of Colombia (Poss 1995). We observed specimens from the *JSL* at various locations in the Galápagos. The striped scorpionfish (brujo listado), *P. strigatus* (Heller and Snodgrass 1903), is a Galápagos endemic, first known from the holotype found within the stomach of a shark captured near Isla Wolf (Wenman). We observed individuals of *P. strigatus*, along

with four other congeners, from the *JSL* at various locations, however we were unable at that time to identify each species with certainty.

Three species of morid cods were collected. The charcoal mora (carbonero de fango), *Physiculus nematopus* (Gilbert 1891) (and its synonym, *P. longipes* Garman 1899), reaches a length of 290 mm, is known from depths of 18-330 m, and is not a commercial species. It was previously known from Baja California to Panama (Paulin 1989), and we report it for the first time from the Galápagos (CAS 87927, 290 mm SL). Popeye mora (mora ojóna), *Laemonema gracillipes* (Garman 1899), were also captured (CAS 86548, 270-325 mm SL); it is known from waters off Panama and the Galápagos, between depths of 332-637 m. The third morid discovered represented a small new species of *Gadella* (Long and McCosker in prep.). Other specimens were observed and captured by the *JSL* at 485-580 m depth from a seamount SE of Isla San Cristóbal and from Cabo Hammond, Isla Fernandina.

An adult spotted brotula (brótula pintada), *Brotula ordwayi* (Hildebrand and Barton 1949) was collected (CAS 86500, 340 mm SL). It is generally found in shallow water, inhabiting crevices of rocky reefs, and is known from the Galápagos Islands and Perú.

Table 1 summarizes the specimens found floating during the eruption.

Table 1. Fishes collected by Godfrey Merlen during the eruption on Isla Fernandina, February 1995.

Collection/ Photo	Species	Family
CAS	<i>Faciocella gilberti</i>	Nettastomatidae
CAS	<i>Argyropelecus lychnus</i>	Sternoptychidae
CAS	<i>Maurollicus breviculus</i>	Sternoptychidae
CAS	<i>Hoplostethus pacificus</i>	Trachichthyidae
CDRS	<i>Myripristis leigonathus</i>	Holocentridae
CAS	<i>Epigonus</i> sp.	Epigonidae
CDRS	<i>Liopropoma fasciatum</i>	Serranidae
photo	<i>Epinephelus labriformis</i>	Serranidae
CDRS	<i>Paranthias colonus</i>	Serranidae
CAS	<i>Pronotogrammus multifasciatus</i>	Serranidae
photo	<i>Anisotremus scapularis</i>	Haemulidae
photo	<i>Sphyraena idiastes</i>	Sphyraenidae
CAS	<i>Aphanopus intermedius</i>	Trichiuridae
CAS	<i>Prognathodes falcifer</i>	Chaetodontidae
CAS, CDRS	<i>Pareques perissa</i>	Sciaenidae
CDRS	<i>Chromis alta</i>	Pomacentridae
photo	<i>Pontinus clemensi</i>	Scorpaenidae
photo	<i>Pontinus strigatus</i>	Scorpaenidae
CAS	<i>Brotula ordwayi</i>	Bythitidae
CAS	<i>Physiculus nematopus</i>	Moridae
CAS	<i>Laemonema gracillipes</i>	Moridae
CAS	<i>Gadella</i> sp.	Moridae

CONCLUSIONS

We feel that the species-composition of our samples was an incomplete reflection of the total species comprising the Galápagos deepshore ichthyofauna. Several of the specimens were so intact that we surmise that causes other than thermal elevation may have killed many of the fishes. Other potential causes of mortality include acoustic shock, dissolved chemicals, suspended sedimentation, and embolism associated with rapid ascents. Most of the fishes that possessed gas bladders exhibited such organs distended from their mouths.

During the November 1995 HBOI/CAS Expedition, two scuba dives and two JSL submersible dives were made to assess the subsequent condition of the submarine lava flow. After ten months, little algal or invertebrate growth was seen over the new bottom. From the surface to 20 m, the primary fish observed was the coquito damselfish, *Nexilosus latifrons* (Tschudi 1845). From the submersible, few fishes, invertebrates or algae were observed at deeper depths. In conclusion, we thank the volcanic activity of Isla Fernandina for providing biologists with interesting specimens as well as an opportunity to follow the colonization of shallow and deep-slope Galápagos reefs.

ACKNOWLEDGMENTS

Many individuals have assisted us in this project, as well as with the operation of the Harbor Branch vessel *Seward Johnson* and its submersible, the *Johnson Sea-Link*, and the *R/V Ratty*. For assistance and permission to study in Ecuador, we sincerely thank: Ing. Oscar Aguirre, Subdirector de Pesca de Galápagos; Biól. Harold Müller and Dr. Franklin Ormaza-González, Instituto Nacional de Pesca; Lic. Arturo Izurieta Valery and Biól. Eduardo Amador, Servicio Parque Nacional Galápagos; Teniente Alejandro Villacis, Capitan de Puerto, Puerto Ayora, Santa Cruz; and Dr. Chantal Blanton, Director of the Charles Darwin Research Station. Bill Bussing assisted with common names. Robert Lavenberg read an earlier version of this manuscript and provided advice on scorpaenids. Richard Rosenblatt, Scripps Institution of Oceanography, and William Eschmeyer and Tomio Iwamoto of the California Academy of Sciences permitted us to examine specimens in their care. We also thank the David and Lucile Packard Foundation and the Discovery Channel for grants and other assistance. TAME airline provided reduced air fare to and from the islands. Special thanks are due to the crew of *R/V Ratty* who skeptically sailed into boiling seas.

LITERATURE CITED

- Allen, G. R. and D. R. Robertson. 1994. Fishes of the Tropical Eastern Pacific. Univ. of Hawaii Press, Honolulu: 1-332.
- Baird, R. C. 1971. The systematics, distribution, and zoogeography of the marine hatchetfishes (family Sternoptychidae). *Bull. Mus. Compar. Zool.*, 142(1): 1-128.
- Garman, S. 1899. The Fishes. *In: Reports of an exploration of the west coasts of Mexico, Central and South America, and off the Galápagos Islands...* by the U.S. Fish Commission steamer *Albatross*, during 1891 ... No. XXVI. *Mem. Mus. Compar. Zool.*, Vol 24. 431 pp, 97 plates.
- Gosline, W. A., V. E. Brock, H. L. Moore and Y. Yamaguchi. 1954. Fishes killed by the 1950 eruption of Mauna Loa. I. The origin and nature of the collections. *Pacific Science*, 8(1): 23-27.
- Jordan, D. S. 1922. Description of deep-sea fishes from the coast of Hawaii, killed by a lava flow from Mauna Loa. *Proc. U. S. Natl. Mus.* 59: 643-656.
- Hildebrand, S. F. 1946. A descriptive catalog of the shore fishes of Peru. *Bull. U. S. Natl. Mus.* 189. 530 pp.
- Humann, P. 1993. Reef fish identification. Galápagos. Deloach, N. (ed) New World Pub., Jacksonville, FL, and Libri Mundi, Quito Ecuador: 1-192.
- Leviton, A. E., R. H. Gibbs, Jr., E. Heal and C. E. Dawson. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resources collections in herpetology and ichthyology. *Copeia* 1985(3): 802-832.
- Merlen, G. 1988. A field guide to the fishes of Galápagos. Wilmot Books, London.
- Merlen, G. 1995. Fundamentals. *Noticias de Galápagos* 55: 4-6.
- Nakamura, I. and N. V. Parin. 1993. FAO Species Catalogue. Vol. 15. Snake Mackerels and Cutlassfishes of the World. *FAO Fisheries Synopsis* 125(15): 1-136.
- Parin, N. V. and S. G. Kobylansky. 1993. Review of the genus *Mauroliticus* (Sternoptychidae, Stomiiformes), with re-establishing validity of five species considered junior synonyms of *M. muelleri* and descriptions of nine new species. *Trans. P. P. Shirshov Institute of Oceanology*, 128: 69-107. In Russian.
- Paulin, C. D. 1989. Review of the morid genera *Gadella*, *Physiculus*, and *Salilota* (Teleostei: Gadiformes) with descriptions of seven new species. *New Zeal. J. Zool.* 16: 93-133.
- Poss, S. G. 1995. Scorpaenidae. *In: Fischer, W. et al., eds. Guía FAO para la identificación de especies para los fines de la pesca. Pacífico centro-oriental.* FAO, Rome Vol. 3: 1544-1564.
- John E. McCosker, California Academy of Sciences, San Francisco, California 94118, USA (e-mail: JMcCosker@casmail.calacademy.org). Godfrey Merlen, Charles Darwin Research Station, Isla Santa Cruz, Galápagos, Ecuador. Douglas J. Long, California Academy of Sciences. R. Grant Gilmore, Harbor Branch Oceanographic Institution, Fort Pierce, Florida 34946, USA. Carlos Villon Zambrano, Instituto Nacional de Pesca, Guayaquil, Ecuador.**